SHIVAJI UNIVERSITY,
KOLHAPUR.

“ A” Re-accredited By NAAC
(2014) with CGPA-3.16

Revised Syllabus For
B.Sc.Part - III
INDUSTRIAL MICROBIOLOGY
To be implemented from June, 2015.
Shivaji University, Kolhapur

Revised Syllabus For Bachelor of Science Part - III : Industrial Microbiology

1. TITLE : Industrial Microbiology

2. YEAR OF IMPLEMENTATION: Revised Syllabus will be implemented from June, 2015 onwards.

3. PREAMBLE:

This syllabus is framed to give sound knowledge with understanding of Industrial Microbiology to undergraduate students at third 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 in day to day life.
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 English.

8. **STRUCTURE OF COURSE**:

   1) **B.Sc.III**: Total Number of Papers - 8

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<th>Sr. No.</th>
<th>Subjects</th>
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   2) **Structure and Titles of Papers of B.Sc.III Industrial Microbiology Course**:

   **Semester-V**
   - **Paper IX**: Environmental Microbiology
   - **Paper X**: Basic techniques of Biotechnology
   - **Paper XI**: Quality assurance and quality control of fermented products.
   - **Paper XII**: Microbial productions of metabolites and bioinsecticides

   **Semester-VI**
   - **Paper XIII**: Environmental pollution and control
   - **Paper XIV**: Applications of Biotechnology
   - **Paper XV**: Industrial management, Government laws and regulations.
   - **Paper XVI**: Microbial fermentations, Foods and Biofuels
9. **SCHEME OF TEACHING AND EXAMINATION:**

[The scheme of teaching and examination should be given as applicable to the course / paper concerned.]

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10. SCHEME OF EXAMINATION : For B.Sc. Part – III

- The examination shall be conducted at the end of each term (semester).
  Practical exams will be conducted annually at the end of second term.
- Each Theory paper shall carry 40 - marks. Each paper will have 10 internal marks.
- The evaluation of the performance of the students in theory papers shall be on the
  basis of Semester Examination of 400 marks and the practicals will be
  evaluated for 200 marks
- Question Paper will be set in view of the in accordance with the entire
  Syllabus and preferably covering each unit of syllabi.

11. EQUIVALENCE IN ACCORDANCE WITH TITLES AND CONTENTS

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12. OTHER FEATURES:

(A) LIBRARY: Reference and Text Books, Journals and Periodicals. Reference Books for Advanced studies. - List Attached

(B) SPECIFIC EQUIPMENTS: Necessary to run 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, distribution pipes & regulators for gas supply.
7) Operational manuals for instruments.
8) Emergency exits.
SHIVAJI UNIVERSITY, KOLHAPUR
B.Sc. III : Industrial Microbiology
(Revised Syllabus From June, 2015)
THEORY

Paper– IX : Environmental Microbiology

UNIT – I
Soil Environment: 10 Lectures
i. Introduction, physical, chemical, microbiological characters.
ii. Microbial interactions in soil & their role in soil fertility
iii. Soil humus

UNIT – II 10 Lectures
Role of Microorganisms in Elemental Cycles :
A. Carbon cycle,
B. Nitrogen cycle,
C. Sulfur cycle,
D. Phosphorus cycle

UNIT – III 10 Lectures
Petroleum and Marine Microbiology :
A) Petroleum Microbiology : i) Types of compounds in petroleum,
ii) Microorganisms in hydrocarbon system,
iii) Role of microorganisms in hydrocarbon degradation.
B) Marine Microbiology : i) Characters of marine environment,
ii) Characters of marine microorganisms,
iii) Role of marine microorganisms

UNIT – IV 10 Lectures
Role of microorganism in Bioleaching and Textile Industry :
A. Bioleaching of elements – i) Introduction, microorganisms involved,
ii) Chemistry of microbial leaching and beneficiation,
iii) Leaching methods – Laboratory and in situ leaching of copper and uranium.
B. Textile Industry – i) Introduction, types of microorganisms found on textile fibres,
ii) Conditions favoring the action of microorganisms,
iii) Types of destruction caused by microorganisms (cotton and wool),
iv) Prevention of growth of microorganisms.
Paper – X: Basic Techniques of Biotechnology

UNIT – I  
10 Lectures

Basic Concept of Genetic Engineering:

A) Introduction

B) Tools of genetic engineering

   i. Cutting and joining enzyme.
   ii. Cloning Vectors – Plasmids, phage, cosmids, and artificial chromosomes.
   iii. Cloning organisms.

UNIT – II  
10 Lectures

Techniques of Genetic Engineering:

A) Isolation of DNA

B) Construction of rDNA – Genomic library, cDNA library

C) Insertion of foreign DNA into a vector – Use of restriction enzymes, linkers, Homopolymer tails, adaptors, polylinkers.

D) Transfer of recombinant DNA in Bacterial Cell – Transformation, transfection

E) Selection of recombinants (Bacteria) - Direct selection of recombinants, Blue white screening methods.

UNIT – III  
10 Lectures

Techniques in Molecular Biology:

A) Blotting Techniques

   i. Southern blotting
   ii. Northern blotting
   iii. Western blotting
   iv. Dot-blot technique

B) Techniques of Detection and Analysis of Nucleic Acid

   i. Radioactive labeling – Nick translation
   ii. Non Radioactive labeling – Horse Radish peroxide (HRP) method

C) DNA sequencing – Sanger’s method
UNIT – IV
10 Lectures

Protein Engineering, Immobilization and PCR:

A) Protein Engineering: Definition, methods and application.

B) Immobilisation of Enzymes and Whole cells: Methods, Advantages, Application.

C) PCR – Requirements, working, different types of PCR’s, PCR product analysis, advantages & disadvantages, applications.

Paper –XI : Quality Assurance and Quality Control in Industrial Products

UNIT – I
10 Lectures

Industrial Rules and standards as per IP, BP, USP, EP:

Indian Pharmacopoeia :

i) Introduction

ii) Concept of pharmacopoeia

iii) Concept of regulatory authorities

iv) Types of pharmaceutical products

iv) Microbiological Q.C

UNIT – II
10 Lectures

Assay of microbial products as per Indian Pharmacopoeia:

A. Alcohol & Acetic acid

B. Vit. A & Vit. D

C. Bacitracin

UNIT – III
10 Lectures

Quality Control Tests of Pharmaceutical Products

i) Sterility test

ii) Pyrogen test

iii) Toxicity test

iv) Carcinogenicity test

iv) Mutagenicity test

v) Allergy test
UNIT – IV 10 Lectures

International Standards as per WHO, ISI, and Validation in Pharmaceutical industry

A) WHO & ISI standards.
B) Validation & in-process monitoring of sterilization procedures
C) Validation of Laminar Air Flow Cabinet

Paper – XII: Microbial Production of Metabolites and Bioinsecticides

UNIT – I Microbial production of nucleosides and nucleotides: 10 Lectures

i) Introduction
ii) Classification of methods for production of 5’IMP and 5’GMP
iii) Production of 5’IMP and 5’GMP by fermentation.

UNIT – II 10 Lectures

Microbial Production of Vitamins:

A) Vitamin B\textsubscript{12} - Organism used, production method- process, recovery and assay.
B) Vitamin C - Organism used production method, process, recovery and assay.
C) Vitamin A - Organism used, production method, process, recovery, and assay

UNIT – III 10 Lectures

Production of Antibiotics and Toxoids:

A) Production of Antibiotics: Organism used, production process and recovery of-
   i. Bacitracin
   ii. Chloramphenicol
   
   Production of toxoids: i) Diptheria ii) Tetanus

10
UNIT – IV

Production of Biopesticides:

i. Introduction
ii. Candidate Microorganisms
iii. Production & formulation
iv. Safety & Effectiveness
v. Advantages & Disadvantages

Paper XIII : Environmental Pollution and Control

UNIT – I
Environmental Monitoring & Biosafety:

A) Environmental Monitoring & Bioburden Tests
B) Biosafety in Laboratories and Pharmaceutical Industries.

UNIT – II
Waste water treatment :

A) Characteristics of Waste Water as per CPCB norms
B) Treatment Procedures
   i. Physical treatment – Sedimentation, screening and removal of oil and grease.
   ii. Biological treatments - Septic tank, bio filter, activated sludge, extended aeration, oxidations ponds, anaerobic digestion-UASB (Upflow anaerobic sludge blanket), Root zone technology
   iii. Chemical treatment – Coagulation by alum/lime/polyelectrolyte disinfection.

UNIT – III

A. Characteristics and treatment of solid & liquid wastes of –
   i. Sugar Industry ii) Distillery and iii) Dairy Industry
B. Eutrophication – Classification of lakes, sources of nutrients, consequences and control.

UNIT – IV

E.M.S. and E.I.A.

A. E.M.S(Environmental Monitoring System)- Concept & Process in dairy industry
Paper-XIV Applications of Biotechnology

UNIT – I 10 Lectures
Applications in Agriculture and Environments:

A) Applications of Genetic Engineering in Agriculture
   i. Transgenic plants – concepts, methods for raising transgenic plants and applications.
   ii. Transgenic animals – Concepts, methods for raising transgenic animals and applications.

B) Applications of genetic engineering in Environment
   i. Concept of GMM’s & its uses.
   ii. Bioremediation

UNIT – II 10 Lectures
Applications in Industry and Diagnostic Techniques

A) GEM’s in Industry - Pharmaceutical industry, food industry.

B) Diagnostic Techniques:
   i) Detection of Human & Plant pathogens-Morphological, cultural & Biochemical characteristics, DNA & lipid profile
   ii) Forensic applications of Biotechnology-DNA Fingerprinting

UNIT – III 10 Lectures
Monoclonal Antibodies and Recombinant Vaccines.

A) Monoclonal antibodies-Definition, production, applications.

B) Recombinant Vaccines - Definition, recombinant vector vaccines, DNA vaccines, Multivalent subunit vaccines, minicell vaccines, conjugate vaccines.

UNIT – IV 10 Lectures
Production of rDNA Products and Merits, Demerits of Biotechnology

A) rDNA Products: Insulin, Somatostatin, interferons, abzymes, immunotoxins

B) Merits & Demerits of Biotechnology
Paper- XV: Industrial Management, Government Laws and Regulations

UNIT – I  10 Lectures
Enterpreneurship - Principles of management, management meaning and importance, Concept of Entrepreneurship.

UNIT – II  10 Lectures
Concepts of Management:
  i. Planning meaning and importance
  ii. Organizing - Meaning and process of organization
  iii. Communication – Meaning and process control techniques.
  iv. Personal Management – Man power planning
  v. Purchase and store management – Concept of quotation, tenders, comparative statement, inspection and quality control, store management.
  vi. Concept of marketing – Basic Concepts, Costing, Pricing

UNIT – III  10 Lectures
IPR, National and International Scenario :
  -Patent, Biopatent, Copyright, Trade secret, Trademark, Geographical Indications, Designs, its basic concepts and laws relating to its infringement
  -IPR and WTO, TRIPS

UNIT – IV  10 Lectures
Laws related to industrial regulation and taxation :
  A ) Industrial development and regulation act-
     -Object
     -Licensing of industries
     -Circumstances when license no required
  B ) Basic concept of taxation -
     -Principle of taxation
     -Direct and indirect tax -Excise, Sales
     VAT
UNIT – I

A) Production of SCP
   i) Introduction
   ii) Production – Algae, Bacteria, Yeast
   iii) Product quality and safety
   iv) Merits & demerits.

B) Production of Mushrooms
   i) Introduction & types
   ii) Spawn production
   iii) Mushroom Production
   iv) Mushroom harvesting

C) Probiotics
   i) History
   ii) Common properties of probiotics
   iii) Examples of probiotic microorganism
   iv) Use of probiotics

UNIT – II

A) Microbial Production of Indian made Foreign liquors- Gin, Whiskey & Rum
   i) Introduction
   ii) Production Process
   iii) Quality of Product

B) Vinegar Production
   i) Introduction
   ii) Production Process
   iii) Quality, Grades & uses of Vinegar
UNIT – III 

Microbial Production of Exopolysaccharides

   i) Introduction
   ii) Mechanism of synthesis
   iii) Process of Xanthan gum & Dextran gum production
   iv) Applications of xanthan and dextran gums

UNIT – IV Production of biofuels

A) Ethanol- microorganisms used, fermentation condition, recovery, purification of Ethanol

B) Biogas- Biomass used, Microbiology & Biochemistry of biogas production,
   i. models used, uses of biogas

C) Biodiesel production from algae
PRACTICAL COURSE

Practical I :

Major Experiments :
1) Determination of MIC of Cr, using suitable microbes.

2) Determination of MIC of Cu, using suitable microbes

3) Estimation of BOD of industrial effluents

4) Determination of COD of industrial effluents.

5) Isolation of hydrocarbon degrading microorganisms.

6) Isolation of plastic degrading microorganisms

Minor Experiments :

1) Determination of oil and grease from industrial waste.

2) Estimation of TS, TSS, TVS, TDS from sewage and industrial effluent.

3) Bacteriological analysis of water

   i) MPN
   ii) Presumptive test.
   iii) confirmed
   iv) completed tests.

4) Estimation of chlorine dose of potable water.

5) Validation of Autoclave as per IP
Practical II:

Major Experiments:
1. Isolation of genomic DNA from bacteria
2. Isolation of genomic DNA yeast.
3. Isolation of plasmid DNA from bacteria
4. Transformation in *E. coli*.
5. Isolation of Vit B12 requiring mutants of *E. coli* using UV
6. Preparation of TAB vaccine.
7. Demonstration of DNA amplification by PCR.
8. Identification of protein by western hybridization.

Minor Experiments:
1) Electrophoresis of plasmid DNA by Agarose gel electrophoresis.
2) Electrophoresis of protein by PAGE
3) Estimation of DNA by diphenylamine method
4) Estimation of RNA by orcinol method.
5) Preparation of protoplast of bacterial cells
6) Protoplast fusion of bacterial cells.

Practical III:

Major Experiments:
1) SPC and identification of pathogens from - Formulation syrup
2) SPC and identification of pathogens from Tooth paste
3) SPC and identification of pathogens from Tablets
4) Bioassay of Vit. B12
5) Bioassay of Penicillin
6) Cultivation of edible mushrooms
7) Production of Biogas from organic waste
8) Production of alcohol from molasses
9) Bioassay of Bacitracin as per IP
Minor Experiments:
1) Chemical assay of Vit C.
2) Chemical assay of Penicillin
3) Isolation of amino acid producers
4) Quantification of amino acids
5) Estimation of alcohol

Practical IV:
1) Compulsory “on Job training” in Industry / Institute for minimum period of one week and submission of report.
2) Project work

Reference Books:

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COMMON NATURE OF QUESTION FOR THEORY PAPER MENTIONED SPERATELY:

**Practical Examination**

A) Exam will be conducted on 3 consecutive days for not less than 6 hours on each day.

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 the guidelines laid down from time to time by Academic Council on the recommendation of Board of studies and has been recorded his/her observations in the laboratory journal and written a report on each exercise performed. Every journal is to be checked and signed periodically by a member teaching staff and certified by the Head of the Department at the end of staff and certified by the Head of the Department at the end of the year. Candidates are to produce their journal at the time of practical examination. Candidates have to visit the least Two (2) places of Microbiological interest (Pharmaceutical industry, Dairy, Research institutes etc.) and submit the report of their visit at the time of examination.

C) Each candidate must undergo on job training in an industry / institute for minimum 1 week and submit the report.

D) The candidates are required to undertake a project and submit the project report.

**Nature Of Question Paper And Distribution Of Marks For B.Sc. III Industrial Microbiology Practical Examination**

**PRACTICALS I , II & III**

- Q.1 Major Experiment 20 Marks
- Q.2 Minor Experiment 15 Marks
- Q.3 Journal 05 Marks
- SPOTTING 10 Marks
- VIVA-VOCE (On practicals not attempted in the examination) 10 Marks

**PRACTICALS IV**

1. Project 30 Marks
2. On Job Training 15 Marks

TOUR REPORT: 15 Marks
List of the minimum equipments and related requirements for B.Sc. III
Industrial Microbiology.

1) Replica plating units of genetics experiments: Two
2) Rotary shaker for fermentation experiments: One
3) Centrifuge (High Speed): One
4) Hot plate: One
5) Hot air oven: One
6) Bacteriological Incubator: One
7) Spectrophotometer (UV and Visible): One
8) Research Microscope: One for each student
9) Separate room for fine instruments of size 9’x15’ feet dimension
9) A separate culture room of at least 9’ x 9’ feet dimension
11) Electrophoresis assembly: Two
12) Laminar air flow cabinet: one
13) Distillation assembly: One (Glass)
14) Reflux assembly: Four
15) Colony counter: One
16) Refrigerator: One
17) Laboratory Scale Fermentor: One

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