

# **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

Sr. No.	Subjects	Marks
	<b>SEMISTER V</b>	
1.	Paper - IX	40+10
2.	Paper - X	40+10
3.	Paper - XI	40+10
4.	Paper - XII	40+10
	<b>SEMISTER VI</b>	
5.	Paper – XIII	40+10
6.	Paper – XIV	40+10
7.	Paper – XV	40+10
8.	Paper - XVI	40+10
	<b>PRACTICALS</b>	
5.	Practical - I	50
6.	Practical - II	50
7.	Practical - III	50
8.	Practical - IV	50
Total		600

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.]

Sr. No.	Subject/Paper	Teaching Scheme ( Hrs/week)			
		L	T	P	Total
1	Paper – IX and X	3			
2	Paper – XI and XII	3			
3	Paper – XIII and XIV	3			12
4	Paper – XV and XVI	3			
5	Practical I			5	
6	Practical II			5	20
7	Practical III			5	
8	Practical IV			5	
	Total				32

#### 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

<b>Sr No</b>	<b>Paper No. And Title of Old Paper</b>	<b>Paper No and Title of New Paper</b>
	<b>SEMESTER V-VI</b>	
1.	<b>Paper V Section I</b> Environmental Microbiology	<b>SEM V</b> <b>Paper IX-</b> Environmental Microbiology
	<b>Section II</b> Bioremediation of Waste	<b>SEM VI</b> <b>Paper XIII-</b> Environmental Pollution & Pollutants
2.	<b>Paper VI Section I</b> Basic Techniques of Biotechnology	<b>SEM V</b> <b>Paper X-</b> Basic Techniques of Biotechnology
	<b>Section II</b> Applications of Biotechnology	<b>SEM VI</b> <b>Paper XIV-</b> Applications of Biotechnology
3.	<b>Paper VII Section I</b> Quality Assurance in Industrial Products	<b>SEM V</b> <b>Paper XI-</b> Quality Assurance in Industrial Products
	<b>Section II</b> Industrial Management, Government Laws & Regulation	<b>SEM VI</b> <b>Paper XV-</b> Industrial Management, Government Laws & Regulation
4.	<b>Paper VIII Section I</b> Fermentation Technology Part I	<b>SEM V</b> <b>Paper XII—</b> Microbial Production of metabolites & Bioinsecticides
	<b>Section II-</b> Fermentation Technology Part II	<b>SEM VI</b> <b>Paper XVI-</b> Microbial Fermentation, foods & Biofuels
5.	<b>Practical - OLD</b>	<b>Practical NEW</b>

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<sub>12</sub>** - 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) Diphtheria ii) Tetanus

## UNIT – IV

10 Lectures

### 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:

10 Lectures

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

### UNIT – II

10 Lectures

#### 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

10 Lectures

#### 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

10 Lectures

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

- A. E.M.S(Environmental Monitoring System)- Concept & Process in dairy industry
- B. E.I.A(Environmental impact assessment): Concept & Process of assessment

## **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**

**Entrepreneurship** - 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
- vii. Financial management – Fund raising, costing and 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

## **Paper-XVI : Microbial fermentations, Foods and Biofuels**

### **UNIT – I**

**10 Lectures**

#### **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**

**10 Lectures**

#### **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**

**10 Lectures**

#### **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**

**10 Lectures**

- 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:**

<b>BOOK</b>	<b>AUTHOR</b>
<u>SOIL MICROBIOLOGY</u>	<u>N.S.SUBBARAO</u>
<u>SOIL MICROBIOLOGY</u>	<u>ALEXANDER</u>
<u>NATURE AND PROPERTIES OF SOIL</u>	<u>BRADY</u>
<u>MODERN SOIL MICROBIOLOGY</u>	<u>D.V.EALASJAN</u>
<u>METHODS IN ENVIORNMENTAL ANALYSIS –WATER SOIL AND AIR</u>	<u>P. K. GUPTA</u>
<u>AQUATIC ECOLOGY</u>	<u>R.RAGOTHAMAN</u>
<u>WATER,ENVIRONMENT AND POLLUTION</u>	<u>KUMAR</u>
<u>AIR,ENVIRONMENT AND POLLUTION</u>	<u>S .S.PUROHIT</u>
<u>MICROBIOLOGY</u>	<u>PELCZAR</u>
<u>MICROBIAL BIOGEOCHEMISTRY</u>	<u>ZAJIC</u>
<u>WATER AND WASTE WATER TECHNOLOGY</u>	<u>HAMMER AND HAMMER</u>
<u>ECOLOGY, ENVIRONMENT AND POLLUTION</u>	<u>PUROHIT AND RANJAN</u>
<u>WASTE WATER TREATMENT</u>	<u>RAO AND DATTA</u>
<u>ENVIRONMENTAL CHEMICAL HAZARDS</u>	<u>KUMAR</u>
<u>AN INTRODUCTION TO AIR POLLUTION</u>	<u>TRIVEDI AND GOEL</u>
<u>ENVIRONMENTAL AND METAL POLLUTION</u>	<u>KHAN</u>
<u>ENVIRONMENTAL POLLUTION</u>	<u>KATYAL AND SATAKE</u>
<u>ENVIRONMENTAL POLLUTION ANALYSIS</u>	<u>S.M. KHOPKAR</u>
<u>WASTE WATER TREATMENT</u>	<u>M. N. RAO</u>
<u>ECOLOGY OF POLLUTED WATER VOLUME 1</u>	<u>KUMAR</u>
<u>AIR POLLUTION</u>	<u>RAO</u>

<u>AEROBIOLOGY</u>	<u>TILAK</u>
<u>ENVIRONMENTAL POLLUTION</u>	<u>PUROHIT AND AGARWAL</u>
<u>GENE BIOTECHNOLOGY</u>	<u>S.N.JOGDAND</u>
<u>PRINCIPLES OF GENE MANIPULATION</u>	<u>PRIMROSE, TWYMAN AND OLD</u>
<u>BIOTECHNOLOGY- FUNDAMENTALS AND APPLICATIONS</u>	<u>S.PUROHIT</u>
<u>GENETIC ENGINEERING AND ITS APPLICATIONS</u>	<u>P.JOSHI</u>
<u>BIOTECHNOLOGY-FUNDAMENTALS AND APPLICATIONS</u>	<u>NAIDU</u>
<u>TEXTBOOK OF BIOTECHNOLOGY</u>	<u>CHATWAL</u>
<u>BIOTECHNOLOGY</u>	<u>DUBEY</u>
<u>RECENT TRENDS IN BIOTECHNOLOGY</u>	<u>V. S. HARIKUMAR</u>
<u>BIO-TECHNOLOGY- FUNDAMENTALS AND APPLICATIONS</u>	<u>S. S. PUROHIT.</u>
<u>PROTEIN BIOTECHNOLOGY</u>	<u>HAZARE</u>
<u>BIOTECHNOLOGY</u>	<u>BARNUM</u>
<u>PHARMACOLOGY &amp; PHARMACOTHERAPEUTICS</u>	<u>R.S.SATOSKAR</u>
<u>PHARMACEUTICAL MICROBIOLOGY</u>	<u>W.B.HUGO</u>
<u>PHARMACEUTICAL MICROBIOLOGY</u>	<u>PUROHIT,SALUJA AND KAKRANI</u>
<u>PHARMACEUTICAL MICROBIOLOGY</u>	<u>HUGO AND RUSSEL</u>
<u>PHARMACEUTICAL MICROBIOLOGY</u>	<u>S. S. PUROHIT, RAJIV RAJAN.</u>
<u>I NDIAN PHARMACOPEIA</u>	
<u>PREVENTION OF FOOD ADULTERATION ACT 1954</u> - <u>Industrial Microbiology</u>  <u>Indian Pharmacopoeia Latest Edition</u>  <u>European pharmacopoeia latest edition</u>	<u>E.L. Manasi</u>

**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**

<b>1. Project</b>	<b>30 Marks</b>
<b>2. On Job Training</b>	<b>15 Marks</b>
<b>TOUR REPORT:</b>	<b>15 Marks</b>

### **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' x 15' 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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