SHIVAJI UNIVERSITY, KOLHAPUR.

Accredited By NAAC with 'A' Grade

Revised Syllabus For

Bachelor of Science Part -III

INDUSTRIAL MICROBIOLOGY

CBCS PATTERN

Syllabus to be implemented from

June, 2020 onwards.

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, 2020 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. DURATION : The course shall be a full time course.

5. PATTERN: Pattern of Examination will be Semester.

6. MEDIUM OF INSTRUCTION : The medium of instruction shall be English.

7. PROGRAMME SPECIFIC OUTCOME OF INDUSTRIAL MICROBIOLOGY

The programme specific outcome of the B.Sc –III syllabus in Industrial Microbiology will enrich the students with

- Knowledge regarding basic, advanced and applicable concepts in emerging areas of Industrial Microbiology.
- Skills required for their careers in various industries, research and various branches of Life Sciences.

8. STRUCTURE OF COURSE :

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

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

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

Annual -V

Course IX : Environmental Microbiology

Course X : Basic techniques of Biotechnology

Course XI : Quality assurance and quality control of fermented products.

Course XII : Microbial productions of metabolites and bioinsecticides

Annual -VI

Course XIII : Environmental pollution and control

Course XIV : Applications of Biotechnology

Course XV : Industrial management, Government laws and regulations.

Course XVI : Microbial fermentations, Foods and Biofuels.

9. Course specific outcome:

Course : B.Sc III

Course IX DSCC 27	Environmental Microbiology	Exploring microbial activities in soil, marine,textile,petroleum mines
Course X DSCC 28	Basic Techniques in Biotechnology	Techniques in Biotechnology and molecular biology
Course XI DSCC 29	Quality Assurance and Quality Control in Industrial Products	Rules and regulations of the regulatory authorities in QA and QC
Course XII DSCC 30	Microbial Production of Metabolites and Bioinsecticide	Industrial microbial production of health and agricultural products
Course XIII DSCC 27	Environmental Pollution and Control	Study of pollution, parameters , its assessment and monitoring in different environment
Course XIV DSCC 28	Applications of Biotechnology	Use of Biotechnology in applied fields like agriculture, industry, medical and Environment
Course XV DSCC 29	Industrial Management, Government laws and Regulations	Industrial management and laws in effective running of industry
Course XVI DSCC 30	Microbial Fermentations, Foods and Biofuels	Microbial production of liquors, biofuels and use of microbes in foods
Practical	Practical based on the above theory	Students gain knowledge / skills and techniques applied in the field of Industrial Microbiology

10. SCHEME OF TEACHING AND EXAMINATION:

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

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

B.Sc part III (Industrial Microbiology) SEMESTER- V

Course -IX	**Course-IX-DSCC-27 (CREDITS:02;TOTALHOURS:45) ENVIRONMENTAL MICROBIOLOGY**	No .of lectures per Credit
UnitI/ CreditI	**ROLE OF MICROORGANISMS IN ENVIRONMENT**	**22**
	A) SOIL ENVIRONMENT a. Introduction,physical,chemical,microbial characters. b. Microbial interactions in soil & their role in soil fertility **B) ELEMENTAL CYCLES** a. Carbon cycle, Nitrogen cycle, Sulfur cycle, Phosphorus cycle b. Role of microorganisms in elemental cycles	
UnitII/Credit II	**EXPLORING MICROORGANISMS ASSOCIATED WITH VARIOUS ENVIRONMENTS**	**23**
	A) MICROORGANISMS IN VARIOUS ENVIRONMENTS **a)Petroleum Microbiology** : 1. Types of compounds in petroleum. 2. Microorganisms in hydrocarbon system. 3. Role of microorganisms in hydrocarbon degradation. **b)Marine Microbiology**: 1. Characters of marine environment. 2. Characters of marine microorganisms. 3. Role of marine microorganisms. **c) Astromicrobiology (space capsule):** 1. Characteristics of space environment. 2. Microorganisms in the astro-environment. 3. Characteristics of microbes. **B) ROLE OF MICROORGANISMS IN BIOLEACHING AND TEXTILE INDUSTRY** **a) Bioleaching of elements** 1. Introduction, microorganisms involved, 2. Chemistry of microbial leaching and beneficiation 3. Leaching methods – Laboratory and in situ leaching of copper and uranium.	

	b) Textile Industry 1. Introduction, types of microorganisms found on textile fibres, 2. Conditions favoring the action of microorganisms, 3. Types of destruction caused by microorganisms (cotton and wool) & its prevention .	

Course -X	Course-XDSCC-28 (CREDITS:02;TOTALHOURS:45) **Basic Techniques of Biotechnology**	No.of lectures
Unit I/ Credit I	GENETIC ENGINEERING	**22**
	A) BASIC CONCEPT OF GENETIC ENGINEERING **a. Introduction** **b. Tools of genetic engineering** 1. Cutting and joining enzyme. 2. Cloning Vectors – Plasmids, phage, cosmids, and artificial chromosomes- BAC & YAC 3. Cloning organisms. **B) 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 II/ Credit II	**TECHNIQUES IN MOLECULAR BIOLOGY**	**23**
	A) TECHNIQUES IN MOLECULAR BIOLOGY **a. Blotting Techniques** 1. Southern blotting 2. Northern blotting 3. Western blotting 4. DOT-BLOT technique **b. Techniques of Detection and Analysis of Nucleic Acid** 1. Radioactive labeling – Nick translation 2. Non Radioactive labeling – Horse Radish Peroxide (HRP) method **c. DNA sequencing**– Sanger's method **Gene editing –** CRISPR-CAS technique **B) PROTEIN ENGINEERING, IMMOBILIZATION AND PCR** **a. Protein Engineering:** Definition, methods and application. **b. Gene mapping** **c. PCR –** Requirements, working, different types of PCRs, PCR product analysis, advantages & disadvantages, applications. Chemical synthesis of gene	

Course-XI	Course-XIDSCC-29 (CREDITS:02;TOTALHOURS:45) **QUALITY ASSURANCE AND QUALITY CONTROL IN INDUSTRIAL PRODUCTS**	
Unit I/ Credit I	**INDUSTRIAL RULES & STANDARDS AS PER IP, BP, USP, EP**	**22**
	A) INDIAN PHARMACOPOEIA : a. Introduction b. Concept of pharmacopoeia c. Concept of regulatory authorities d. Types of pharmaceutical products e. Microbiological Q.C **B) ASSAY OF MICROBIAL PRODUCTS AS PER INDIAN PHARMACOPOEIA:** a. Alcohol & Acetic acid b. Vit. A & Vit. D c. Bacitracin	
Unit II/ Credit II	**VALIDATION AND QUALITY CONTROL IN PHARMA INDUSTRIES**	**23**
	A) QUALITY CONTROL TESTS OF PHARMACEUTICAL PRODUCTS a. Sterility test b. Pyrogen test c. Toxicity test d. Carcinogenicity test e. Mutagenicity test f. Allergy test **B) 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	

Course -XII	Course-XIDSCC-30 (CREDITS:02;TOTALHOURS:45) **MICROBIAL PRODUCTION OF METABOLITES AND BIOINSECTICIDES**	
UnitI/ Credit I	**MICROBIAL PRODUCTION OF VITAMINS, ORGANIC ACIDS AND ANTIBIOTICS**	**22**
	A) Microbial Production of Vitamins: **a. Vitamin B12** - 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 **B) Microbial Production of organic acid** a. Gluconic acid b. Indole Acetic Acid c. Itaconic acid **C) Production of Antibiotics:** a. Bacitracin b. Chloramphenicol	
Unit II/ Credit II	**PRODUCTION SAFETY, MERITS, EFFECTIVITY OF BIOPESTICIDES, TOXOIDS, SCP**	**23**
	PRODUCTION OF ANTIBIOTICS AND TOXOIDS **A)Biopesticides:** a. B. t. Bacillus thuringiensis b. Baculovirus heliathius c. Trichoderma **B)Production of toxoids:** a. Diptheria b. Tetanus c. Botulism **C)SCP** a. Yeast b. Algae c. Bacteria	

Course - XIII	**Course-XIII DSCC-27** **(CREDITS:02;TOTALHOURS:45)** **ENVIRONMENTAL POLLUTION AND CONTROL**	
Unit I/ Credit I	**ENVIRONMENTAL MONITORING AND E.M.S. & E.I.A.**	**22**
	A) ENVIRONMENTAL MONITORING : a. Environmental Monitoring &Bioburden Tests b. E.M.S. (Environmental Monitoring System): Concept & Process in dairy industry **B) BIOSAFETYand E.I.A.** a. E.I.A. (Environmental Impact Assessment): Concept & Process of assessment b. Biosafety in Laboratories and Pharmaceutical Industries.	
Unit II/ Credit II	**CHARACTERISTICS OF WASTE**	**23**
	WASTE WATER TREATMENT : **A) Characteristics of Waste Water as per CPCB norms** **B) Treatment Procedures :** **a. Physical treatment** – Sedimentation, screening and removal of oil and grease. **b. Biological treatments** - Septic tank, bio filter, activated sludge, extended aeration, oxidation ponds, anaerobic digestion-UASB (Up flow Anaerobic Sludge Blanket), Root zone technology **c. Chemical treatment** – Coagulation by alum/lime/polyelectrolyte /disinfection. **C) Characteristics and treatment of solid & liquid wastes of –** a. Sugar Industry b. Distillery c. Dairy Industry **D) Eutrophication –** Classification of lakes, sources of nutrients, consequences and control.	

Course - XIV	Course- XIVDSCC-28 (CREDITS:02;TOTALHOURS:45) **APPLICATIONS OF BIOTECHNOLOGY**	
Unit I/ Credit I	**APPLICATIONS IN AGRICULTURE, ENVIRONMENT& INDUSTRY**	**22**
	A) APPLICATIONS OF GENETIC ENGINEERING IN AGRICULTURE a. **Transgenic plants** – concepts, methods for raising transgenic plants and applications. b. **Transgenic animals** – Concepts, methods for raising transgenic animals and applications. **B) APPLICATIONS OF GENETIC ENGINEERING IN ENVIRONMENT** a. **Bioremediation -** Use of naturally occurring microorganisms and GEMs **C) APPLICATIONS OF GENETIC ENGINEERING IN INDUSTRY** a. **GEMs in industry:** Pharmaceutical and food industry	
Unit II/ Credit II	**APPLICATIONS IN MEDICAL FIELD**	**23**
	A) MONOCLONAL ANTIBODIES AND RECOMBINANT VACCINES a. **Monoclonal antibodies -** Definition, production- Hybridoma technology, applications. b. **Recombinant vaccines -** Definition, recombinant vector vaccines, DNA vaccines, Multivalent subunit vaccines, mini cell vaccines, conjugate vaccines. **B) PRODUCTION OF rDNA PRODUCTS AND MERITS, DEMERITS OF BIOTECHNOLOGY** a. **rDNA Products:** Insulin, Somatostatin, interferons, abzymes, immunotoxins b. **Merits & Demerits of Biotechnology** c. **Diagnostic techniques** a. Detection of human and plant pathogens- ELISA, RIA b. TB detection: 1. Genexpert test 2. Line probe assay	

Course -XV	Course- XVDSCC-29 (CREDITS:02;TOTALHOURS:45) **INDUSTRIAL MANAGEMENT, GOVERNMENT LAWS AND REGULATIONS**	
Unit I/ Credit I	**CONCEPTS OF MANAGEMENT AND ENTREPRENEURSHIP**	**22**
	A)Enterpreneurship - Principles of management, management meaning and importance, Concept of Entrepreneurship. **B)Concepts of Management:** **a. Planning meaning and importance** **b. Organizing -** Meaning and process of organization **c. Communication –** Meaning and process control techniques. **d. Personal Management –** Man power planning **e. Purchase and store management –** Concept of quotation, tenders, comparative statement, inspection and quality control, store management. **f. Concept of marketing –** Basic Concepts, Costing, Pricing **g. Financial management –** Fund raising, costing and pricing.	
UNIT II/ CREDIT II	**NATIONAL AND INTERNATIONAL LAWS RELATED TO INDUSTRIAL REGULATION AND TAXATION**	**23**
	A) Basic concepts and laws relating to its infringement a. Patent, Bio patent, Copyright, Trade secret, Trademark, Geographical Indications, Designs, its b. IPR and WTO, TRIPS c. Industrial development and regulation act 19 object, licensing and registration **B) Concept of tax, principles of taxation, types of tax. Good and service tax 2017, features and benefits of GST**	

Course - XVI	Course- XVI DSC C-30 (CREDITS:02; TOTAL HOURS : 45) **MICROBIAL FERMENTATIONS, FOODS AND BIOFUELS**	
Unit I/ Credit I	**PRODUCTION OF SCP, MUSHROOM, PROBIOTICS & INDIAN MADE FOREIGN LIQUORS**	**22**
	A) Production of SCP a. Introduction b. Production – Algae, Bacteria, Yeast c. Product quality and safety **B) Production of Mushrooms** a. Introduction & types b. Spawn production c. Mushroom Production & harvesting **C) Probiotics** a. Introduction & common properties of probiotics b. Examples of probiotic microorganism c. Use of probiotic **D) Microbial production of indian made foreign liquors- gin, whiskey & rum** a. Introduction b. Production Process c. Quality of Product	
Unit II/ Credit II	**PRODUCTION OF VINEGAR, EXOPOLYSACCARIDES & BIOFUELS`**	**23**
	A) Vinegar production a. Introduction & Mechanism of vinegar production b. Production process : Orlean's process, Trickling type generator, Submerged culture method c. Types & Uses of vinegar **B) Microbial Production of Exopolysaccharides** a. Introduction & Mechanism of synthesis b. Production process of Xanthan & Dextran gum c. Applications of xanthan and dextran gums **C) Production of biofuels** a. Ethanol- microorganisms used, fermentation conditions, recovery, purification of Ethanol b. Biogas- Biomass used, microbiology & Biochemistry of biogas production, models used, uses of biogas c. Biodiesel production from Algae	

B.Sc. III INDUSTRIAL MICROBIOLOGY:
PRACTICAL COURSE:

Course V	PRACTICAL COURSE V (CREDITS:02; TOTAL HOURS:180)	No. of lectures per credit
Credit 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. Estimation of chlorine dose of potable water. 4. Validation of Autoclave as per IP 5. Validation of Laminar air flow	
Credit II	**Major Experiments :** 1. Isolation of genomic DNA from bacteria 2. Isolation of genomic DNA from yeast. 3. Isolation of plasmid DNA from bacteria. 4. Transformation in E. coli. 5. Isolation of Vit B_{12} 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 blot.	

	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. 7. ELISA	

Course VI	**PRACTICAL COURSE VI** **(CREDITS:02; TOTAL HOURS:60)**	**No. of lectures per credit**
Credit I	**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. B_{12} 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 10. Production of IAA **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 6. Chemical Assay of IAA	
Credit II	1. Compulsory "on Job training" in Industry / Institute for minimum period of one week and submission of report. 2. Project work	

Reference Books:

BOOK	AUTHOR
SOIL MICROBIOLOGY	N.S.SUBBARAO
SOIL MICROBIOLOGY	ALEXANDER
NATURE AND PROPERTIES OF SOIL	BRADY
MODERN SOIL MICROBIOLOGY	D.V.EALASJAN
METHODS IN ENVIORNMENTAL ANALYSIS –WATER SOIL AND AIR	P. K. GUPTA
AQUATIC ECOLOGY	R.RAGOTHAMAN
WATER,ENVIRONMENT AND POLLUTION	KUMAR
AIR,ENVIRONMENT AND POLLUTION	S .S.PUROHIT
MICROBIOLOGY	PELCZAR
MICROBIAL BIOGEOCHEMISTRY	ZAJIC
WATER AND WASTE WATER TECHNOLOGY	HAMMER AND HAMMER
ECOLOGY, ENVIRONMENT AND POLLUTION	PUROHIT AND RANJAN
WASTE WATER TREATMENT	RAO AND DATTA
ENVIRONMENTAL CHEMICAL HAZARDS	KUMAR
AN INTRODUCTION TO AIR POLLUTION	TRIVEDI AND GOEL
ENVIRONMENTAL AND METAL POLLUTION	KHAN
ENVIRONMENTAL POLLUTION	KATYAL AND SATAKE
ENVIRONMENTAL POLLUTION ANALYSIS	S.M. KHOPKAR
WASTE WATER TREATMENT	M. N. RAO
ECOLOGY OF POLLUTED WATER VOLUME 1	KUMAR
AIR POLLUTION	RAO
AEROBIOLOGY	TILAK
ENVIRONMENTAL POLLUTION	PUROHIT AND AGARWAL
GENE BIOTECHNOLOGY	S.N.JOGDAND
PRINCIPLES OF GENE MANIPULATION	PRIMROSE,TWYMAN AND OLD
BIOTECHNOLOGY- FUNDAMENTALS AND APPLICATIONS	S.PUROHIT
GENETIC ENGINEERING AND ITS APPLICATIONS	P.JOSHI
BIOTECHNOLOGY-FUNDAMENTALS AND APPLICATIONS	NAIDU
TEXTBOOK OF BIOTECHNOLOGY	CHATWAL
BIOTECHNOLOGY	DUBEY
RECENT TRENDS IN BIOTECHNOLOGY	V. S. HARIKUMAR
BIO-TECHNOLOGY- FUNDAMENTALS AND APPLICATIONS	S. S. PUROHIT
PROTEIN BIOTECHNOLOGY	HAZARE
BIOTECHNOLOGY	BARNUM
PHARMACOLOGY & PHARMACOTHERAPEUTICS	R.S.SATOSKAR
PHARMACEUTICAL MICROBIOLOGY	W.B.HUGO
PHARMACEUTICAL MICROBIOLOGY	PUROHIT,SALUJA AND KAKRANI
PHARMACEUTICAL MICROBIOLOGY	HUGO AND RUSSEL
PHARMACEUTICAL MICROBIOLOGY	S. S. PUROHIT, RAJIV RAJAN.
INDIAN PHARMACOPEIA	
FERMENTATION TECHNOLOGY	PEPPLER
PREVENTION OF FOOD ADULTERATION ACT 1954 Industrial Microbiology Indian Pharmacopoeia Latest Edition European pharmacopoeia latest edition	E.L. MANASI

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

PRACTICAL I

Q.1 Major Experiment	**20 Marks**
Q.2 Minor Experiment	**15 Marks**

PRACTICAL II

Q.1 Major Experiment	**20 Marks**
Q.1 Major Experiment	**15 Marks**

PRACTICAL III

Q.1 Major Experiment	**20 Marks**
Q.2 Minor Experiment	**15 Marks**

PRACTICAL IV

Q.1 Project	**35 Marks**
Q5. ON JOB TRAINING	**20 Marks**
Q6. JOURNAL	**20 Marks**
Q7. SPOTTING / VIVA COURSE	**10 Marks**
Q8. TOUR REPORT	**10 Marks**