



SU/BOS/Science/350

Date: 24/06/2024

To,

The Principal,
All Concerned Affiliated Colleges/Institutions
Shivaji University, Kolhapur

Subject: Regarding Minor Change syllabi of B.Sc. Part-I (Sem.I & II) as per NEP-2020 (2.0) degree programme under the Faculty of Science and Technology.

Ref: SU/BOS/Science/876/ Date: 26/12/2023 Letter.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the Minor Change syllabi, nature of question paper of B.Sc. Part-I (Sem.I & II) as per NEP-2020 (2.0) degree programme under the Faculty of Science and Technology.

B.Sc.Part-I (Sem. I & II) as per NEP-2020 (2.0)			
1.	Botany	9.	Geology
2.	Physics	10.	Zoology
3.	Statistics	11.	Chemistry
4.	Astrophysics	12.	Geography
5.	Mathematics	13.	Electronics
6.	Microbiology	14.	Drug Chemistry
7.	Plant Protection	15.	Industrial Microbiology
8.	Astrophysics and Space Science	16.	Sugar Technology (Entire)

This syllabus, nature of question and equivalence shall be implemented from the academic year 2024-2025 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website www.unishivaji.ac.in NEP-2020@suk(Online Syllabus)

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2024 & March/April 2025. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Dy Registrar
Dr. S. M. Kubal

Copy to:

1	The Dean, Faculty of Science & Technology	4	B.Sc. Exam/ Appointment Section
2	Director, Board of Examinations and Evaluation	5	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	6	Affiliation Section (U.G.) (P.G.)

SHIVAJI UNIVERSITY, KOLHAPUR



Established: 1962

A⁺⁺ Accredited by NAAC (2021) with CGPA 3.52

Structure and Syllabus in Accordance with

National Education Policy - 2020

with Multiple Entry and Multiple Exit

**Syllabus For
B.Sc. Part-I**

INDUSTRIAL

MICROBIOLOGY

**(Faculty of Science and
Technology)**

SEMESTER I AND II

(To Be Implemented From Academic Year 2024-25)

First Year

Level	Sem ester				3-OE	4-SEC	5-AEC, VEC, IKS			6-OJT, FP, CEP, CC, RP			Total Credits
					IDC/MDC/ OE/GE	SEC	AEC (Language)	Value Education Courses (VEC)	IKS	CC	Summer Internship/Field Project/OJT	Research Project / Dissertation	
					Subject-1								
4.5	I	DSC-I (2) DSC-II (2) DSC Pract. -I (2)	DSC-I (2) DSC-II (2) DSC Pract. -I (2)	DSC-I (2) DSC-II (2) DSC Pract. -I (2)	OE -I (T/P) (2)				IKS-I (2) Introduction to IKS			-	
	Credit s	4+2=6	4+2=6	4+2=6	2+0=2	-	-	-	2	-	-	-	22
	II	DSC-III (2) DSC-IV (2) DSC Pract.-II (2)	DSC-III (2) DSC-IV (2) DSC Pract.-II (2)	DSC-III (2) DSC-IV (2) DSC Pract.-II (2)	OE-II (T/P) (2)			VEC- I (2) Democracy				-	
	Credit s	4+2=6	4+2=6	4+2=6	0+2=2	-	-	2	-	-	-	-	22
1 st Year Cum. Credits		12	12	12	4	-	-	2	2				44

Exit option: Award of UG Certificate with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor

Shivaji University, Kolhapur

Syllabus For Bachelor of Science Part – I : Industrial Microbiology

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, 2024-25.

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 vigor 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 fulltime course.

5. PATTERN: Examination will be conducted at the end of each Semester.

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

7. Learning Outcomes or Program Specific Outcomes of Industrial Microbiology:

After completion of three years Industrial Microbiology program, the students vision insights will broaden into –

1. Application of Basic & Advanced concept of industrial microbiology to diverse areas such as fermentation technology, quality control, government's law and regulations, quality management and environmental monitoring.
2. Competence of a working knowledge of theory, practicals, skills and use of various aspects of industrial microbiology according to the needs of industries.
3. Identifying societal problems and providing innovative remedies with a broader perspective of industrial microbiology.
4. Development of entrepreneur skills.

Learning Outcomes:

A candidate who wish to graduate in B.Sc. (Microbiology Course) needs to have acquired/developed following competencies:

1. Acquired knowledge and understanding of the microbiology concepts as applicable to diverse areas such as medical, industrial, environment, genetics, agriculture, food and others.
2. Demonstrate key practical skills/competencies in working with microbes for study and use in the laboratory as well as outside, including the use of good microbiological practices.
3. Competent enough to use microbiology knowledge and skills to analyze problems involving microbes, articulate these with peers/ team members/ other stake holders, and undertake remedial measures/studies etc.
4. Developed a broader perspective of the discipline of Microbiology to enable him to identify challenging societal problems and plan his professional career to develop innovative solutions for such problems.

SEMESTER- I

F. Y. B. Sc. (INDUSTRIAL MICROBIOLOGY)

SEMESTER I

DSC- I: Introduction to Industrial Microbiology

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK - 02]

Learning Objectives:

1. To get acquainted with the contribution made by prominent scientist in the field of industrial microbiology.
2. To study industrially important products
3. To understand the basic concept of fermentation and technique used for isolation of industrially useful microorganisms.
4. To study the characteristics and industrial importance of microorganisms

Course learning outcomes:

After completion of this course, learner will:

1. Be acquainted with the scope of Industrial Microbiology and be familiarized with its various branches
2. Understand the historical development of the subject and recent developments in the field
3. Understand the applications of the microorganisms
4. Be acquainted with fermentation of various products

Credit I	History and Basic Concepts of Industrial Microbiology	No. of hours: 15
	A. Historical developments of industrial microbiology 1. Definition and scope of Industrial Microbiology. 2. Contributions of various scientists to Industrial Microbiology. a) Louis Pasteur b) Antony Van Leeuwenhoek c) Alexander Fleming d) Selman Waksman e) Edward Jenner 3. Introduction to Industrially important products	

	<p>a) Pharmaceutical products –</p> <ul style="list-style-type: none"> i) Vitamins – Vit B12 ii) Antibiotics–Penicillin iii) Vaccine – Types with examples <p>b) Agricultural products –</p> <ul style="list-style-type: none"> i) Biofertilizers – Azotobacter ii) Biopesticides – Bacillus thuringiensis. <p>c) Food products –</p> <ul style="list-style-type: none"> i) Fermented milk products – Curd, Yogurt ii) Pickles – Sauerkraut <p>B. Concepts of Fermentation</p> <ol style="list-style-type: none"> 1. Fermentation – Definition 2. Primary and secondary metabolites 3. Types of fermentation - <ul style="list-style-type: none"> a) Batch and continuous fermentations b) Dual and multiple fermentation <p>Solid state and liquid state fermentation</p>	
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Credit II	Isolation & Study of industrially important microorganisms	No. of hours: 15
	<p>A. Screening of industrially important microorganisms</p> <p>1. Primary Screening of -</p> <ul style="list-style-type: none"> a) Antibiotic producers b) Organic acid producers c) Amylase producers d) Amino acid producers <p>2. Secondary screening -</p> <ul style="list-style-type: none"> i) Detail information of microorganism used. ii) Detail information of products produced. iii) Qualitative & quantitative study of products <p>B Study of Industrially Important Microorganisms</p> <p>1. General characteristics and industrial importance of:</p> <ul style="list-style-type: none"> a) Bacteria including actinomycetes b) Fungi (yeasts and molds) c) Algae 	

DSC- II: Basics of Fermentations

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK - 02]

Learning Objectives:

1. To study the formulation of fermentation media.
2. To understand the use of agricultural and industrial waste as fermentation media
3. To understand the principles of sterilization of equipment, culture media, air in industries and validation of sterilization process.

Course Learning Outcomes:

After completion of this course learner will be able to:

1. Capable of media preparation
2. Understand the knowledge of different ingredients.
3. Acquainted with sterilization of equipment's
4. Capable of validation of sterilization processes

Credit I	Fermentation media and Waste as fermentation media	No. of hours: 15
	<p>A. Components of Fermentation media</p> <ol style="list-style-type: none"> 1. Basic components <ol style="list-style-type: none"> a) water, b) Sources of: carbon, nitrogen, minerals 2. Special ingredients – <ol style="list-style-type: none"> a) growth factors b) buffers c) precursors, inhibitors, inducers, d) antifoam agents e) redox potential 3. Types of media used <ol style="list-style-type: none"> a) synthetic, semisynthetic b) crude <p>B. Types of Waste and Use of Wastes:</p> <ol style="list-style-type: none"> 1. Concept of Pretreatment and addition of supplements. 2. a) Industrial waste - <ol style="list-style-type: none"> i) Molasses ii) Corn steep liquor iii) SWL b) Agricultural wastes <ol style="list-style-type: none"> i. Wheat bran ii) Rice husk 	

Credit II	Sterilization Techniques in Fermentation Industry	No. of hours: 15
	A. Sterilization Technique: 1. Principles of Sterilization 2. Sterilization of Equipment 3. Sterilization of production media with respect to Acid Alkali Buffer, Antifoam agent and precursors 4. Sterilization of air. B. Validation of sterilization processes	

PRACTICAL COURSE **DSC Pract. -I**

PRACTICALS BASED ON CORE SUBJECT 1& 2

[CREDITS - 02; PRACTICALS - 60 hours , Practicals /week - 04]

Paper I & Paper II	Paper I &II: Introduction to Industrial Microbiology and Basics of Fermentations (CREDITS: 02)	No. of Hours
	LEARNING OBJECTIVES : <ol style="list-style-type: none"> 1. To understand and practice various biosafety techniques used in microbiology laboratory. 2. To study working, principles, handling and use of microscope as well as various instruments used in microbiology laboratory. 3. To prepare liquid, solid media and to study the working principles of sterilization and disinfection of culture media and glassware. 4. To understand the basic laboratory technique used to isolate and cultivate bacteria, yeast, molds and actinomycetes 	
	LEARNING OUTCOMES <ol style="list-style-type: none"> 1. Understands biosafety procedures 2. Capable of cleaning, proper disposal of used material. 3. Capable of sterilization of glasswares independently. 4. Capable of media preparation and sterilization. 	
Credit I	Introduction to Industrial Microbial Techniques	
	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 glassware <ol style="list-style-type: none"> 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) Centrifuge g) pH meter h) Spectrophotometer i) Distillation Unit 	30

Credit-II	Preparation of Media and Study of Microorganism in Fermentation	
	<p>4. Preparation of media and isolation of Bacteria, Molds, Yeasts</p> <p>a) Preparation of -agar plates, slants and isolation of</p> <p>b) Bacteria –</p> <ul style="list-style-type: none"> • Nutrient agar- <i>Bacillus subtilis</i> • Soil extract agar- Actinomycetes <p>c) Molds – i. Potato Dextrose Agar-<i>Aspergillus oryzae</i></p> <p>d) Yeasts – Sabouraud's agar - <i>Saccharomyces cerevisiae</i></p> <p>e) Actinomycetes – i. Glycerol Asparagine Agar-<i>Streptomyces</i> species</p> <p>5. Sterilization of culture medium using Autoclave and assessment for sterility.</p> <p>6. Sterilization of glassware using Hot Air Oven and assessment for sterility</p> <p>7. Isolation and identification of <i>Azotobacter chroococcum</i> from soil</p> <p>8. Primary Screening of -</p> <p>a) Antibiotic producers</p> <p>b) Organic acid producers</p> <p>c) Amylase producers</p> <p>d) Amino acid producers</p>	30

SEMESTER- II

DSC- III: : Introduction to Fermentation Technology

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK - 02]

Learning Objectives:

1. To study the fermenter design and to understand different types of fermenter.
2. To study the temperature, pH, pressure and foam control systems and their importance.
3. To understand the concepts of inoculums preparation, strain improvement, stock culture maintenance and culture collection centers.
4. To study the various factors affecting fermentation process.

Learning Outcomes:

1. Capable of handling the fermenter.
2. Understand the different types of fermenters.
3. *Aqanted with the strain improvement techniques.*
4. Capable of preparing inoculum.

Credit I	Design of Fermenter& working system	No. of hours: 15
	<p>A. Basic Fermenter design:</p> <ol style="list-style-type: none"> 1. Parts and their functions of Conventional Stirred tank fermenter. 2. Fermenter Types - <ol style="list-style-type: none"> a) Airlift Fermenter b) Fluidized bed fermenter c) Packed bed fermenter d) Bubble cap fermenter <p>B. Fermenter 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. e) Contamination 	

Credit II	Production strains and Factors affecting fermentation process	No. of hours: 15
	<p>A. Production strains</p> <ol style="list-style-type: none"> 1. Concept 2. Concept of strain improvement 3. Stock culture maintenance 4. Culture collection centers <p>B. Preparation of inoculum</p> <p>C. Factors Affecting fermentation process</p> <p>Temperature</p> <ol style="list-style-type: none"> 2. pH 3. Aeration 4. Agitation 5. Foam <p>Media composition</p>	

[CREDITS - 02; LECTURES - 30 hours; LEC/WEEK - 02]

Learning Objectives:

1. To study industrial production of penicillin, semisynthetic penicillin and Vit B12
2. To study microbiological assay of vitamins and antibiotics.
3. To understand various downstream processes.
4. To study economic protection of fermentation product.

Learning Outcomes:

1. Acquainted with production process
2. To Acquaint with the knowledge of Vitamins and antibiotics
3. To understand the purification process

Credit I	Microbial fermentations and microbial assay	No. of hours: 15
	A. Antibiotics: <ol style="list-style-type: none"> 1. Production of antibiotics -: Penicillin., Streptomycin B. Vitamin <ol style="list-style-type: none"> 1. Production of Vitamin -: Vitamin B12 C. Amino acid- 1. Production of L-lysine D. Other Industrial products – <ol style="list-style-type: none"> 1. Enzymes – Amylase 2. Organic acid -Citric acid E. Fermented Soyabean Products – miso, tofu, soy sauce F. Probiotic foods	
Credit II	Purification and assay of fermentation products	15
	A. Downstream processes <ol style="list-style-type: none"> 1. Cell harvesting 2. Precipitation, filtration and centrifugation 3. Cell disruption 4. Liquid-liquid extraction 5. Chromatography – adsorption, ion exchange, gel, affinity 6. Distillation 7. Crystallization B. Assay of fermentation products <ol style="list-style-type: none"> 1. Microbiological assay of Vitamins and Antibiotics. Chemical assays of Penicillin.	

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
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.

DSC Pract. -II: : PRACTICALS BASED ON CORE SUBJECT III & IV
: [CREDITS - 02; PRACTICALS - 60 hours , Practicals /week - 04]

Paper III & Paper IV	Practical Course II: Introduction to Fermentation Technology and Microbial Fermentations and Economics (CREDITS: 02)	No. of Hours
	OBJECTIVES <ol style="list-style-type: none"> 1. To study morphological and cultural characteristics of bacteria, fungi and actinomycetes 2. To study giant colony techniques of actinomycetes. 3. To study screening techniques for amylase, organic acid, antibiotics and amino acids producers. 4. Detection and identification of sugars and amino acid by paper chromatography 5. Chemical assay of penicillin. 	
	Learning Outcomes <ol style="list-style-type: none"> 1. Capable of isolation of organisms. 2. Acquainted with isolation of various organisms. 3. Capable of detecting the antimicrobial activity. 4. Capable of screening the industrially important organisms. 	
Credit I	Study of Industrially Important Microorganism	
	<ol style="list-style-type: none"> 1. Isolation and study of microorganisms: <ol style="list-style-type: none"> a. Bacteria – Isolation, colony characters, Gram staining & motility of <i>Bacillus amyloliquefaciens</i>. b. Fungi – <i>Aspergillus niger</i> and <i>Penicillium chrysogenum</i> mounting & identification. c. Yeasts – <i>Candida albicans</i>, monochrome staining. d. Actinomycetes –cultivation using coverslip technique and direct microscopic observation of <i>Streptomyces griseus</i> 2. Sub culturing of Microorganism by using solid media 3. Demonstration of antimicrobial activity of actinomycetes by the Giant Colony Technique. 4. Bioassay of Penicillin 5. Production of Sauerkraut and estimation of Lactic acid by titrable acidity 	30

Credit II	Microbial Fermentations	
	1. Chemical assay of Penicillin 2. Separation of amino acids by paper chromatography. 3. Separation of sugars by paper chromatography. 4. Demonstration of lab Fermenter 5. Production of citric acid by surface culture method and estimation of citric acid by titrable acidity.	30

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.

List of Minimum Equipment's

- 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 - 2
- 7) pH meter - 1
- 8) Seitz filter – 1
- 9) Centrifuge - 1
- 10) Colorimeter - 1
- 11) Distilled Water Plant – 1
- 12) Laminar air flow cabinet - 1
- 13) Arrangements for gas supply and fitting of two burners portable.
- 14) One working table of 6' x 2½' for two students.
- 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) Colony counter
- 18) Water bath
- 19) One separate instrument room attached to lab (10' x 15')
- 20) One laboratory for one batch including working tables (6' x 2½') per two students for one batch
- 21) Store room (10' x 15')

Practical Examination

- (A) The practical examination will be conducted at the end of each semester on two consecutive days for three hours per day per batch .
- (B) There will be at least one external examiner for practical examination.
- (C) Each candidate must produce a certificate from the Head of the Department in her/his 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.

Theory Examination

Question Paper Pattern (40 Marks) Theory Exam		
Q. No.	Nature / Type of Question	Marks
1.	Multiple Choice Questions (MCQ) 8 Questions	8 Marks (1 Marks for each question)
2.	Write descriptive question Attempt any 2 out of 3 questions	16 Marks (8 Marks for each question)
2.	Write Short Notes Attempt any 4 out of 6 questions	16Marks (4 Marks for each question)
6.	Total Marks	40
