



**VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY**  
JNANASAGARA CAMPUS, BALLARI-583105

**Department of Studies in**  
**Microbiology**

**IV Semester Syllabus**

Bachelor of Science

With effect from 2022-23 and onwards

**Dept Name: Microbiology**  
**Semester-III**  
**DSC4:Industrial Microbiology**

Course Title: Industrial Microbiology	Course code: 21BSC4C4MBL
Total Contact Hours: 52 hours	Course Credits: 04
Formative Assessment Marks: 40	Duration of ESA/Exam: 2 hours
Summative Assessment Marks: 60	

**Course Outcomes (CO's):**

**At the end of the course, students will be able to:**

**Course Outcomes (CO): After completion of this course student should able to**

1. Understand the origin concept of fermentation, and strain development. Understand the construction and design of fermentor and the types of fermentors.
2. Get acquainted with preparation of culture media formulations for the production of metabolites and growth kinetics.
3. Production of purification of microbial products such as enzyme, organic acids, amino acids, antibiotics, alcoholic beverages.
4. Understand the concept of Bioprocess engineering.
5. Learn the basic component of bioprocess engineering includes Upstream and Downstream bioprocess.

**DSC4: Industrial Microbiology**

Unit	Description	Hours
1	Introduction to fermentation technology. Construction and Design of a typical fermenter. Manual and automatic control systems. Design of sterilization process for batch and continuous fermentation.  Types of fermenters- Tower, Jet, Loop, Airlift, Bubble, Column, Packed bed, Fluidized bed.  Types of Fermentations- Surface, Submerged, Solid State, Batch, Continuous, Dual and Fed batch fermentations.	<b>(10 Hrs)</b>
2	Media for industrial fermentations: Criteria, Media formulation, Media ingredients. Buffers, Precursors and Growth factors. Oxygen requirement, Chelaters and Antifoaming agents.  Industrially important Microorganisms, Screening of metabolites. Phases of cell	<b>(12Hrs)</b>

	<p>growth in batch culture. Monod model. Growth of filamentous organisms. Growth associated (primary) and non - growth associated (secondary) product formation Kinetics. Strain development- Mutation, Recombination and Protoplast fusion technique. Inoculum development for industrial fermentation.</p>	
3	<p>Production and purification of few important microbial products: Enzymes (Amylase, Proteases), Organic acids (Citric acid and Vinegar), Amino acids (L-lysine and L-glutamic acid), Antibiotics (Penicillin and Streptomycin), Solvents (Ethyl alcohol, Acetone) Alcoholic beverages (Beer, Wine). Vitamins (Vitamin B<sub>12</sub>).</p>	<b>(8 Hrs)</b>
4	<p>Bioprocess Engineering: Concept and Principles of Bioprocess Engineering. Upstream bioprocess: Major process variables. Optimization of process variables. Strategies for the enhanced production: Immobilization and Response surface methodology.</p>	<b>(10 Hrs)</b>
5	<p>Downstream bioprocess: Filtration-Micro, Cross-flow and Ultra, Centrifugation-High speed, Continuous and Ultra. Cell disruption. Precipitation, Coagulation and Flocculation. Solvent /Aqueous 2-phase extractions, Dialysis and Electrodialysis. Reverse osmosis. SDS-PAGE, Ion Exchange chromatography, HPLC and Gel Filtration, Drying and Crystallization.</p>	<b>(12 Hrs)</b>

**References:**

1. Ali Cinar, S.J. Parulekar, et al., (2003) Batch Fermentation: Modelling, Monitoring, and Control. Marcel Dekker
2. Arnold D & J E. Davies, Atlas. RM 1999 Manual of Industrial Microbiology & Biotechnology 2nd Ed. Berry, D.R. (Ed) 1998 Physiology of Industrial fungi BSP, Oxford University.
3. Crueger & Crueger Biotechnology: A Text Book of Industrial microbiology 2nd edition
4. Casida, Industrial Microbiology
5. Demain, A.L Biology of Industrial Microorganisms 6. Diliello Methods in Food and Dairy Microbiology
7. Harold B. Reisman 1988 Economic Analysis of Fermentation Processes CRC Pr I Llc
8. Vogel A & L. Celeste Todaro 2005 Fermented and Biochemical Engineering Hand Book 2<sup>nd</sup> Standard Publishers Distribution New Delhi
9. Harvey, W., Blanch, S. Clark. 2007 Biochemical Engineering, Marcel Dekker
10. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. 2002. Industrial Microbiology: An Introduction. Blackwell Science.

Date

Course Coordinator

Subject Committee Chairperson

### **DSC 4 : Industrial microbiology Lab**

Course Title: industrial microbiology Lab	Course code: 21BSC4C4MBP
Total Contact Hours:30 Hours	Course Credits: 02
Internal Assessment Marks: 25 Marks	Duration of ESA/Exam:3 hrs
Semester End Examination Marks: 25 Marks	

#### **Course Outcomes (CO's):**

##### **At the end of the course, students will be able to:**

1. Study the fermentation antibiotic penicillin, citric acid production.
2. To learn the isolation and screening of various industrially important microorganisms and production industrially important microbial products.
3. Understand the production of vitamins and alpha amylase.
4. Do Preparation of wine, and immobilized cells.

#### **DSC 9P7 : Bioprocess engineering and industrial microbiology Lab**

##### **List of Experiments**

1. Study of Fermentor and On-line measurement of a fermentation process.
2. Isolation of industrially important microorganisms for microbial processes.
3. Batch fermentation of Citric acid production, recovery and estimation of citric acid.
4. Antibiotic fermentation and estimation of penicillin.
5. Preparation of wine and estimation of alcohol by specific gravity method.
6. Alcoholic fermentation and determination of total acidity and non-reducing sugars
7. Production of Pectinase from *Aspergillus niger* by using Wheat bran, Coffee pulp using small scale fermentor and its assay.
8. Production of  $\alpha$ - Amylase using *A. oryzae*, *Bacillus licheniformis* using Wheat bran in small scale solid state fermentation and its assay
9. Preparation of banana juice using Pectinase.
10. Immobilization of yeast cells by calcium alginate gel entrapment and assay for enzymes Invertase.
11. Preparation of immobilized cells of *B. licheniformis* for the use in the production of alpha amylase.

**References:**

1. Demain, A.L. and Davies, J.E. 1999. Manual of Industrial Microbiology and Biotechnology IInd Edition. ASM Press, Washington.
2. Maheshwari, D.K., Dubey, R.C. and Saravanamtu, R. 2010. Industrial Exploitation of
3. Microorganisms. I.K. International Publishing House. New Delhi.
4. Nduka Okafor 2010. Modern Industrial Microbiology and Biotechnology ASM Publisher
5. Nupur Mathur Anuradha 2007. Industrial Microbiology A Laboratory Manual.
6. Pepler, H.J. and Perlman, D. 2005. Microbial Technology: Fermentation Technology Second Edition Volume 1. Elsevier India Private Limited.
7. Pepler, H.J. and Perlman, D. 2005. Microbial Technology: Fermentation Technology Second Edition Volume 2. Elsevier India Private Limited.
8. Richard H Baltz, Julian E Davies and Arnold L Demain 2010. Manual of Industrial Microbiology and Biotechnology 3e ASM Publisher

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