

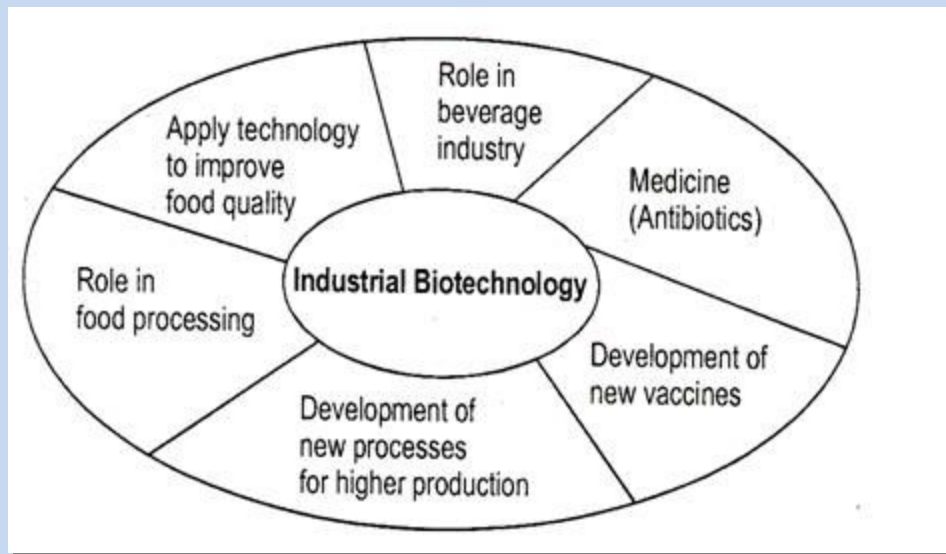
# T.Y B.SC. BIOTECHNOLOGY

*Semester V*

*2015-16*

*Paper: Industrial Biotechnology*

*Paper XI*



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Course taught by: **Ms. Lee-Anne D'Costa**

Assistant professor

Department of Biotechnology

Parvatibai Chowgule College of Arts & Science (Autonomous)

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## COURES HOME

Course Title: **INDUSTRIAL BIOTECHNOLOGY**

Course Code: **Paper XI**

Course taught by: Theory: **Ms. Lee-Anne D'Costa**

Course marks: Theory: 20 (ISA) + 80 (SEE) = 100 marks & Practical: 50 marks

## COURSE SCHEDULE

Number of Lectures/week: Three

Number of Practical/week: One

Classrooms: B - 305

Timings & Days of the week: **Theory**

**Monday, Tuesday, Wednesday – 08:30 – 09:30 a.m**

Timings & Days of the week: **Practical**

Biotechnology Laboratory – **Monday 10:30 – 01:30**

## COURSE OBJECTIVES

**1. INTRODUCTION AND RATIONALE:** Industrial biotechnology, known mainly in Europe as **white biotechnology** is the application of biotechnology for industrial purposes, including manufacturing pharmaceutical products, alternative energy or "bioenergy" and biomaterials. It includes the practice of using cells or components of cells like enzymes to generate industrially useful products. This syllabus module will make the students aware of

various techniques used in this ever growing industry right from the isolation of microorganisms to their cultivation and maintenance and their use in producing economically important products.

**2. LEARNING OUTCOMES:** The students will gain the knowledge of the history and scope of industrial biotechnology. They will understand the basic designing and operational aspects of fermentation processes, as well as the various steps involved in their product recovery. They will also be acquainted with the various methods of assaying economically viable fermentation products and will learn the commercial production of some important fermentation products.

**3. INDICATIVE CONTENTS:** The course starts with the definition, history and scope of industrial biotechnology and advance with the various techniques of primary and secondary screening techniques, followed by the fermentation designing and operational aspects of it. The course then goes on towards the assaying methods of these products and the course finishes with the commercial production of some important fermentation products.

**4. MAIN LEARNING AND TEACHING ACTIVITIES:** The course will be taught with the help of formal lectures, along with power point presentations, quiz, assignments, seminars, surprise tests and group discussions. Video films will be used to give the understanding of the various fermentation production methods.

#### **5. ASSESSMENT AND EVOLUTION DETAILS:**

##### **ISA**

Two ISA's: 20 marks each will be conducted and an average of the two will be taken.

First ISA will be a written examination whereas the second will be assignment.

##### **SEE**

Semester end exams: 80 marks and will be carried out by the Goa university.

**PROJECT WORK:** The project work will be evaluated at the end of VI semester on the following criteria's:

Internal assessment 50 marks

Project Report 20 marks

Field work/ Library work/Practical work 20 marks

Attendance of the student 05 marks

Maintenance of the record by the student of 05 marks

Field work/ Library work/Practical work

EXTERNAL EXAMINOR'S ASSESSMENT 50 marks

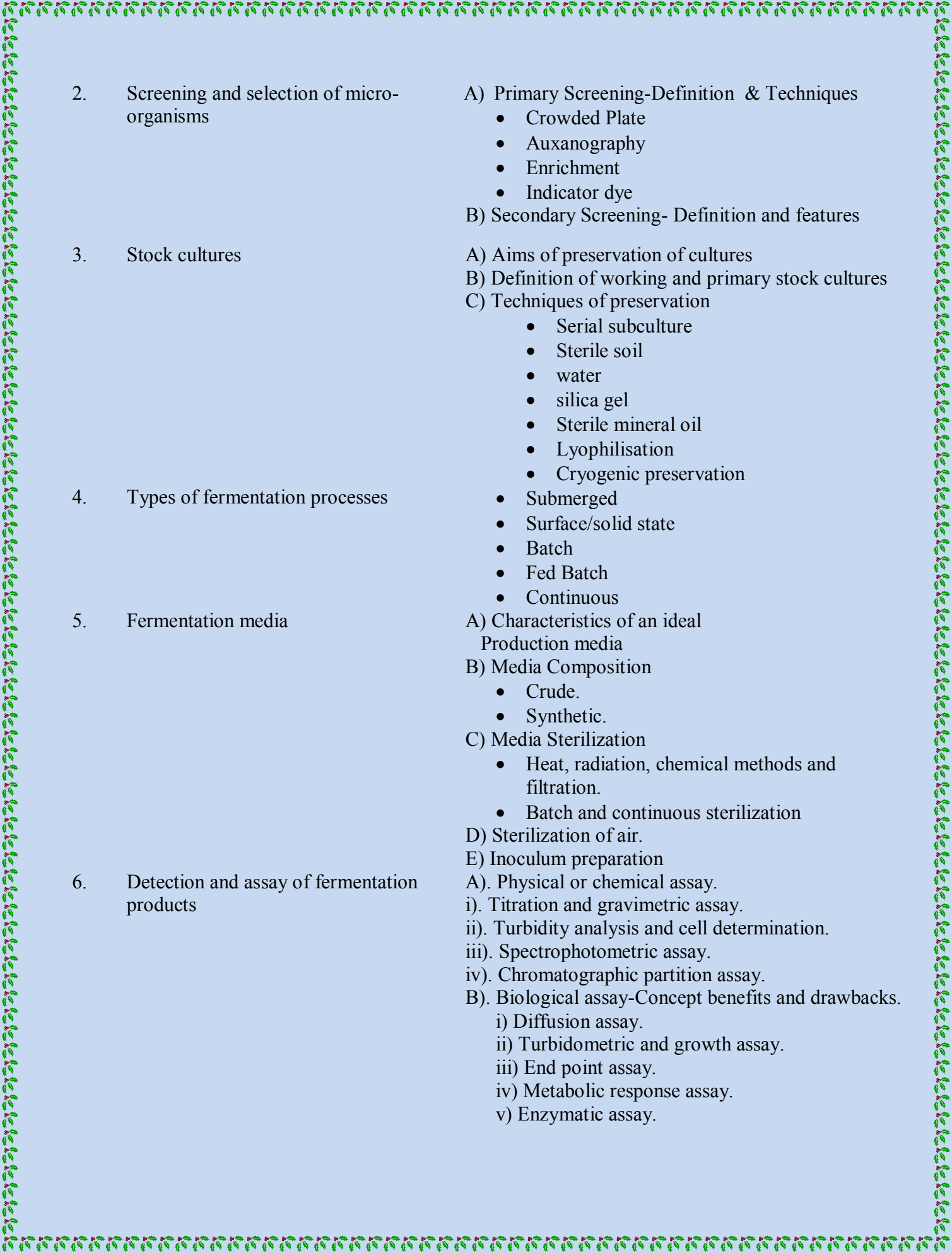
Project Report 25 marks

Viva Voce 25 marks

## SYLLABUS

### Theory

Sr. No.	Topic	Subtopics
1.	Fermentation Equipment and its use	<p>A) Definition of Fermentor/Bioreactors</p> <p>B) Structure of Ideal Fermentor</p> <p>C) Definition and uses of</p> <ul style="list-style-type: none"><li>• Impellers and their types</li><li>• Spargers and their types</li><li>• Baffles</li><li>• Headspace</li></ul> <p>D) Controls and Sensors (temperature, pH, antifoam, dissolved oxygen and carbon dioxide sensor)</p> <p>E) Types of reactors (Definition, description, diagram and uses)</p> <ul style="list-style-type: none"><li>• Stirred Tank reactors</li><li>• Bubble columns</li><li>• Airlift Bioreactors (internal and external loop)</li><li>• Fluidised bed</li><li>• Packed Bed column</li><li>• Photobioreactors</li><li>• Tray bioreactors</li></ul>

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- |    |  |   |
|----|--|---|
| 2. | Screening and selection of micro-organisms   | A) Primary Screening-Definition & Techniques <ul style="list-style-type: none"><li>• Crowded Plate</li><li>• Auxanography</li><li>• Enrichment</li><li>• Indicator dye</li></ul> B) Secondary Screening- Definition and features  |
| 3. | Stock cultures                               | A) Aims of preservation of cultures<br>B) Definition of working and primary stock cultures<br>C) Techniques of preservation <ul style="list-style-type: none"><li>• Serial subculture</li><li>• Sterile soil</li><li>• water</li><li>• silica gel</li><li>• Sterile mineral oil</li><li>• Lyophilisation</li><li>• Cryogenic preservation</li></ul>   |
| 4. | Types of fermentation processes              | <ul style="list-style-type: none"><li>• Submerged</li><li>• Surface/solid state</li><li>• Batch</li><li>• Fed Batch</li><li>• Continuous</li></ul>  |
| 5. | Fermentation media                           | A) Characteristics of an ideal Production media<br>B) Media Composition <ul style="list-style-type: none"><li>• Crude.</li><li>• Synthetic.</li></ul> C) Media Sterilization <ul style="list-style-type: none"><li>• Heat, radiation, chemical methods and filtration.</li><li>• Batch and continuous sterilization</li></ul> D) Sterilization of air.<br>E) Inoculum preparation   |
| 6. | Detection and assay of fermentation products | A). Physical or chemical assay. <ul style="list-style-type: none"><li>i). Titration and gravimetric assay.</li><li>ii). Turbidity analysis and cell determination.</li><li>iii). Spectrophotometric assay.</li><li>iv). Chromatographic partition assay.</li></ul> B). Biological assay-Concept benefits and drawbacks. <ul style="list-style-type: none"><li>i) Diffusion assay.</li><li>ii) Turbidometric and growth assay.</li><li>iii) End point assay.</li><li>iv) Metabolic response assay.</li><li>v) Enzymatic assay.</li></ul> |

7. Scale up of fermentations and increasing product yields
  - A) Significance of scale up.
  - B) Pilot fermentors
  - C) Increasing product yields by mutagens-physical and chemical mutagens/Strain improvement.
8. Quality control
  - Good Manufacturing Practice
  - Factors affecting GMP
  - LAL assay
9. Down stream processing
  1. BIOMASS
    - A) Separation of cells
      - Flocculation
      - Flootation
      - Filter aids and Filtration(Surface, Depth)
      - Centrifugation
        - a) Batch centrifuge eg. tubular bowl centrifuge
        - b) Continuous centrifuge eg. basket centrifuge.
    - B) Disintegration in brief
      - Mechanical:eg Ultrasonication,homogenisers and use of ballotini
      - Non Mechanical:eg. thermal lysis
      - Chemical: eg.detergent solubilisation,organic solvents
      - Enzymatic methods eg. Lysozyme.
  2. BROTH
    - A) Enrichment: evaporation,membrane filtration, liquid-liquid extraction,precipitation,adsorption.
    - B) Purification: Crystallization and Chromatography.
    - C) Drying:
      - Convection drying eg. spray dryers.
10. Industrial Production

Organisms,fermentation media and conditions,downstream. processing and uses.

  - Penicillin
  - Streptomycin
  - Wine
  - Alcohol

## Practical

- 1 Growth curve using fermentor



- 2 Setting up a Batch and fed batch fermentation
- 3 Production of alcohol using jaggery
- 4 Production of vinegar
- 5 Production of wine
- 6 Screening for antibiotic producers and assay
- 7 Industrial visit to a Brewery/Wine Making unit
- 8 Industrial visit to an effluent treatment plant

### **Reference books for theory:**

#### **MANDATORY**

- 1) Casida L.E. ;1968;Industrial Microbiology; New age international (P) limited; New Delhi
- 2) Patel A.H.; 2002;Industrial Microbiology; MacMillan Publication; Bangalore, India
- 3) Cruger A. & Cruger W.; A text book of Industrial Microbiology; Panima Publishing Corporation; New Delhi; India

#### **OPTIONAL**

- 1) Ratlege Collin.; 2006; Basic Biotechnology; Cambridge university press; UK
- 2) Marwaha S.S & Arora J.K; 2002; Food processing: Biotechnological Applications; Asiatec publisher inc. New Delhi, India.
- 3) Prescott and Dunn; 2004; Industrial Microbiology; AVI Publication company .Inc. USA

## **COURSE SCHEDULE**

Number of Lectures/week: Three

Number of Practical/week: One

Classrooms: As on Time Table

Timings & Days of the week: **Theory**

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**Monday, Tuesday, Wednesday – 08:30 a.m**

Timings & Days of the week: **Practical**

Biotechnology Laboratory – **Monday 10:30 – 01:30**

## **TEACHING SCHEDULE**

**T.Y B.Sc Biotechnology (2015-2016)**

**PAPER XI: Industrial Biotechnology**

**Day and Time: Monday, Tuesday, Wednesday 08:30-09:30am**

**Class room: B - 305**

<b>Lecture no</b>	<b>Topics</b>	<b>Reference Books</b>	<b>Page no</b>
1 - 3	<b>Fermentation Equipment &amp; its Use</b>	Cassida & A.H Patel	25-49 64-86
4 - 6	<b>Screening &amp; Selection of microorganisms</b>	Cassida A.H Patel	55-62 15-20
7 - 9	<b>Stock cultures</b>	Cassida A.H Patel	100-113 20-25
10	<b>Revision of chapters 1, 2, 3</b>		
11	<b>Types of fermentation processes</b>	A.H Patel Crueger	6-10
12 - 14	<b>Fermentation media</b>	Cassida A.H Patel	130-132 43-45
15 - 18	<b>Detection and assay of fermentation products</b>	A.H Patel	96-111
19	<b>Scale up of fermentations and increasing product yields</b>	Cassida Cruegar	142-143 60-62
20	<b>Revision of chapters 4. 5. 6. 7</b>		
\	<b>Quality control</b>		



21 - 22			
23 - 31	<b>Down stream processing</b>	Prave	50 -92
32 - 36	<b>Industrial Production</b>	Prescott & Dunns  A. H Patel  Cassida	80 – 82; 85-90   95 - 99
37, 38	<b>Revision of chapters 8, 9, 10 followed by solving previous years question papers</b>		

## References

- 1) Casida L.E. ;1968;Industrial Microbiology; New age international (P) limited; New Delhi
- 2) Patel A.H.; 2002;Industrial Microbiology; MacMillan Publication; Bangalore, India
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- 6) Prescott and Dunn; 2004; Industrial Microbiology; AVI Publication company .Inc. USA