



Department of Biotechnology		
B.E/B.Tech/M.E/M.Tech : <b>Biotechnology</b>	<b>Regulation: 2022</b>	<b>LP: BT22308</b>
<b>PG Specialisation</b> : - NA-		<b>Rev. No: 01</b>
<b>Sub. Code / Sub. Name</b> : BT 22308 / Basic Industrial Biotechnology		<b>Date: 14/06/2024</b>
<b>Unit</b> : I Introduction to Industrial Bioprocess		

**Unit Syllabus: Introduction to Industrial Bioprocess**

**(12 Hrs)**

**Objective:** To understand the various fermentation techniques in bioprocess and learn the hands-on experiment on production of bioproducts.

Session No. #	Topics to be covered	Ref	Teaching Aids
1.	Introduction to biochemical process in industries	RB2 - Ch1 Pg. 1-10 RB6 - Ch1 Pg. 1-12	Black Board / LCD
2.	Biochemistry of fermentation – bacterial, fungal and yeast fermentation	RB2 - Ch1 Pg. 11-52, 553-569	Black Board / LCD
3.	Comparative analysis on Traditional and modern methods of fermentation	TB1 - Ch.19 Pg. 239-269 RB 2 - Ch1 Pg.14-19	Black Board / LCD
4.	Industrially important microorganisms for fermentation processes and their products.	TB1 - Ch. 19 Pg. 239-245 RB2 - Ch.11 Pg. 309-311 TB3 - Ch.14 Pg. 350 RB5 - Ch.1 Pg. 1-10	Black Board / LCD
5.	Fermenter design and configuration	TB1- Ch. 19 Pg.239-269	Black Board / LCD
6.	Upstream and downstream processing	TB1 - Ch. 20 Pg.270-280 TB3 - Ch.14 Pg. 366 RB3 - Ch.5 Pg.74-80 RB3 - Ch.6 Pg.111-123	Black Board / LCD
7.	Preparation and analysis of difference between inoculation media and production media.	RB6 – Ch 6 Pg. 147-167	Demonstration & Experimentation
8.			
9.			
10.	Production of traditional fermentation products	Journal 1	Demonstration & Experimentation
11.			
12.			
<b>Content beyond syllabus covered (if any):</b> Advanced bioprocessing technologies			

\* Session duration: 50 minutes



**Sub. Code / Sub. Name: BT22308/Basic Industrial Biotechnology**  
**Unit : II Production of Primary Metabolites**

**Unit Syllabus:** Production of Primary Metabolites

**(12 Hrs)**

**Objective:** To be familiar with commercial production of Industrial Products and hands-on experiment on production of bioproducts.

Session No *	Topics to be covered	Ref	Teaching Aids
13.	Citric acid production – biosynthesis by microorganisms, strain improvement, industrial process, product recovery and purification	TB1 - Ch.24 Pg.318-322 RB3 - Ch.8 Pg. 134 RB2 - Ch25 Pg.572-601	Black Board / LCD
14.	Lactic acid production - biosynthesis by microorganisms, strain improvement, industrial process, product recovery and purification	TB1 - Ch.24 Pg.325 RB3 - Ch.8 Pg. 147	Black Board / LCD
15.	Acetic acid production and outline of process for production of other commercially important organic acids.	TB1 - Ch.24 Pg.326 RB3 - Ch.8 Pg. 142	Black Board / LCD
16.	Glutamic acid production - biosynthesis by microorganisms, strain improvement, industrial process, product recovery and purification	TB1 - Ch.26 Pg.344-346 RB3 - Ch.8 Pg. 158	Black Board / LCD
17.	Ethanol production – HPLC, electrophoresis, gas chromatography, mass spectroscopy	TB1 - Ch.23 Pg.311-316 RB3 - Ch.7 Pg. 124 RB2 - Ch4 Pg. 113-141	Black Board / LCD
18.	Butanol production – biosynthesis, nutrient preparation, fermentation and distillation of product	TB1 - Ch.23 Pg.311-316 RB3 - Ch.7 Pg. 129	Black Board / LCD
19.	Production of ethanol from yeast	Journal 2	Demonstration & Experimentation
20.			
21.			
22.	Production of organic acid from agricultural waste	RB7 - 415– 438	Demonstration & Experimentation
23.			
24.			
<b>Content beyond syllabus covered (if any): -Nil-</b>			

\* Session duration: 50 mins



**Sub. Code / Sub. Name: BT22308 / Basic Industrial Biotechnology**  
**Unit : III Production of Secondary Metabolites**

**Unit Syllabus: Production of Secondary Metabolites (12 Hrs)**

Secondary metabolites: Production of commercially important secondary metabolites, antibiotics, steroids, and industrial enzymes.

1. Analysis of antibiotic activity by well diffusion/disc diffusion method
2. Production of enzyme by batch fermentation method

**Objective:** To be familiar with commercial production of secondary metabolites and learn the hands on experiment on isolation of product producing microorganisms and production of bioproducts.

Session No *	Topics to be covered	Ref	Teaching Aids
25.	Introduction to secondary metabolite production	RB3 - Ch.13 Pg. 229 TB4 - Ch.18 Pg. 433-456	Black Board / LCD
26.	Overview of production process of antibiotics – antimicrobial activity, mechanism of action, strain development and biosynthesis	RB3 - Ch.13 Pg. 229 TB1 - Ch.25 Pg.329 RB3 - Ch.13 Pg. 230-270	Black Board / LCD
27.	Production process of steroids – corticosteroids, androgens, estrogens and progestogens.	RB3 - Ch.15 Pg. 274 & 292	Black Board / LCD
28.	Introduction to enzyme production – intracellular and extracellular enzymes	TB1- Ch.21 Pg.281-286 TB4 - Ch.20 Pg. 477-497	Black Board / LCD
29.	Production of Proteases – alkaline, neutral and acid proteases	RB3 - Ch.11 Pg. 203	Black Board / LCD
30.	Production of amylases – $\alpha$ amylases, $\beta$ amylases, gluconases, glucose isomerases, isoamylases	RB3 - Ch.11 Pg. 191	Black Board / LCD
31.	Analysis of antibiotic activity by well diffusion/disc diffusion method	Journal 3	Demonstration & Experimentation
32.			
33.			
34.	Production of protease/amylase by batch fermentation method	Journal 4	Demonstration & Experimentation
35.			
36.			
<b>Content beyond syllabus covered (if any):</b> Product formulation strategies of bioproducts			



\* Session duration: 50 mins

**Sub. Code / Sub. Name: BT22308 / Basic Industrial Biotechnology**  
**Unit : IV Production of Modern Biotechnology Products**

### Unit Syllabus: Production of Other Bioproducts (12 Hrs)

Production of biopesticides, biofertilizers, biopolymers, biodiesel, and SCP.

1. Production of biopolymer by batch fermentation method
2. Production of biodiesel

**Objective:** To apply basic biotechnological principles, methods and models to solve biotechnological tasks and learn the hands on experiment on production of bioproducts.

Session No *	Topics to be covered	Ref	Teaching Aids
37.	Production of biopesticides – <i>Bacillus thuringiensis</i> and its effect	RB3 - Ch.15 Pg. 301	Black Board / LCD
38.	Production of biofertilizers – phospho fertilizer, ageto bacter fertilizer, rhizo fertilizer, n <sub>2</sub> fixing fertilizer	TB1 - Ch.52 Pg.645-647	Black Board / LCD
39.	Production of xanthan gum - production, recovery and yield	TB1 - Ch.30 Pg.373-386 RB3 - Ch.16 Pg. 306-315	Black Board / LCD
40.	Production of PHB - production, recovery and yield	TB1 - Ch.30 Pg.373-386 RB3 - Ch.16 Pg. 306-315	Black Board / LCD
41.	Production of biodiesel	Journal 5	Black Board / LCD
42.	Production of SCP – bacteria, fungi, yeast and actinomycetes producing single cell protein	TB1 - Ch.29 Pg.373-381 RB3 - Ch.16 Pg. 306-315	Black Board / LCD
43.	Production of biopolymer by batch fermentation method	Journal 6	Demonstration & Experimentation
44.			
45.			
46.	Production of biodiesel	Journal 5	Demonstration & Experimentation
47.			
48.			

**Content beyond syllabus covered (if any):** Edible vaccine production and application of nanotechnology in bioprocess.

\* Session duration: 50 mins



**Sub. Code / Sub. Name: BT22308 / Basic Industrial Biotechnology**  
**Unit : V Modern Biotechnology Products**

### Unit Syllabus: Modern Biotechnology Products (12 Hrs)

Production of recombinant proteins having therapeutic and diagnostic applications, Bioprocess strategies in plant cell and animal cell culture.

1. Plant cell culture techniques
2. Animal cell culture techniques

**Objective:** To identify and debate the ethical, legal, professional issues in the field of biotechnology and learn the latest application of recombinant protein production, vaccine Production using bioprocess technology.

Session No *	Topics to be covered	Ref	Teaching Aids
49.	Production of recombinant proteins – Protein production, Expression and Problems faced in protein expression.	RB4 - Ch.8 Pg.227-243	Black Board / LCD
50.	Production of recombinant proteins – Protein Biotechnology for production of new structural proteins for industrial application.	RB4 - Ch.8 Pg.227-243	Black Board / LCD
51.	Production of recombinant proteins – Protein expression system, Translational fusion and optimizing translation of clone	RB4 - Ch.8 Pg.227-243	Black Board / LCD
52.	Production of vaccines	RB4 - Ch.8 Pg.286-298	Black Board / LCD
53.	Production of monoclonal antibodies – PEG method to produce hybridoma cells and application in pregnancy and HIV test	RB4. - Ch.8 Pg.286-298	Black Board / LCD
54.	Products of plant cell culture – tissue culture, callus culture, cell suspension culture, anther culture, embryo culture, protoplast culture, micropropagation and Applications. Animal cell culture - cell lines, culturing media, subculturing, Transfecting, Model systems for toxicity testing and cancer research. Products of animal cell culture.	TB1 - Ch.33 Pg. 407-414 & 497-516 TB3 - Ch.12 Pg. 178-202 & 255-307 TB4 - Ch.23 Pg. 549-578 TB5 - Ch.10 Pg. 196-223 RB5. - Ch.12 Pg.159-179	Black Board / LCD
55.	Plant cell culture techniques	Journal 7	Demonstration & Experimentation
56.			
57.			
58.	Animal cell culture techniques	Journal 8	Demonstration & Experimentation
59.			
60.			
<b>Content beyond syllabus covered (if any):</b>			

\* Session duration: 50 mins



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## REFERENCES:

### TEXT BOOKS

1. Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005.
2. Kumar, H.D. "A Textbook on Biotechnology" 2nd Edition. Affiliated East West Press Pvt.Ltd., 1998.
3. Balasubramanian, D. "Concepts in Biotechnology" Universities Press Pvt.Ltd., 2004.
4. Ratledge, Colin and Bjorn Kristiansen "Basic Biotechnology" 3<sup>rd</sup> Edition Cambridge University Press, 2006.
5. Dubey, R.C. "A Textbook of Biotechnology" S.Chand & Co. Ltd., 2022.

### REFERENCE BOOKS

1. Patel, A H. "Industrial Microbiology" Macmillan (P) Ltd., 2005.
2. Presscott, S.C. and Cecil G. Dunn, "Industrial Microbiology", Agrobios (India), 2005.
3. Cruger, Wulf and Anneliese Crueger, "Biotechnology: A Textbook of Industrial Microbiology", 2nd Edition, Panima Publishing, 2000.
4. Moo-Young, Murrey, "Comprehensive Biotechnology", 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.
5. Ramawat K.G. and Shaily Goyal, "Comprehensive Biotechnology", 4<sup>th</sup> Edition S. Chand publications, 2019
6. Stanbury P.F, Whitaker A and Hall S.J, "Principles of Fermentation Technology", 2<sup>nd</sup> Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
7. Sharma, N., Sahota, P.P., Singh, M.P. (2020). Organic Acid Production from Agricultural Waste. In: Kashyap, B.K., Solanki, M.K., Kamboj, D.V., Pandey, A.K. (eds) Waste to Energy: Prospects and Applications. Springer, Singapore. [https://doi.org/10.1007/978-981-33-4347-4\\_17](https://doi.org/10.1007/978-981-33-4347-4_17)

### JOURNAL

1. Rawat, K., Kumari, A., Kumar, S., Kumar, R. and Gehlot, R., 2018. Traditional fermented products of India. *Int J Curr Microbiol App Sci*, 7(4), pp.1873-1883.
2. Maicas, S., 2020. The role of yeasts in fermentation processes. *Microorganisms*, 8(8), p.1142.
3. Balouiri, M., Sadiki, M. and Ibsouda, S.K., 2016. Methods for in vitro evaluating antimicrobial activity: A review. *Journal of pharmaceutical analysis*, 6(2), pp.71-79.
4. Sharma, K.M., Kumar, R., Panwar, S. and Kumar, A., 2017. Microbial alkaline proteases: Optimization of production parameters and their properties. *Journal of Genetic Engineering and Biotechnology*, 15(1), pp.115-126.
5. Chintagunta, A.D., Zuccaro, G., Kumar, M., Kumar, S.J., Garlapati, V.K., Postemsky, P.D., Kumar, N.S., Chandel, A.K. and Simal-Gandara, J., 2021. Biodiesel production from lignocellulosic biomass using oleaginous microbes: Prospects for integrated biofuel production. *Frontiers in Microbiology*, 12, p.658284.
6. Singhaboot, P. and Kaewkannetra, P., 2015. A higher in value biopolymer product of polyhydroxyalkanoates (PHAs) synthesized by *Alcaligenes latus* in batch/repeated batch fermentation processes of sugar cane juice. *Annals of microbiology*, 65(4), pp.2081-2089.
7. Espinosa-Leal, C.A., Puente-Garza, C.A. and García-Lara, S., 2018. In vitro plant tissue culture: means for production of biological active compounds. *Planta*, 248, pp.1-18.
8. Yao, T. and Asayama, Y., 2017. Animal-cell culture media: History, characteristics, and current issues. *Reproductive medicine and biology*, 16(2), pp.99-117.

**REFERENCES:****TEXT BOOKS**

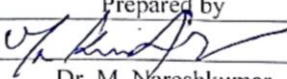
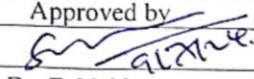
1. Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005.
2. Kumar, H.D. "A Textbook on Biotechnology" 2nd Edition. Affiliated East West Press Pvt.Ltd., 1998.
3. Balasubramanian, D. "Concepts in Biotechnology" Universities Press Pvt.Ltd., 2004.
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7. Sharma. N., Sahota, P.P., Singh. M.P. (2020). Organic Acid Production from Agricultural Waste. In: Kashyap, B.K., Solanki, M.K., Kamboj, D.V., Pandey, A.K. (eds) Waste to Energy: Prospects and Applications. Springer, Singapore. [https://doi.org/10.1007/978-981-33-4347-4\\_17](https://doi.org/10.1007/978-981-33-4347-4_17)

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5. Chintagunta, A.D., Zuccaro, G., Kumar, M., Kumar, S.J., Garlapati, V.K., Postemsky, P.D., Kumar, N.S., Chandel, A.K. and Simal-Gandara, J., 2021. Biodiesel production from lignocellulosic biomass using oleaginous microbes: Prospects for integrated biofuel production. Frontiers in Microbiology, 12, p.658284.
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7. Espinosa-Leal, C.A., Puente-Garza, C.A. and Garcia-Lara, S., 2018. In vitro plant tissue culture: means for production of biological active compounds. Planta, 248, pp.1-18.
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	Prepared by	Approved by
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Designation	Assistant Professor, Biotechnology	HOD, Biotechnology
Date	14/06/2024	14/06/2024
Remarks *	The same lesson plan will be followed in the subsequent semester/year	
Remarks *:	-	

\* If the same lesson plan is followed in the subsequent semester/year it should be mentioned and signed by the Faculty and the HOD

  
9/7/24