Name: Enrolment No:	

UPES

End Semester Examination, December 2024

Course: Fermentation Technology — **Semester : V**

Program: Integrated (B.Sc.-M.Sc.) Microbiology — **Duration : 3 Hours**

Course Code: HSMB3015 — **Max. Marks: 100**

Instructions: Attempt all questions

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q 1	Fermentation technology combines which disciplines? a) Microbiology and chemistry b) Microbiology, biochemistry, and biochemical engineering c) Biophysics and microbiology d) Chemistry and biophysics	1.5	CO1
Q 2	What is fermentation in biological terms? a) Aerobic energy production b) Anaerobic breakdown of glucose c) Cellular respiration using oxygen d) DNA synthesis in prokaryotes	1.5	CO1
Q 3	Modern fermentation technology includes the production of: a) Primary metabolites only b) Secondary metabolites only c) Primary and secondary metabolites d) None of the above	1.5	CO1
Q 4	Solid-state fermentation was first developed for: a) Antibiotic production b) Alcohol production c) Enzyme production d) Vaccine production	1.5	CO1
Q 5	Which of these substrates is used in solid-state fermentation? a) Molasses b) Rice bran c) Glucose solution d) Ethanol	1.5	CO1
Q 6	Why is genetic stability important in microbial culture selection? a) To minimize product variability b) To increase pathogen resistance c) To optimize growth rate	1.5	CO2

	d) To reduce contamination risks		
Q 7	Which of these industries heavily relies on fermentation? a) Textile b) Pharmaceutical c) Automotive d) Mining	1.5	CO2
Q 8	The quality of raw materials affects fermentation primarily by influencing: a) Microbial strain selection b) Yield and efficiency of the fermentation process c) Reactor design d) Pretreatment method choice	1.5	CO2
Q 9	What is the role of cyclic AMP (cAMP) in carbon catabolite repression? a) It represses transcription of genes b) It activates catabolic operons in low glucose conditions c) It inhibits enzyme activity d) It degrades unwanted proteins	1.5	CO2
Q 10	The Crabtree effect is observed in: a) Aerobic conditions with low glucose b) Anaerobic conditions c) Aerobic conditions with high glucose concentrations d) Anaerobic conditions with low oxygen	1.5	CO2
Q 11	Which of the following is NOT a commonly used method for isolating mutants? a) UV irradiation b) Chemical mutagenesis c) Serial dilution d) Transposon mutagenesis	1.5	CO3
Q 12	A commonly used chemical mutagen for inducing mutations is: a) Acridine orange b) Ethyl methanesulfonate (EMS) c) Sodium hydroxide d) Ethanol	1.5	CO3
Q 13	Which medium is commonly used for preserving bacterial mutants in glycerol stocks? a) Minimal medium b) Nutrient-rich medium c) Luria-Bertani (LB) medium d) Synthetic defined medium	1.5	CO3
Q 14	UV irradiation primarily induces mutations by causing: a) Double-stranded DNA breaks b) Formation of thymine dimers c) Deamination of cytosine	1.5	CO3

	d) Incorporation of base analogs		
Q 15	Which of the following fermentation parameters is most critical for the production of citric acid using Aspergillus niger? a) High pH b) High oxygen levels c) Low temperature d) Acidic pH	1.5	CO3
Q 16	Which microorganism is primarily used in the industrial production of lysine? a) *Aspergillus niger* b) *Corynebacterium glutamicum* c) *Penicillium chrysogenum* d) *Saccharomyces cerevisiae*	1.5	CO4
Q 17	Which enzyme is produced industrially by fermentation using Bacillus subtilis and used in detergent formulation? a) Lipases b) Proteases c) Amylases d) Cellulases	1.5	CO4
Q 18	What type of microbial fermentation is most commonly used for the production of amino acids like lysine? a) Solid-state fermentation b) Submerged fermentation c) Both d) Neither	1.5	CO4
Q 19	Which of the following is not a scale-up process? a) Laboratory to pilot-scale b) Pilot-scale to industrial-scale c) Industrial to pilot-scale d) Laboratory to industrial-scale	1.5	CO4
Q 20	Which of the following is not a criterion for the choice of the recovery process? a) Location of the product b) Price of the product c) Use of the product d) Source of organism	1.5	CO4
Section B: Short-Answer Questions (4Qx5M=20 Marks)			
Q 1	Discuss the historical significance of fermentation technology and its evolution into a modern industry.	5	CO1
Q 2	Explain the importance of pretreatment in raw material processing for microbial fermentation. Provide examples of commonly used pretreatment methods.	5	CO2

Q 3	With the help of a workflow diagram, explain the procedure for isolating feedback inhibition-resistant mutants.	5	CO3
Q 4	Briefly explain the process and key parameters for the industrial manufacture of β-lactam antibiotics	5	CO4
Section C: Case study (2Qx15M=30 Marks)			
Q 1	A biotech company, BioFerma Ltd., is exploring advancements in fermentation technology to enhance the production of biopharmaceuticals and industrial enzymes. They aim to address challenges such as low yield, high production costs, and environmental sustainability. The company recently adopted cutting-edge strategies, including the use of genetically engineered microorganisms (GEMs), continuous fermentation processes, and integrated bioprocessing systems. They also experimented with CRISPR-Cas9 technology to enhance microbial strains for high-yield enzyme production and implemented artificial intelligence (AI) tools for real-time monitoring of fermentation parameters. Their primary focus is on producing insulin, protease, and amylase for pharmaceutical and industrial applications. Based on this case study, answer the following questions: A) Describe the benefits of using genetically engineered microorganisms (GEMs) in fermentation processes? Provide two examples of GEMs used in industry. B) How does continuous fermentation differ from batch fermentation, and why might BioFerma Ltd. prefer continuous fermentation for enzyme production? C) Explain the role of CRISPR-Cas9 technology in strain improvement. D) What is the significance of using AI tools for real-time monitoring in fermentation processes? Provide two examples of parameters monitored using AI. E) Discuss challenges does scaling up fermentation processes present, and how can these challenges be addressed?	15 marks (3 marks each)	CO2
Q 2	PharmaBio Solutions, a pharmaceutical company, is exploring the use of microbial transformation to produce corticosteroids. These steroids are vital for treating various conditions, including inflammation, allergies, and autoimmune disorders. Instead of traditional chemical synthesis, which is expensive and environmentally taxing, the company employs Rhizopus arrhizus to transform plant-derived sterols (e.g., stigmasterol) into hydrocortisone.	15 marks (5 marks each)	CO4

	Based on your understanding of fermentation, answer the following questions: A) What is microbial transformation, and why is it advantageous over chemical synthesis for steroid production? B) Explain the role of *Rhizopus arrhizus* in the microbial transformation of steroids. What challenges might arise in scaling up microbial transformation processes, and how can they be addressed? C) How can genetic engineering improve the efficiency of microbial transformation in this context? Discuss the environmental and economic benefits of microbial transformation for pharmaceutical production.		
Section D: Long-Answer Questions (2Qx10M=20 Marks)			
Q 1	A) Define primary and secondary metabolites, giving two examples of each and their industrial significance. B) Compare and contrast feedback repression and feedback inhibition, providing an example for each.	5+5 marks	CO3
Q 2	Explain microbial leaching for metal extraction. Discuss the mechanism, microorganisms involved, and advantages over traditional methods.	10 marks	CO5