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	Who is known as the "Father of Fermentation Technology"? a) Alexander Fleming b) Louis Pasteur c) Robert Koch d) Carl Woese	1.5	CO1
Q 2	The production of penicillin during WWII marked: a) The beginning of biotechnology b) The industrialization of fermentation technology c) The discovery of fermentation d) The first use of genetic engineering	1.5	CO1
Q 3	Submerged fermentation is characterized by: a) Low moisture content b) High moisture content c) No water usage d) No microbial growth	1.5	CO1
Q 4	Solid-state fermentation is most suitable for: a) High-value low-volume products b) Large-volume low-value products c) Alcohol production d) All microbial processes	1.5	CO1
Q 5	Solid-state fermentation is particularly advantageous for: a) Bacterial growth b) Fungal growth c) Virus cultivation d) None of the above	1.5	CO1
Q 6	Which of the following is NOT a secondary metabolite? a) Penicillin b) Vitamin B12 c) Lactic acid	1.5	CO2

	d) Rifamycin		
Q 7	Which mechanism prevents simultaneous utilization of multiple carbon sources? a) Induction b) Carbon catabolite repression c) Feedback inhibition d) Nutritional repression	1.5	CO2
Q 8	Nutritional repression is observed when: a) A nutrient is limited b) An excess of a nutrient inhibits enzyme synthesis c) Microbial growth is slowed d) Enzymes degrade nutrients	1.5	CO2
Q 9	Feedback inhibition-resistant mutants are commonly isolated by: a) Direct selection on minimal media b) Exposure to feedback inhibitors and screening survivors c) Replica plating technique d) Use of antibiotic markers	1.5	CO2
Q 10	The most reliable method for long-term preservation of mutants is: a) Refrigeration b) Cryopreservation in liquid nitrogen c) Serial sub-culturing d) Storage in glycerol stocks at −20°C	1.5	CO2
Q 11	Lyophilization, used for mutant preservation, involves: a) Freezing samples in glycerol b) Drying under vacuum after freezing c) Storing at room temperature d) Sub-culturing onto fresh medium	1.5	CO3
Q 12	Which of the following best describes an induction-resistant mutant? a) A mutant that does not require an inducer for enzyme production b) A mutant resistant to inducers that enhance gene expression c) A mutant unable to grow in minimal medium d) A mutant sensitive to antibiotics	1.5	CO3
Q 13	Which enzyme characteristic is commonly altered in feedback inhibition-resistant mutants? a) Allosteric site specificity b) Active site configuration c) Cofactor requirement d) Substrate binding efficiency	1.5	CO3
Q 14	Spontaneous mutations in microorganisms arise due to: a) Chemical mutagens b) Errors in DNA replication c) UV irradiation d) Induced transposons	1.5	CO3
Q 15	The process of microbial leaching involves:	1.5	CO3

	a) The use of acids to break down ores b) The conversion of solid metals into liquids by microorganisms c) The use of electrochemical methods for metal extraction d) The solubilization of valuable metals from ores using microbes		
Q 16	Which of the following is true regarding the use of *E. coli* for industrial production of insulin? a) It produces insulin naturally b) Recombinant DNA technology is used to express the insulin gene c) *E. coli* is used to express the insulin gene, but the protein is not purified d) *E. coli* is unable to produce insulin	1.5	CO4
Q 17	In the industrial production of ethanol, which is the most common feedstock used? a) Wheat b) Barley c) Corn d) Sugarcane	1.5	CO4
Q 18	Which of the following is not a stage of product recovery? a) Removal of solids b) Isolation of organism c) Purification and concentration d) Cell disruption	1.5	CO4
Q 19	Which of the following is not a criterion for the choice of a recovery process? a) Location of the product b) Price of the product c) Use of the product d) Source of organism	1.5	CO4
Q 20	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
Section B: Short-Answer Questions (4Qx5M=20 Marks)			
Q 1	What are the key criteria for selecting a microbial culture for industrial fermentation processes?	5	CO1
Q 2	Discuss the role of carbon catabolite repression in microbial metabolism and provide an example of its occurrence in bacteria.	5	CO2
Q 3	What are the long-term methods used for preserving mutants to maintain their genetic and phenotypic stability?	5	CO3
Q 4	Briefly describe the industrial process for manufacturing citric acid using *Aspergillus niger*.	5	CO4

Section C: Case study (2Qx15M=30 Marks)			
Q 1	EcoEnergy Pvt. Ltd., a renewable energy company, is working on the industrial-scale production of biofuels to meet the growing demand for sustainable energy sources. The company focuses on second-generation biofuels. To enhance their production process, they have invested in microbial engineering to optimize the degradation of lignin and cellulose. They employ *Clostridium thermocellum* and genetically modified yeast strains to convert biomass into bioethanol and biobutanol efficiently. Additionally, they are exploring algae-based systems for biodiesel production. Based on this case study, answer the following questions: A) What are second-generation biofuels, and how do they differ from first-generation biofuels? Provide two examples of second-generation biofuels. B) What role do microbial strains play in the production of biofuels? Mention an example of a microorganism used and its function C) What are the challenges associated with lignocellulosic biomass conversion, and how can enzymatic cocktails help overcome these challenges? D) What advantages does algae-based biodiesel offer compared to traditional biofuels E) What challenges must be addressed for large-scale biofuel production?	15 marks (3 marks each)	CO2
Q 2	BioTech Innovations, a leading biotechnology company, is working to enhance the production of two commercially valuable metabolites: **Primary Metabolite:** Glutamic acid, used in the food industry as a flavor enhancer (monosodium glutamate, MSG). **Secondary Metabolite:** Erythromycin, an antibiotic produced by Saccharopolyspora erythraea. To increase yield, the company is employing various strategies, including genetic engineering, optimization of fermentation conditions, adaptive laboratory evolution. Challenges faced by the company include managing byproduct formation, ensuring the stability of genetically engineered strains, and minimizing production costs while maintaining high yields. Based on this case study, answer the following questions: A) Describe how feedback inhibition affects the production of glutamic acid and how it can be alleviated in *Corynebacterium glutamicum*.	15 marks (5 marks each)	CO4

	B) Why are fermentation conditions crucial for the overproduction of secondary metabolites like erythromycin? Provide two key parameters that should be optimized. C) Discuss the environmental and economic advantages of optimizing microbial production of primary and secondary metabolites		
Section D: Long-Answer Questions (2Qx10M=20 Marks)			
Q 1	A) Differentiate between submerged fermentation (SmF) and solid-state fermentation (SSF) in terms of process characteristics and applications. B) Define the Crabtree effect and explain its significance in industrial fermentation processes	5+5 marks	CO3
Q 2	What are microbial transformations? Discuss the types, various mechanisms, and their industrial applications of microbial transformations with examples.	10 marks	CO5