

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)**

**CLASS: M TECH  
BRANCH: BIOTECHNOLOGY**

**SEMESTER : II  
SESSION : SP/2023**

**SUBJECT: BE506 BIOPROCESS PLANT DESIGN**

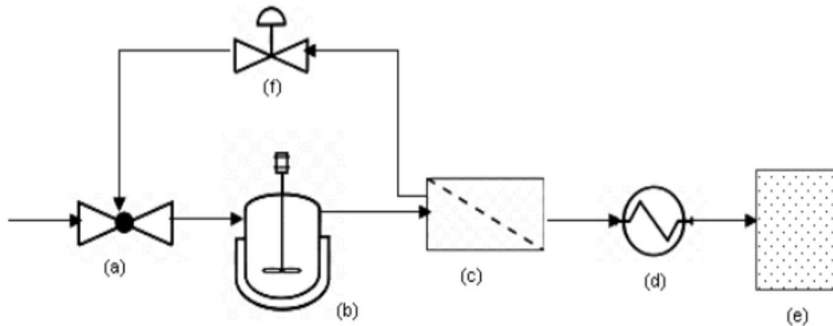
**TIME: 3 Hours**

**FULL MARKS: 50**

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data handbook/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1(a) Symbols are frequently used in bioprocess flow sheet. Referring to a simple flow sheet below, what is the meaning of the following symbols starting from (a),(b),(c), (d), (e) and (f) respectively? [5] BL  
1,4,5



- Q.1(b) Ethanol production through biotechnology route is an age-old method and currently commercialized. Bio ethanol is produced mainly through raw materials using , Sugar Platform (1. Sugarcane, 2. Sugar beet), 3. Starch Platform, 4. Cellulose Platform. Draw a neat flow diagram showing all the unit operations involved in the production of bioethanol, choosing **any two** from the four of the above-mentioned raw materials. [5] 4,5
- Q.2(a) You are working as piping engineer in a dairy processing industry. You have the choice of choosing piping material which will have contact with milk / milk product. The choice of materials are: 1. Copper, 2. Stainless Steel, 3. Ceramic, 4. Plastic. Which one you will choose and why? [5] 3,4,5
- Q.2(b) What is pressure drop in hydraulic system ? You are observing some pressure drop in dairy processing unit. Among the factors mentioned below which are the factors do you think could be responsible for the observed pressure drop? The factors are: (i) long length of pipe, (ii) friction, (iii) fluid type and (iv) losses in valves and bends [5] 4,5
- Q.3(a) Your team is designing a 1000-liter fermenter for a pilot scale operation. You are assigned the task of designing heat transfer equipment to the fermenter. You have the choice to choose between a jacketed type or an immersed coil type of heating. What are the factors you would consider in making your choice and why? [5] 3,4,5
- Q.3(b) How do you define and characterize turbulence in fluid flow [5] 1,2
- Q.4(a) Discuss the five distinct phases of a plant shutdown. [5] 1,2
- Q.4(b) What are the types of plant shut down? What are the procedures you will follow when you are planning to shut down a specific unit of a plant? [5] 1,2,4
- Q.5(a)(i) Zen International has two subsidiaries Company A and Company B. Both companies are into the manufacturing of Air Conditioners and serve two different markets. The company intends to venture into the manufacturing of Air conditioner Coils and decide to price the Product cost by mapping the various expenses to determine the Product cost and the applicable margin (11%) to derive the Selling Price for the same. The company can utilize both the subsidiaries to manufacture Air Conditioner Coils and did break up analysis of Product Costs as shown below: [2.5] 4,5

**PTO**

Particulars	Company A	Company B
Copper coil (Raw material)	\$11,000	\$10,000
Condenser (Per Unit Cost)	\$105	\$100
Two-way filter pipe	\$4,000	\$2,500
Set Box	\$2,500	\$2,300
Direct Material Cost	\$17,605	\$14,900
Technician Salaries	\$3,400	\$4,200
Helper Wages	\$700	\$700
Direct labour Cost	\$4,100	\$4,900
Factory Rent	\$2,300	\$2,400
Administrative Salary	\$2,000	\$1,900
Overhead Cost	\$4,300	\$4,300
Total Product Cost	\$26,005	\$24,100
Units Produced	1000	1000
Product Cost Per Unit	\$26.01	\$24.10
Applicable Profit Margin (in %)	11%	11%
Profit Margin (in \$)	\$2.86	\$2.65
Selling Price	\$28.87	\$26.75

Perform the cost analysis of the company and comment on the resource allocation to maximize the overall profit of Zen International.

- Q.5(a)(ii) In a manufacturing, the following costs are incurred. Classify them under direct, indirect, semi variable costs. Present your analysis in a **table form**. [2.5] 4,5
1. Depreciation or financing payments for equipment
  2. Equipment maintenance
  3. Supervisor and administrator wages
  4. Insurance premiums
  5. Business licenses
  6. Raw materials
  7. Wages for the people manufacturing goods hands on
  8. Credit card and payment processing fees
  9. Outgoing freight
  10. Utilities. .
  11. Bookkeeping and accounting
  12. Legal consultation.

- Q.5(b)(i) Is all overhead cost/s , fixed cost/s ? Justify your answer. [2.5] 4
- Q.5(b)(ii) You are required to classify each of the following costs according to whether they are direct or indirect, with respect to (a) Department and (b) Product line and present in the form of a table for which the template is provided: [2.5] 4,5

Cost	Department	Product line
Salary of restaurant supervisor		
Rent of shop unit		
Depreciation of computer reservation system		
Sales commission		
Purchase of goods for resale in a shop		
Paint for each product		
Oil for central heating system		
Home delivery service costs for supermarket		
Cashiers' wages		
Facilities managers salary		