Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2023

Course: Process Design & Economics **Semester: VI**
Program B. Tech: CE+RP **Time: 03 hrs.**
Course Code: CHCE 3040 **Max. Marks: 100**

Instructions: Assume suitable and necessary data if required and Justify

SECTION A
(5Qx4M=20Marks)

S.No		Marks	CO
Q 1	How does a continuous process differ from a batch process?	**4**	**CO1**
Q 2	What are the objectives of PFD?	**4**	**CO2**
Q 3	Identify factors responsible for process hazards.	**4**	**CO3**
Q 4	List out different types of estimates	**4**	**CO4**
Q 5	What does Gross Refinery Margin (GRM) mean?	**4**	**CO5**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Describe the steps in process design documentation with a neat BFD	**10**	**CO2**
Q 7	Explain safety precautions in design and construction of furnaces.	**10**	**CO3**
Q 8	Estimate by the turnover ratio method, the FCI required for a proposed sulfuric acid plant(battery-limit) which has an annual capacity of 1.3 x 10^8 kg/yr of 100 percent sulfuric acid (Contact process), using the given data, when the selling price for the sulfuric acid is $ 86 per metric ton. The plant will operate 325 days/year. Repeat the calculation, using the cost capacity exponent method Capital cost data for chemical and petroleum processing is as below.	**10**	**CO4**

Process/Product	Process	Size, 10^3 kg/yr (10^3 ton/yr)	FCI, million $	Power factor
Sulfuric Acid	Contact	9 x 10^4	4	0.65

<table>
<tr><td>Q 9</td><td>Elaborate the factors that determine the profitability of a fuel refinery.</td><td>10</td><td>CO5</td></tr>
<tr><td colspan="4">SECTION-C
(2Qx20M=40 Marks)</td></tr>
<tr><td>Q 10</td><td>The annual variable production costs for a plant operating at 70 percent capacity are $280,000. The sum of the annual fixed charges, overhead costs, and general expenses is $200,000, and may be considered not to change with production rate. The total annual sales are $560,000, and the product sells for $4/kg. What is the breakeven point in kilograms of product per year? What are the gross annual profit (depreciation included) and net annual profit for this plant at 100 percent capacity if the income tax rate is 35 percent of gross profit?</td><td>20</td><td>CO4</td></tr>
<tr><td>Q 11</td><td>Instead of flaring the associated natural gas separated along with crude oil, it was decided to recover the lost heat by using the waste-heat recovery system (W.H.R.S.). For pilot test runs, four designs were offered each has a lifetime of 5 years. The minimum annual rate of return desired by the management is 10%. Which of the following design is to be recommended.? The data associated with each design is as follows:
<table>
<tr><td></td><td>Design A</td><td>Design B</td><td>Design C</td><td>Design D</td></tr>
<tr><td>Capital Investment</td><td>10,000</td><td>16,000</td><td>20,000</td><td>26,000</td></tr>
<tr><td>No: of Years</td><td>5</td><td>5</td><td>5</td><td>5</td></tr>
<tr><td>Average Depreciation</td><td>2000</td><td>3200</td><td>4000</td><td>5200</td></tr>
<tr><td>Average Operational Cost</td><td>100</td><td>100</td><td>100</td><td>100</td></tr>
<tr><td>Revenue $/year</td><td>4100</td><td>6000</td><td>6900</td><td>8850</td></tr>
</table></td><td>20</td><td>CO5</td></tr>
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