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

CLASS: BTECH **SEMESTER : V/ADD**
BRANCH: CHEMICAL ENGINEERING **SESSION : MO/2025**
SUBJECT: CL327 PROJECT ENGINEERING & ECONOMICS
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 hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Explain the cash flow in an industrial operation with the help of a neat diagram.	[5]	1	2
Q.1(b)	A rough rule of thumb for the chemical industry is that $1 of annual sales requires $1 of fixed-capital investment. In a chemical processing plant where this rule applies, the total capital investment is $2,500,000 and the working capital is 20 percent of the total capital investment. The annual total product cost amounts to $1,500,000. If the national and regional income-tax rates on gross earnings total 36 percent, determine the following: (a) Percent of total capital investment returned annually as gross earnings. (b) Percent of total capital investment returned annually as net profit.	[5]	1	3
Q.2(a)	It is desired to borrow $1000 to meet a financial obligation. This money can be borrowed from a loan agency at a monthly interest rate of 2%. Determine the following: (a) The total amount of principal plus compounded interest due after 2 years if no intermediate payments are made. (b) The effective interest rate when the interest is compounded monthly.	[5]	2	3
Q.2(b)	A new storage tank can be purchased and installed for $10,000. This tank would last for 10 years. A worn-out storage tank of capacity equivalent to the new tank is available, and it has been proposed to repair the old tank instead of buying the new tank. If the tank were repaired, it would have a useful life of 3 years before the same type of repairs would be needed again. Neither tank has any scrap value. Money is worth 9 percent compounded annually. On the basis of equal capitalized costs for the two tanks, how much can be spent for repairing the existing tank?	[5]	2	3
Q.3(a)	An initial fixed capital of $100,000 and working capital of $10,000 is invested in a project. The estimated life of the project is 5 years. The predicted profit after tax (PAT) is given in the table below. Determine the Net Present Worth (NPW) of the project. Assume rate of interest is 15% annually.	[5]	3	3

Year	1	2	3	4	5
Predicted PAT ($)	30,000	31,000	36,000	40,000	43,000

Q.3(b)	A piece of equipment originally costing $40,000 was put into use 12 years ago. At the time the equipment was put into use, the service life was estimated to be 20 years and the salvage and scrap value at the end of the service life were assumed to be zero. On this basis, a straight-line depreciation fund was set up. The equipment can now be sold for $10,000, and a more advanced model can be installed for $55,000. Assuming the depreciation fund is available for use, how much new capital must be supplied to make the purchase?	[5]	3	3
Q.4(a)	An organic chemical is being produced by a batch operation. Each cycle consists of the operating time necessary to complete the reaction plus a total time of 1.4 h for discharging and charging. The operating time per cycle is equal to $1.5P^{0.25}$ h, where P is the kg of product produced per batch. The operating costs during the operating period are $20 per hour, and the costs during the discharge-charge period are $15 per hour. The annual fixed cost for the equipment varies with the size of the batch as follows: $C_F = 340P^{0.8}$ Inventory and storage charges may be neglected. If necessary, the plant can be operated 24 h per day for 300 days per year. The annual production is 1 million kg of product. At this capacity, raw-material and miscellaneous costs, other than those already mentioned, amount to $260,000 per year. Determine the cycle time for conditions of minimum total cost per year.	[5]	4	3

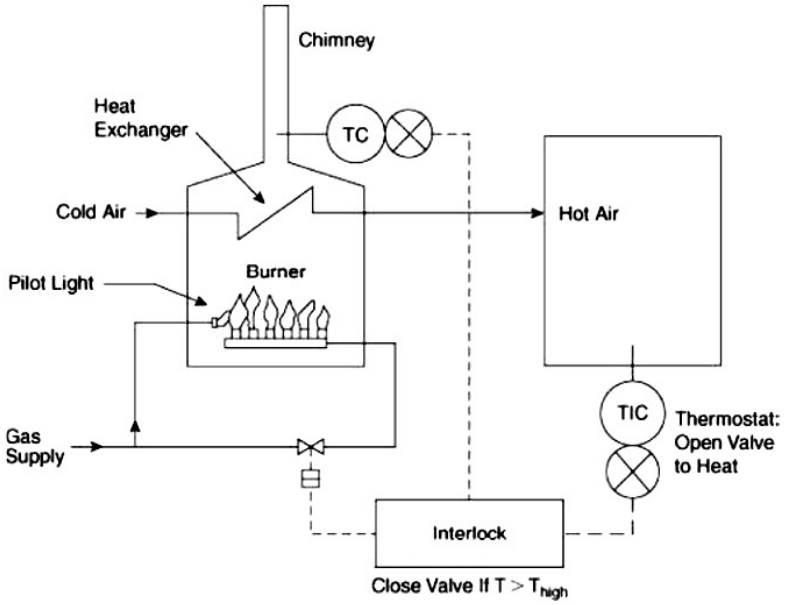
PTO

Q.4(b) A plant produces refrigerators at the rate of P units per day. The variable costs per refrigerator have been found to be \$47.73 + O.1$P^{1.2}$. The total daily fixed charges are \$1750, and all other expenses are constant at \$7325 per day. If the selling price per refrigerator is \$173, determine: (a) The daily profit at a production schedule giving the minimum cost per refrigerator. (6) The daily profit at a production schedule giving the maximum daily profit. (c) The production schedule at the break-even point. [5] 4 3

Q.5(a) Write a short note on Material Safety Data Sheet (MSDS) within ten sentences. [5] 5 2

Q.5(b) A gas fired furnace is shown below in figure. The hot combustion gases pass through a heat exchanger to heat fresh air for space heating. The gas flow is controlled by an electric solenoid valve connected to a thermostat. The gas is ignited by a pilot light flame. A high temperature switch shuts off all gas in the event of high temperature in the fresh air plenum. [5] 5 2

(a) Determine various ways in which this system can fail, leading to excess heating of the plenum and possible fire.
(b) What type of valve is recommended for the gas supply? (normally open or normally closed).
(c) What is the most likely failure mode?



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