B.E. Food Technology and Bio-Chemical Engineering - Fourth Year (Second Semester), 2024

Industrial Management

Duration: 3 hours **Answer any five questions.** **Full Marks: 100**

1. (a) Historical demand for a product is:

Month	April	May	June	July	August	September
Actual demand	60	55	75	60	80	75

i. Using a three-month simple moving average, calculate a forecast for October.
ii. Using a three-month weighted moving average with weights 0.5, 0.3, and 0.2, calculate a forecast for October.
iii. Using a single exponential smoothing with $\alpha = 0.6$ and August forecast = 65, calculate a forecast for October.
(b) What is the purpose of a tracking signal in the context of forecasting practice?
(c) Develop two normal equations based on linear regression analysis and determine the constants' values. [10+3+7]

2. (a) The following data is obtained for a company. Fixed cost = Rs. 3×10^5; variable cost /unit product = Rs. 300; price/unit product = Rs. 500; actual quantity of production produced by the company = 5000 units. Determine the break-even volume, angle of incidence and margin of safety.

(b) Consider a project consisting of seven jobs (A, B, C, D, E, F, and G) with the following precedence relations, and time estimates (days).

Job	Predecessor(s)	Optimistic time	Pessimistic time	Most likely time
A	----	2	8	5
B	A	6	12	9
C	A	5	17	14
D	B	5	11	8
E	C, D	3	9	6
F	-----	3	21	12
G	E, F	1	7	4

Z:	0	0.4	0.8	1.0	1.2	1.6	2.0	2.4	2.8	3.0
Probability:	0.500	0.655	0.788	0.841	0.885	0.945	0.977	0.991	0.997	0.998

Draw the project network based on AOA. What is the expected length of the project and its variance? Compute the probability of completing the project 3 days earlier than the expected time. [6+14]

3. (a) What is linear programming? Define optimal solution and basic feasible solution.
(b) Consider the following LP formulation.
Maximize $Z = 7x1 + 3x2$; subject to: $x1 + 2x2 \geq 3$; $x1 + x2 \leq 4$; $0 \leq x1 \leq 5/2$; $0 \leq x2 \leq 3/2$; and $x1, x2 \geq 0$
(i) Graphically illustrate the feasible solution region and apply the extreme point solution method to indicate which corner point produces the optimal solution. (ii) What is the optimal solution? (iii) Is there more than one optimal solution? Explain. [6+(10+2+2)]

4. Given below is a group of jobs. Develop a network based on AOA for these jobs, minimizing as far as possible the number of dummy activities. Also, determine the critical path. Discuss the significance of the critical path in project management.

Job	A	B	C	D	E	F	G	H	I	J	K	L
Immediate predecessor(s)	----	---- -	A	A	B	C,E	B	C,D	G	G	H,F	I,J
Time (days)	5	4	3	2	2	4	3	6	5	2	2	3

[12+5+3]

5. (a) Determine the initial feasible solution to the following transportation problem by using VAM.

		Destination				Supply
		D1	D2	D3	D4	
Source	S1	1	5	1	1	40
	S2	4	3	6	8	30
	S3	3	2	5	9	40
Demand		30	40	30	10	

(b) A department has six employees with six jobs to be performed. The time (in hrs) each person will take to perform each job is given in the following matrix. How should the jobs be allocated, one per employee, to minimize the total hours? Use the Hungarian method. [8+12]

		Employees					
		1	2	3	4	5	6
Jobs	A	21	5	21	15	15	28
	B	30	11	16	8	16	4
	C	28	2	11	16	25	25
	D	19	16	17	15	19	8
	E	26	21	22	28	29	24
	F	3	21	21	11	26	26

6. (a) Each year a company purchases 18000 units of an item that costs Rs. 16 per unit. The cost of placing an order is Rs. 12, and the cost to hold the item for a year is 30 per cent of the unit cost. Determine (i) the economic order quantity, (ii) the optimal number of orders per year, (iii) the optimal order cycle time, (iv) the average inventory level assuming that the minimum inventory level is zero, and (v) total cost comprising the total ordering cost and the carrying cost if the EOQ is used. (b) Derive the formula of the EOQ you use in part (a). (c) What is the significance of EOQ in inventory management? [10+6+4]

7. (a) Compare between flow shop and job shop scheduling.

(b) Find the optimum sequence of eight jobs for processing them through two work centres in flow shop scheduling. Times at each centre are in hours. Compute the makespan for the optimum sequence of jobs and the corresponding idle times at the two work centres. [4+16]

Jobs	A	B	C	D	E	F	G	H
WC 1	10	8	12	11	10	12	10	5
WC 2	2	7	8	16	8	8	14	3

8. (a) A work operation consisting of three elements has been subjected to a stopwatch time study. The recorded observations are shown in the following table. The allowances for tasks are personal 5%, fatigue 7%, and delay 2%. Determine the normal time and the standard time for the work operation.

Task element	Observations (minutes)					Performance rating (%)
	1	2	3	4	5	
1	0.8	0.6	3.1	0.7	0.8	90
2	0.4	0.5	1.2	0.3	0.6	110
3	1.0	2.1	0.9	1.0	0.9	80

(b) What is 'THERBLIGS'? Discuss its importance in time study. [15+5]

9. (a) The values of the sample mean and the range for ten samples of size 5 each are given in the following table. Draw the corresponding charts from the data and comment on the state of control of the process. If the process is out of control, then, what is to be done? Control limit factors for sample size 5 are as follows: $A_2 = 0.58$, $D_3 = 0$ and $D_4 = 2.115$.

Sample No.	1	2	3	4	5	6	7	8	9	10
Mean	43	49	37	44	45	37	51	46	43	47
Range	5	6	5	7	7	4	8	6	4	6

(b) Discuss ABC analysis in inventory control. [15+5]

END