Subject Code: KOE086

PAPER ID-410203

Roll No: | | | | | | | | | | | | | |

BTECH
(SEM VIII) THEORY EXAMINATION 2023-24
INDUSTRIAL OPTIMIZATION TECHNIQUES

TIME: 3 HRS **M.MARKS: 100**

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. **2 x 10 = 20**

Q no.	Question	Marks	CO
a.	Differentiate between CPM and PERT.	02	2
b.	Differentiate between individual and group replacement policy.	02	5
c.	Define saddle point and optimal strategy.	02	3
d.	Define slack and surplus variables.	02	1
e.	What are various customer behaviors in a queue?	02	3
f.	Discuss the application of Monte Carlo Simulation in engineering.	02	4
g.	Discuss the principle of dominance.	02	3
h.	Define optimistic time, pessimistic time, and most likely time.	02	2
i.	Write the dual of the following primal: Minimize Z= 3x+2y Subjected to: $8x+y \geq 8$, $2x+y \geq 6$, $x+3y \geq 6$, $x+6y \geq 8$, $x, y \geq 0$	02	1
j.	How degeneracy can be determined in a transportation problem?	02	1

SECTION B

2. Attempt any *three* of the following: **3 x 10 = 30**

a.	Solve the following LPP using simplex method. Maximize: $z = 50x + 60y$ Subjected to: $2x + y \leq 300$ $3x + 4y \leq 509$ $4x + 7y \leq 812$ $x, y \geq 0$	10	1
b.	Consider a construction project to build a residential complex. The project consists of the following activities:	10	2

Activity	Description	Predecessors	Duration
A	Site Preparation	-	5
B	Foundation Work	A	10
C	Framing	A	15
D	Plumbing and Electrical	B, C	12
E	Roofing	B	8
F	Exterior Finishing (Siding,	C	10
G	Interior Finishing	D, E, F	15
H	Final Inspection and	G	5

Using the information provided, construct the project network diagram, determine the earliest start time (ES), earliest finish time (EF), latest start time (LS), latest finish time (LF), and the total float for each activity. Identify the critical path(s) and calculate the total duration of the project. Also, analyse the implications if there is a delay in any activity along the critical path.

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c.	Consider a two-person zero-sum game given in the following payoff matrix: Determine if the game has a saddle point. If so, identify the saddle point and the optimal strategy for both players. If the game does not have a saddle point, apply the Maximin and Minimax principles to find the optimal strategies for both players.	10	3
d.	Illustrate the application of Dynamic Programming through examples such as the Capital Budgeting Problem and the Cargo-loading Problem. Explain how DP techniques are used to optimize resource allocation and decision-making in these scenarios.	10	4
e.	Calculate the economical lot size and the minimum total cost in the given problem. A company requires 50000 units per year which costs Rs.10 per unit. Ordering cost is estimated to be Rs.100 per order, and carrying costs are 15% per annum of average inventory. The supplier is prepared to give 2% discount in the price of the original value if the company purchases 10000 units or more but less than 20000 lot size. A further discount of 1% in the price of the original value is available on the order of 20000 or more units.	10	5

	Strategy 1	Strategy 2	Strategy 3
Player 1	3	5	2
Player 2	1	4	6
Player 3	2	3	5

SECTION C

3. Attempt any *one* part of the following: **1 x 10 = 10**

a.	a) Describe the various costs associated with inventory, including holding costs, ordering costs, and shortage costs. b) Differentiate between deterministic and probabilistic (non-deterministic) inventory models.	10	5
b.	The purchase price of a machine is Rs. 52,000. The installation charges amount to Rs. 14400 and its scrap value is Rs. 6400. The maintenance cost in various years is given below: After how many years should the machine be replaced? Assume that the machine replacement can be done only at the year ends.	10	5

Year	Maintenance Cost (₹)
1	1000
2	3000
3	4000
4	6000
5	8400
6	11600
7	16000
8	19200

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4. Attempt any *one* part of the following: 1 x 10 = 10

a.	a) Explain the concept of a single-server queuing model and its components. Discuss the parameters involved in analyzing a single-server queuing system, including arrival rate, service rate, queue length, and waiting time. b) Define two-person zero-sum games and explain how they are represented using payoff matrices. Explain the principle of dominance.	10	3
b.	A self-service store employs one cashier at its counter. Nine customers arrive on an average every 5 minutes while the cashier can serve 10 customers in 5 minutes. Assuming Poisson distribution for arrival rate and exponential distribution for the service time, find: i) Average number of customers in the system. ii) Average number of customers in the queue or average queue length. iii) Average time a customer spends in the system. iv) Average time a customer waits before being served.	10	3

5. Attempt any *one* part of the following: 1 x 10 = 10

a.	Explain the steps involved in Monte Carlo simulation. Discuss the application of Monte Carlo Simulation in engineering.	10	4
b.	Consider a capital budgeting problem where a company needs to decide on the allocation of funds to different investment projects. The company has a budget of $100,000 and five investment options with the following initial investments and expected returns: **Investmen** / **Initial Investment ($)** / **Expected Return ($)** 1 / 20,000 / 30,000 2 / 30,000 / 25,000 3 / 15,000 / 20,000 4 / 25,000 / 35,000 5 / 10,000 / 15,000 Using Dynamic Programming, determine the optimal investment strategy that maximizes the company's expected return within the budget constraint.	10	4

6. Attempt any *one* part of the following: 1 x 10 = 10

a.	Explain the fundamentals of network analysis, including the construction of network diagrams and the rules for drawing them. Illustrate with a practical engineering scenario where network analysis can be applied to plan and manage project activities effectively.	10	2
b.	Consider a manufacturing facility with three machines: M1, M2, and M3. There are four jobs, labelled as Job 1, Job 2, Job 3, and Job 4, that need to be processed on these machines. The processing times (in hours) for each job on each machine are given in the table below: **Job** / **M1** / **M2** / **M3** **Job 1** / 2 / 3 / 1 **Job 2** / 4 / 2 / 3 **Job 3** / 3 / 1 / 2 **Job 4** / 2 / 3 / 4	10	2

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	Assuming that each job must be processed sequentially on the machines in the given order (M1, M2, M3), find the optimal sequence of jobs and calculate the total processing time required.		

7. Attempt any *one* part of the following: 1 x 10 = 10

a.	A distribution company has three warehouses (W1, W2, W3) and four retail stores (S1, S2, S3, S4). The transportation costs in rupees per unit are given in the table below: Each warehouse has a limited supply of goods: W1 can supply 100 units, W2 can supply 150 units, and W3 can supply 200 units. Each store has a demand requirement: S1 requires 100 units, S2 requires 130 units, S3 requires 120 units, and S4 requires 100 units. Use transportation model to determine the optimal allocation of goods from the warehouses to the stores which minimizes the total transportation cost.	10	1
b.	A manufacturing company produces two types of products: Product A and Product B. Each unit of Product A requires 2 hours of labour and 1 hour of machine time, while each unit of Product B requires 1 hour of labour and 3 hours of machine time. The company has 100 hours of labour and 120 hours of machine time available per-week. Product A sells for $50 per unit and Product B sells for $40 per unit. The company wants to maximize its weekly profit. Formulate this problem as a linear programming model and find the optimal production quantities for Products A and B to maximize the weekly profit using the graphical method.	10	1

	S1	S2	S3	S4
W1	6	8	10	9
W2	9	11	7	6
W3	4	5	12	10