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**013702**

**December 2023**

**B.Tech. (ME) VIIIth SEMESTER**

**Operations Research (PCC-ME-702-21)**

Time : 3 Hours]

[Max. Marks : 75

*Instructions :*

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*
4. *Use of calculator is permitted.*

**PART-A**

1. (a) Discuss the different types of models used in operations research. (CO1) (1.5)  
(b) Describe the advantages of operations research in decision making. (CO1) (1.5)  
(c) What do you understand by the term "duality" in linear programming? (CO2) (1.5)  
(d) Provide the general form of Linear Programming problem. (CO2) (1.5)  
(e) How would you identify whether a transportation problem is balanced or unbalanced? (CO3) (1.5)

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- (f) What is the difference between deterministic and probabilistic models? (CO3) (1.5)
- (g) How is the CPM different from PERT? (CO4) (1.5)
- (h) What do you mean by "Free Float" and "Total Float"? (CO4) (1.5)
- (i) What is the role of queuing systems in industries? (CO4) (1.5)
- (j) What makes simulation essential for problem solving? (CO5) (1.5)

### PART-B

2. (a) How would you justify the role of operation research in solving industrial problems? What are steps used in conducting an "operation research" study? (CO1) (10)
- (b) A firm manufactures three products A, B and C. Time to manufacture product A is twice that for B and thrice that for C. If the entire labour is engaged in making product A, 1,600 units of this product can be produced. These products are to be produced in the ratio of 3 : 4 : 5. There is demand for at least 300, 250 and 200 units of products A, B and C and the profit earned per unit is Rs. 90, Rs. 40 and Rs. 30 respectively.
- Formulate the problem as a liner programming problem. (CO1) (5)

3. (a) Two products, A and B are to be machined on three machine tools, P, Q and R. Product A takes 10 hrs on machine P, 6 hrs on machine Q and 4 hrs on machine R. Product B takes 7.5 hrs on machine P, 9 hrs on machine Q and 13 hrs on machine R. The machining time available on P, Q, and R machine tools are 75 hrs, 54 hrs and 65 hrs per week respectively. The producer contemplates profit of Rs. 60 per product A, and Rs. 70 per product B. Formulate LP model for the above problem and show the feasible solutions to the above problem? Estimate graphically/geometrically the optimum product mix for maximizing the profit. Explain why one of the vertices of the feasible region becomes the optimum solution point. (CO2) (5)

(b) A company has three plants at A, B, C which supply to warehouses located at D, E, F, G and H. Weekly plant capacities are 200, 125 and 225 tons respectively. Weekly warehouses requirements are 75, 105, 130, 155 and 85 tons respectively. Unit transportation cost matrix is given below :

To → From ↓	D	E	F	G	H
A	50	82	65	60	35
B	45	70	70	65	50
C	80	45	75	60	40

Determine the optimum cost distribution pattern along with the minimum total cost using Vogel's approximation method. (CO2) (10)

4. A project consists of 7 jobs. Jobs A and F can be started and completed independently. Jobs B and C can start only after job A has been completed. Jobs D, E and G can start only after jobs B, (C and D) and (E and F) are completed, respectively. Time estimates of all the jobs are given in the following table :

Time Estimates (Days)			
Job	Optimistic	Pessimistic	Most Likely
A	3	7	5
B	7	11	9
C	4	18	14
D	4	12	8
E	4	8	6
F	5	19	12
G	2	6	4

Draw the network and determine the critical path, and its expected duration ( $T_e$ ). What is the probability of completing the project in  $T_e$  days? Also, determine the total and free slacks of all the jobs. (CO4) (15)

5. (a) Arrival of machinists at a tool crib are considered to be distributed as Poisson distribution with an average rate of 7 per hour. The service time at the tool crib is exponentially distributed with mean of 4 minutes.
- What is the probability that a machinist arriving at the tool crib will have to wait?
  - What is the average number of machinists at the tool crib?

(iii) The company made a policy decision that it will install a second crib if a machinist has to wait at least five minutes before being served. What should be additional flow of machinist to the tool crib to justify a second tool crib?

(CO4) (10)

(b) Explain the concept of "Little's Law" in queuing theory. (CO4) (5)

6. (a) Consider the following problem and solve it by the simplex method :

$$\text{Maximize } Z = 7X_1 + 6X_2$$

$$\text{Subject to } X_1 + X_2 \leq 4$$

$$2X_1 + X_2 \leq 6$$

$$\text{where } X_1, X_2 \geq 0. \quad (\text{CO2}) (7)$$

(b) Explain the sensitivity analysis with respect to  
(i) Change in constraint matrix (ii) Addition of a new constraint. (CO2) (8)

7. (a) A car manufacturer company sells their manufactured parts in lots of 20,000 parts each. Parts undergo inspection process before shipping them to the customer. Five inspection ratings established for quality control represent the percentage of defective items contained in each lot. The management is considering two possible courses of action :

(i) Shut down the entire plant operations and thoroughly inspect each machine. This action costs Rs. 500.



- (ii) Continue production but offer the customer a refund of Rs. 1 for each defective item that is detected and returned.

Rating	Proportion of defective items	Frequency
Excellent (A)	0.03	25
Good (B)	0.06	30
Acceptable (C)	0.10	20
Fair (D)	0.15	20
Poor (E)	0.20	5

What is the optimum decision for the company? Also find the expected value of perfect information (EVPI). (CO5) (10)

- (b) Briefly explain the Monte Carlo simulation with suitable example. (CO5) (5)