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10ME74

Seventh Semester B.E. Degree Examination, Dec.2015/Jan.2016
Operations Research

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Use of Normal distribution tables is permitted.

PART – A

1 a. The following are the two constraints for the LPP under consideration:
$x_1 - x_2 \geq 1$; $x_1 + x_2 \geq 7$; and $x_1, x_2 \geq 0$
using the graphical method, answer the following questions:
i) What are the extreme points for the feasible region?
ii) If the problem has an objective function, maximize $z = 3x_1 + x_2$, what is the optimal point?
iii) If the problem has an objective function, minimize $z = 3x_1 + x_2$, what is the optimal point. **(10 Marks)**

b. Solve the following problem using graphical method maximize $Z = 2x_1 + 3x_2$
Subject to constraints : $2x_1 + x_2 \leq 6$; $x_1 - x_2 \geq 3$; $x_1, x_2 \geq 0$ **(06 Marks)**

c. List any four characteristics of a good model. **(04 Marks)**

2 a. Solve the following LPP by Big – M method.
Maximize $Z = 30000x_1 + 20000x_2$
Subject to : $x_2 \leq x_1 + 3$; $x_2 \leq 6$; $x_2 \geq 2$; $x_1 + 2x_2 \leq 18$;
$2x_1 + x_2 \leq 24$ and $x_1, x_2 \geq 0$ **(14 Marks)**

b. Write the dual for the following primal.
Minimize $Z = 25000x_1 + 35000x_2$
Subject to : $50x_1 + 60x_2 = 2500$; $80x_1 + 60x_2 \geq 3000$; $100x_1 + 200x_2 \geq 7000$
Non-negativity constraints : $x_1, x_2 \geq 0$ **(06 Marks)**

3 a. A product is produced by four factories A, B, C & D. The unit production costs in them are ₹2, ₹3, ₹1 and ₹5 respectively. Their production capacities are: Factory A : 50 units ; B : 70 units ; C = 30 units and D : 50 units. These factories supply the product to four stores, the demand of which are 25, 35, 105 and 20 units respectively. Unit transportation cost in rupees from each factory to each store is given in the table below.

		Stores			
		1	2	3	4
Factories	A	2	4	6	11
	B	10	8	7	5
	C	13	3	9	12
	D	4	6	8	3

Determine the extent of deliveries from each of the factories to each of the stores so that the total production and transportation cost is minimum. **(12 Marks)**

b. Four machines M_1 , M_2 , M_3 and M_4 are to be installed in a machine shop. There are five vacant places A, B, C, D and E. Owing to the limitations machine M_2 cannot be placed at C and M_3 cannot be placed at A. The assignment cost of machine i to place j in rupees (1000) is shown below.

	A	B	C	D	E
M_1	4	6	10	5	6
M_2	7	4	-	5	4
M_3	-	6	9	6	2
M_4	9	3	7	2	3

Find the optimal assignment schedule. **(08 Marks)**

4 Solve the below given integer programming problem:

Maximize $Z = 4x_1 + 6x_2 + 2x_3$

Subject to $4x_1 - 4x_2 \leq 5$

$-x_1 + 6x_2 \leq 5$

$-x_1 + x_2 + x_3 \leq 5$

$x_1 , x_2 , x_3 \geq 0$ and x_1 , x_3 are integers. **(20 Marks)**

PART – B

5 Following data refer to a project:

Activity	Immediate Predecessor	Optimistic Time (Hrs)	Most likely Time(Hrs)	Pessimistic Time (Hrs)
A	-	4	6	8
B	-	1	4.5	5
C	A	3	3	3
D	A	4	5	6
E	A	0.5	1	1.5
F	B, C	3	4	5
G	B, C	1	1.5	5
H	E, F	5	6	7
I	E, F	2	5	8
J	D, H	2.5	2.75	4.5
K	G, I	3	5	7

a. Draw the network diagram

b. Find out the ES, EF, LS, LF and slack for each activity.

c. Find out the variance and standard deviation for the critical path.

d. Determine the probability of completing the project in 24 hrs. **(20 Marks)**

6 a. Mention and discuss seven elements of a queing system. **(07 Marks)**

b. Define : (i) Balking (ii) Renegging (iii) Jockeying **(03 Marks)**

c. On an average 96 patients per 24 – hours day require the service of an emergency clinic. On an average a patient requires 10 minutes of active attention. The facility can handle only one emergency at a time. Suppose that it costs the clinic ₹100 per patient treated to obtain an averaging service time of 10 minutes and that each minute of decrease in this average time would cost the clinic ₹10 per patient treated. How much would have to be budgeted by the clinic to decrease the average queue size from $1\frac{1}{3}$ patients to $\frac{1}{2}$ patient? **(10 Marks)**

7 a. What are the characteristics of games? **(04 Marks)**

b. Solve the following game by the dominance rule.

A's Strategy \ B's strategy	b_1	b_2	b_3
a_1	12	- 8	- 2
a_2	6	7	3
a_3	- 10	- 6	2

Can we formulate the above game as LPP and solve it by simplex / Big-M method? If yes, discuss how? **(08 Marks)**

c. Solve the following game using graphical approach:

A's Strategy \ B's Strategy	b_1	b_2	b_3	b_4
a_1	8	5	- 7	9
a_2	- 6	6	4	- 2

(08 Marks)

8 a. You are given the following data regarding the processing times of some jobs on three machines I, II and III. The order of processing is I – II – III. Determine the sequence that minimizes the total elapsed time required to complete all the jobs. Mention clearly the total elapsed time and the idle time of machine II and III.

Processing Time (Hours)

Job	Machine		
	I	II	III
A	3	4	6
B	8	3	7
C	7	2	5
D	4	5	11
E	9	1	5
F	8	4	6
G	7	3	12

(10 Marks)

b. Madan Mathur is the supervisor of legal-copy-express, which provides copy services for downtown Los Angeles law firms. Five customers submitted their orders at the beginning of the week and are as follows. Schedule the jobs as per i) EDD rule ii) SPT rule and iii) Slack-time remaining per operation rule. Which rule gives the best result in terms of mean-flow-time?

Job (In order of arrival)	A	B	C	D	E
Processing Time (Days)	3	4	6	2	1
Due date (Days hence)	5	6	7	9	2

(10 Marks)

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