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10ME74

Seventh Semester B.E. Degree Examination, June/July 2016
Operations Research

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. A cargo plane has 3 compartments for storing cargo: front, centre and rear. These compartments have the following limits on both weight and space.

Compartment	Weight capacity (in Tonnes)	Space capacity (in cubic meters)
Front	10	6800
Centre	16	8700
Rear	8	5300

Furthermore, the weight of the cargo in the respective compartments must be the same proportion of that compartment's weight capacity to maintain the balance of the plane. The following four cargoes are available for shipment on the next flight:

Cargo	Weight (Tonnes)	Volume (Cubic meters)	Profit (£/Tonne)
C_1	18	480	310
C_2	15	650	380
C_3	23	580	350
C_4	12	390	285

Any proportion of these cargoes can be accepted. The objective is to determine how much of each cargo C_1 , C_2 , C_3 and C_4 should be accepted and how to distribute each among the compartments so that the total profit for the flight is maximized.
Formulate the above problem as a linear program. **(10 Marks)**

b. Solve the following problem using graphical method.
Maximize $Z = 2x_1 + 3x_2$
Subject to $2x_1 + x_2 \leq 6$
$x_1 - x_2 \geq 3$
$x_1 , x_2 \geq 0$ **(10 Marks)**

2 a. Solve the following linear programming problem using simplex method.
Maximize $Z = 6000x_1 + 4000x_2$
Subject to $4x_1 + 3x_2 \leq 360$
$2x_1 + x_2 \leq 160$
$2x_1 + 3x_2 \leq 300$
$x_1 , x_2 \geq 0$ **(12 Marks)**

b. Solve by dual simplex method the following problem.
Minimize $Z = 2x_1 + 2x_2 + 4x_3$
Subject to $2x_1 + 3x_2 + 5x_3 \geq 2$
$3x_1 + x_2 + 7x_3 \leq 3$
$x_1 + 4x_2 + 6x_3 \leq 5$
$x_1 , x_2 , x_3 \geq 0$ **(08 Marks)**

3 a. A product is produced by four factories A, B, C & D. The unit production counts in them are A – 50 units; B – 70 units; C – 30 units and D – 50 units. These factories supply the product to four stores, demands of which are 25, 35, 105 and 20 units respectively. Unit transport cost in Rupees from each factory to each store is given below.

	1	2	3	4
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 factory to each of the stores so that the total production and transportation cost is minimum. **(12 Marks)**

b. Four new machines M_1, M_2, M_3 & M_4 are to be installed in a machine shop. There are five vacant places A, B, C, D & E. Because of limited place, machine M_2 cannot be placed at C and M_3 cannot be placed at A. C_{ij} , the assignment cost of machine i to place j in dollars 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 optimum assignment schedule. **(08 Marks)**

4 Solve the following using Gomory's cutting plane algorithm.

Maximize $Z = 20000x_1 + 30000x_2$

Subject to $2x_1 + x_2 \le 6$; $x_1 + 2x_2 \le 8$; $x_1 - x_2 \le 1$; $x_1 \le 2$

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

PART – B

5 a. A project schedule has the following characteristics:

Activity	Time (Weeks)	Activity	Time (Weeks)
1 – 2	4	5 – 6	4
1 – 3	1	5 – 7	8
2 – 4	1	6 – 8	1
3 – 4	1	7 – 8	2
3 – 5	6	8 – 10	5
4 – 9	5	9 – 10	7

i) Construct the network and compute E & L for each event.

ii) Find the critical path and project duration. **(12 Marks)**

b. What are the characteristics of a project? Also define the PERT and crashing cost. **(08 Marks)**

6 a. Define five operating characteristics of a queueing system. **(10 Marks)**

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 service time, find

i) Average no. of customers in the system.

ii) Average no. of customers in the queue.

iii) Average time a customer spends in the system.

iv) Average time a customer waits before being served. **(10 Marks)**

7 a. Reduce the following game by dominance and find the game value. **(10 Marks)**

		Player B			
		1	2	3	4
Player A	1	3	2	4	0
	2	3	4	2	4
	3	4	2	4	0
	4	0	4	0	8

b. Solve the following game by the graphical method. **(10 Marks)**

		Player B			
		1	2	3	4
Player A	1	3	3	4	0
	2	5	4	3	7

8 a. Six jobs A, B, C, D, E & F have arrived at one time to be processed on a single machine. Assuming that no new jobs arrive thereafter, determine

Job	A	B	C	D	E	F
Processing Time (in minutes)	7	6	8	4	3	5

i) Optimal sequence as per SPT rule
ii) Completion time of the jobs
iii) Mean flow time
iv) Avg. in process inventory.

(08 Marks)

b. There are seven jobs, each of which has to go through the machines A & B in the order AB. Processing times in hours are given as

Job	1	2	3	4	5	6	7
Machine A	3	12	15	6	10	11	9
Machine B	8	10	10	6	12	1	3

Determine a sequence of these jobs that will minimize the total elapsed time. Also find the idle time for both the machines.

(12 Marks)

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