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# Manipal Institute of Technology, Manipal



(A Constituent Institute of Manipal University)

## VI SEMESTER B.TECH END SEMESTER EXAMINATIONS, MAY 2016

### SUBJECT: BASICS OF OPERATIONS RESEARCH [MME - 378] (Open Elective)

#### **REVISED CREDIT SYSTEM**

Time: 3 Hours

MAX. MARKS: 50

### Instructions to Candidates:

- Answer ANY FIVE FULL the questions.
- Missing data may be suitably assumed.
- **1A.** Write short note on (i) PERT and CPM (ii) Event times and Activity Times in **05** Project network.
- 1B. An alloy is made from steel and scrap metal costing Rs.3000 and Rs.1000 per ton respectively. The technological requirements of the alloy are (1) a minimum of 1 ton of steel is required for every 2 tons of scrap (2) 1 hour of processing time is required for each ton of steel and 4 hours for each ton of scrap (3) steel and scrap combine linearly to make the alloy. The process loss from steel is 10% and loss from scrap is 20%. A minimum of 40 tons of alloy must be manufactured. Formulate L.P. Problem and draw the first simplex tableau. Show the key column and key row. Do not solve.
- 2A. State the significance of and attach physical interpretation to (i) slack variables 05 (ii) surplus variables (iii) Artificial variables . What should be their objective function coefficients in Minimization and Maximization problems? Justify your answer
- **2B.** A company produces two models of electronic gadgets X<sub>1</sub> and X<sub>2</sub>, using **05** resisters, capacitors and chips. The L.P.Problem is formulated as

Maximize Z =  $30 X_1 + 40 X_2$  (Total profit) Subject to  $2X_1 + 3X_2 \le 1200$  (Maximum Resisters available)  $2X_1 + 1X_2 \le 1000$  (Maximum Capacitors available)  $4X_2 \le 800$  (Maximum Chips available)  $X_1 X_2 \ge 0$ 

Given below the optimal tableau for the above problem.

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	Basis	Q	X <sub>1</sub>	X <sub>2</sub>	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>
30	X <sub>1</sub>	450	1	0	-1/4	3/4	0
0	S <sub>3</sub>	400	0	0	-2	2	1
40	X <sub>2</sub>	100	0	1	1/2	-1/2	0
	Zj	17500	30	40	25/2	5/2	0
		C <sub>j</sub> - Z <sub>j</sub>	0	0	- 25/2	- 5/2	0

40

0

0

c) Value of the game

0

- a) Conduct sensitivity analysis w.r.t RHS values.
- b) If the management plans to secure additional units of only one of the resources, which should it be and how much should it be?
- c) Perform sensitivity analysis w.r.t profit coefficients.

**C**<sub>i</sub> :

30

- **3A.** Explain with an example an Unbounded L.P. problem and show how it is **02** reflected in the final simplex tableau.
- 3B. A company has 3 plants whose monthly capacities are 12, 17 and 11 units of a 05 product respectively. The product is shipped to 4 distribution centres. Each centre needs to receive 10 shipments per month. The distance (in 00's kms) from each plant to the respective centre is given below

Distribution o	1	2	3	4	
Plant	1	8	13	4	7
	2	11	14	7	10
	3	6	12	8	9

- i) Determine optimal transportation schedule using transportation algorithm and total distance at the optimum. ii) Find the alternate optimum if any.
- **3C.** With a numerical example explain the following w.r.t. Game theory Models:
  - a) Pay off Matrix b) Rule of dominance
  - d) Saddle point e) Mixed strategy Game. f) Optimal plan
- **4A.** The table below gives cost of assigning 4 workers to 4 machines. Worker A **05** cannot handle machine 4 and worker B cannot handle machine 3. Using Assignment Algorithm, find the optimal assignment and total cost at the optimum.

Machine: 1	2	3	4
Worker A 12	2 3	6	x
B 4	11	x	5
C 8	2	10	9
D 5	7	8	6

03

- 4B. A Company has one repairman to repair machine break downs that occur on 05 average of 6 per day in Poisson fashion. He can service on average 8 machines per day. The repair time distribution follows Exponential distribution. Determine
  - (a) Expected number of machines in the system
  - (b) Expected down time per machine.

(c) Probability that more than two machines are down and waiting to be repaired.

(d) The down time cost of the machine is Rs.1000 per hour and repairman is paid Rs.200 per hour. Do you recommend employing one more repair man?

**5A.** Solve the following 2 person zero sum game and find the value of the game. **03** 



Explain the criteria you have used in solving the game?

**5B.** Using Monte Carlo technique, simulate the waiting line problem given below **05** (one server, unlimited queue length FIFO, single line).

The distribution of inter arrival time (IAT) in minutes is given as:

IAT	1	2	3	4	
Probability	0.15	0.25	.0.35	0.25	

The distribution of service time (ST) in minutes is as shown below

ST	2	3	4
Probability	0.4	0.4	0.2

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Simulate the system for ten customers using the Random numbers given below:

Random number for IAT :	46	20	25	24	46	37	09	02	40	89
Random numbers for ST :	20	31	16	66	59	43	91	34	92	78
From the simulated data, o	leter	mine	mea	an wa	aiting	time,	me	an s	syste	m time,
server utilization. Are the res	sults	obtai	ned	reliab	le? G	ive yo	our c	omn	nent.	

- 5C. Write a note on the need for introducing dummy row and dummy column while 02 solving transportation problem. Give the physical interpretation of allocations made in the dummy cells.
- 6A. Give an account of information requirements and assumptions to formulate 05 waiting line models. Also briefly explain their operating characteristics.

**6B.** Table below shows time and predecessor for 8 jobs involved in an assembly **05** operation.

Job	Α	B	С	D	E	 F	G	Н
Time (days)	7	2	9	5	9	8	6	5
Predecessors			A	A	A	B, C	D	E, F, G

(i) Draw the network. Which jobs are on critical path?

(ii) Find activity times, and total, free, and independent floats for the noncritical activities.

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