

Code: 9E00207

MBA II Semester Supplementary Examinations February 2014

### OPERATIONS RESEARCH

(For students admitted in 2010, 2011 and 2012 only)

Time: 3 hours

Max. Marks: 60

Answer any FIVE questions  
All questions carry equal marks

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- 1 (a) Define operations research. How OR is useful for decision makers?  
(b) What is meant by mathematical model of a real solution? Discuss the importance of model in the solution of OR problems.
- 2 (a) Consider a small plant which makes two types of automobiles parts, say A and B. It buys casting that is machined, bored and polished. The capacity of machining is 25 per hour for A and 24 per hour for B, capacity of boring is 28 per hour for A and 35 per hour for B and the capacity of polishing is 35 per hour for A and 25 per hour for B. Casting for part A cost Rs. 2 and sells for Rs. 5 each and those for part B cost Rs. 3 and sells for Rs. 6 each. The three machines have running cost of Rs. 20, Rs. 14 and Rs. 17.50 per hour. Assuming that any combination of parts A and B can be sold, formulate this problem as an LP model to determine the product mix which would maximizes profit.

- (b) Comment on the solution of the following LP problem:

$$\text{Maximize : } Z = 4X_1 + 2X_2$$

$$\text{subject to : } -X_1 + 2X_2 \leq 6, -X_1 + X_2 \leq 2 \text{ and } X_1, X_2 \geq 0.$$

- 3 (a) A company has received a contract to supply gravel to three new construction projects located in towns A, B and C. The construction engineers have estimated that the required amount of gravel which will be needed at these construction projects are:

Project location	Weekly requirement
	(truck loads)
A	72
B	102
C	41

The company has 3 gravels pits located in town X, Y and Z. The gravel required by the construction projects can be supplied by three pits. The amount of gravel that can be supplied by each pit is as follows:

Plant	:	X	Y	Z
Amount available (truck loads):		76	82	77

The company has computed the delivery cost from each pit to each project site. These costs (in Rs) are shown in the following table:

		Project location		
		A	B	C
Pit	X	4	8	8
	Y	16	24	16
	Z	8	16	24

Schedule the shipment from each point to each project in such a manner that it minimizes the total transportation cost within the constraints imposed by pit capacities and project requirements. Also find the minimum cost.

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- 3 (b) A department of a company has five employees with five jobs to be performed. The time (in hours) that each man takes to perform each job is given in the effectiveness matrix.

		Employees				
		U	V	W	X	Y
Jobs	A	10	5	13	15	16
	B	3	9	18	13	6
	C	10	7	2	2	2
	D	7	11	9	7	12
	E	7	9	10	4	12

How should the job be allocated, one per employee, so as to minimize the total man-hours?

- 4 The personnel manager of a manufacturing company is in the process of filling 175 jobs in six different entry level skills due to the establishment of a third shift by the company. Union wages scale and requirement for the skills are shown in the following table:

Entry level skills	Pay scale and skills requirements					
	A	B	C	D	E	F
Wage scale	1,000	1,100	1,200	1,300	1,400	1,500
Rs/month	25	29	31	40	33	17
No. required						

230 applicants for the jobs have been tested and their aptitudes and skills for the jobs in question have been matched against company standards and evaluated. The applicants have been grouped into four categories by their abilities; the grouping and the values of each category to the company shown in the table below:

Applicants	Category value (Rs per month)						Number of applicants
	A	B	C	D	E	F	
U	1,000	1,100	1,500	1,400	1,400	1,450	54
V	1,200	1,250	1,200	1,350	1,400	1,400	54
	1,000	1,100	1,200	1,400	1,500	1,600	45
④	1,500	1,500	1,600	1,400	1,400	1,500	74

How many applicants of each category should the personnel manager hire and for which post?

- 5 Assume that two firms are competing for the market share for a particular product. Each firm is considering what promotional strategy to employ for the coming period. Assume the following payoff matrix describe the increase in market share of firm A and the decrease in market share for firm B. Determine the optimal strategies for each firm.

Firm A	Firm B		
	No promotion	Moderate	Much
Promotion			
No promotion	5	0	-10
Moderate promotion	10	6	2
Much promotion	20	15	10

- (a) Which firm would be the winner, in terms of market share?  
 (b) Would the solution strategies necessary maximize the profit for either of the firm?

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- 6 (a) Find the sequence that minimize the total elapsed time and processing time in hours required to complete the following jobs:

Job	1	2	3	4	5	6
Machine A	4	8	3	6	7	5
Machine B	6	33	7	2	8	4

- (b) Find the optimal sequence for the following sequence problem of four jobs and five machines (when passing is not allowed) of which processing time (in hrs) is as follows:

Job	1	2	3	4
Machine M <sub>1</sub>	6	5	4	7
Machine M <sub>2</sub>	4	5	3	2
Machine M <sub>3</sub>	1	3	4	2
Machine M <sub>4</sub>	2	4	5	1
Machine M <sub>5</sub>	8	9	7	5

Also find the total elapsed time.

- 7 (a) Queuing theory can be effective in determining optimal service levels. Elucidate this statement with the help of an example.
- (b) Patients arrive at a clinic according to a Poisson's distribution at the rate of 30 patients per hour. The waiting does not accommodate more than 14 patients. The examination time per patient is exponential with mean rate of 20 per hour.
- Find the effective arrival rate at the clinic.
  - What is the probability that an arriving patient will not wait? Will he find a vacant seat in the room?
  - What is the expected waiting time until a patient is discharged from the clinic?

- 8 (a) Draw the network diagram from the following list of activities:

Activity	Predecessor Activity			
	Set-1	Set-2	Set-3	Set-4
A	-	-	-	-
B	-	-	-	A
C	-	-	-	A
D	A	A	A	B
E	B	A, B	A, B	B
F	B, C	A, B, C	B, C	D, E
G	D, E, F	D, E, F	C	D
H	E, F	F	D, E, F	C, F, G

- (b) A small project consists of seven activities, the details of which are given below:

Activity	Duration (days)			Immediate predecessor
	Most likely	Optimistic	Pessimistic	
A	3	1	7	-
B	6	2	14	A
C	3	3	3	A
D	10	4	22	B, C
E	7	3	15	B
F	5	2	14	D, E
G	4	4	4	D

Draw the network, number the nodes, find the critical path, the expected project completion time and the next most critical path.

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