

JK Lakshmipat University, Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular), April 2018
B. Tech (CSE, CSE-BDA/CC/IS/MC, ECE), Semester IV

Roll No.....

MA 403: Engineering Optimization

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write or mark anywhere other than your roll number on question paper.
2. Use of calculator is permitted.

Q.1 Choose the correct answer for the following problems (10 questions @ 1 mark) 10

- i. Linear programming is a;
(a) constrained optimization technique
(b) technique for economic allocation of limited resources
(c) mathematical technique
(d) all of the above
- ii. For a maximization problem, the objective function coefficient for an artificial variable is;
(a) + M (b) - M (c) zero (d) none of the above
- iii. If a primal LP problem has a finite solution then the dual LP problem should have;
(a) finite solution (b) infeasible solution
(c) unbounded solution (d) none of the above
- iv. The solution to a transportation problem with m -rows and n -columns is feasible if number of positive allocations are;
(a) $m + n$ (b) $m \times n$ (c) $m + n + 1$ (d) $m + n - 1$
- v. If an activity has zero float, it implies that;
(a) it lies on the critical path (b) it is a dummy activity
(c) the project is processing well (d) none of the above
- vi. The utilization factor in a queueing model $M/M/1 : \infty/FCFS$ is;
(a) $\frac{\lambda}{\mu}$ (b) $\frac{\lambda}{\mu} - 1$ (c) $1 - \frac{\lambda}{\mu}$ (d) none to these
- vii. The purpose of using simulation technique is to;
(a) imitate a real world situation
(b) understand properties and operating characteristics of complex real-life problems
(c) reduce the cost of experiment on a model of real situation
(d) all of the above

- viii. The sufficient condition for the function $f(x_1, x_2)$ to have maxima at the point (a, b) are;
 (a) $rt - s^2 > 0, r < 0$ (b) $rt - s^2 > 0, r > 0$
 (c) $rt - s^2 < 0, r < 0$ (d) $rt - s^2 < 0, r > 0$
- ix. In sequencing, the time for which a machine does not work is known as;
 (a) the total elapsed time (b) the idle time
 (c) difference of (a) and (b) (d) none of these
- x. Dijkstra's algorithm is used to determine;
 (a) shortest path (b) critical path
 (c) minimal spanning tree (d) none of these

Q.2 Solve the following problems (4 questions @ 2.5 marks)

10

- Write down any four applications of optimization techniques.
- Explain random numbers and their usefulness in simulation.
- Explain the difference between total float and free float in project scheduling.
- Explain all the components of queueing model defined as $\{a / b / c : d / e\}$.

Q.3A Write down the dual of the following linear programming problem.

05

Maximize $Z = 2x_1 + 3x_2 + 4x_3$

subject to: $2x_1 + 3x_2 + 5x_3 \geq 2, 3x_1 + x_2 + 7x_3 = 3, x_1 + 4x_2 + 6x_3 \leq 5;$

$x_1, x_2 \geq 0$ and x_3 is unrestricted in sign.

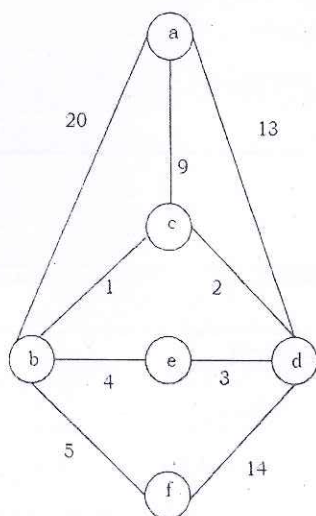
Q.3B For the following project, draw the network diagram. Find minimum project duration and identify the critical activities and critical path.

05

Activity	A	B	C	D	E	F
Precedence activity	-	A	B	A	D	C, E
Duration	5	6	5	4	3	4

Q.4A Find the minimum spanning tree for the following network.

05



Q.4B Write down the Kuhn-Tucker conditions to get an optimal solution of the following Non-linear programming problem: 05

$$\text{Maximize } Z = x_1 + x_2$$

Subject to: $x_1 x_2 - 2x_2 \geq 3$; $3x_1 + 2x_2 \leq 24$ and $x_1, x_2 \geq 0$

Q.5A Solve the following problem using dynamic programming: 05

$$\text{Maximize } Z = x_1^2 + x_2^2 + x_3^2$$

Subject to: $x_1 + x_2 + x_3 \geq 15$ and $x_1, x_2 \geq 0$

Q.5B A television repairman finds that the time spent on his jobs has an exponential distribution with a mean of 30 minutes. If he repairs the sets in the order in which they came in, and if the arrival of sets follows a Poisson distribution with an approximate average rate of 10 per 8-hours day, what queuing model does it represent? What is the repairman's expected idle time each day? How many jobs are ahead of the average set just brought in? 05

Q.6A A book binder has one printing press, one binding machine and manuscripts of 7 different books. The times required for performing printing and binding operations for different books are shown below. 05

Book	1	2	3	4	5	6	7
Printing time (in hours)	20	90	80	20	120	15	65
Binding time (in hours)	25	60	75	30	90	35	50

Decide the optimum sequence of processing of books in order to minimize the total time required to bring out all the books.

Q.6B Explain mixed congruential method to generate pseudo-random numbers by taking a suitable example. 05

Q.7 A product is manufactured at four factories A, B, C and D. Their unit production cost is Rs. 2, Rs. 3, Rs. 1 and Rs. 5, respectively. Their production capacities are 50, 70, 30 and 50 units, respectively. These factories supply the product to four stores, demands 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 following table. 10

Factories	Stores			
	I	II	III	IV
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.

OR

- Q.7 Use the graphical method to minimize the time needed to process the following jobs on the machines shown, i.e., for each machine find the job that should be done first. Also, calculate the total elapsed time to complete both jobs. 10

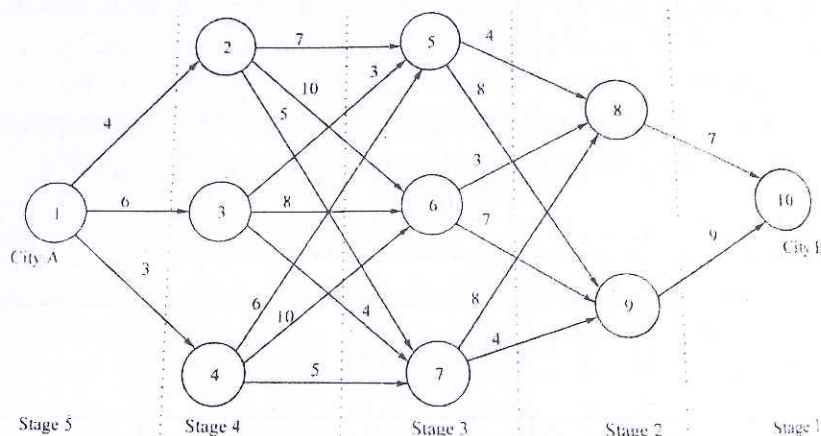
		Machines				
Job 1	Sequence	A	B	C	D	E
	Time (hrs)	3	4	2	6	2
		Machines				
Job 2	Sequence	B	C	A	D	E
	Time (hrs)	5	4	3	2	6

- Q.8 Solve the following assignment problem using Hungarian method. 10

	I	II	III	IV	V
A	40	35	25	20	15
B	16	26	48	50	24
C	22	12	32	15	17
D	16	18	12	15	36
E	45	20	36	24	18

OR

- Q.8 A salesman located in a city A decided to travel to city B. He knew the distances of alternative routes from city A to city B. He then drew a highway network map as shown in the following network. The city of origin A, is city 1. The destination city B is city 10. Other cities through which the salesman will have to pass through are numbered 2 to 9. The arrow representing routes between cities and distances in kilometers are indicated on each route. The salesman's problem is to find the shortest route that covers all the selected cities from A to B. Use dynamic programming to solve the problem. 10



- Q.9A A small project is composed of nine activities whose time estimates are listed in the table below: 10

Activity	A	B	C	D	E	F	G	H	I
Duration (Optimistic)	5	18	26	16	15	6	7	7	3
Duration (Most likely)	10	22	40	20	25	12	12	9	5
Duration (Pessimistic)	8	20	33	18	20	9	10	8	4

- (a) Draw the project network diagram.
(b) Find the expected duration and variance of each activity.
(c) Find the critical path and expected project length.
(d) Find the probability of expected completion time of the project if the original scheduled time of completing the project is 41.5 days.
- Q.9B Solve the following LP problem by simplex method. 10
- Maximize $Z = 4x_1 + 3x_2$
subject to: $2x_1 + x_2 \leq 1000$, $x_1 + x_2 \leq 800$, $x_1 \leq 400$, $x_2 \leq 700$; $x_1, x_2 \geq 0$

OR

- Q.9B A company is a producer of printed circuits for radios. The company has just expanded into full scale production and marketing of AM and AM-FM radios. It has built a new plant that can operate 48 hours per week. Production of an AM radio in the new plant will require 2 hours and production of an AM-FM radio will require 3 hours. Each AM radio will contribute Rs. 40 to profits while an AM-FM radio will contribute Rs. 80 to profits. The marketing department, after extensive research has determined that a maximum of 15 AM radios and 10 AM-FM radios can be sold each week. 10
- (a) Formulate a linear programming model to determine the optimum production mix of AM and FM radios that will maximize profit.
(b) Solve this problem using graphical method.