

JK Lakshmipat University, Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular), April 2018

B. Tech (CHE, CE and ME), Semester IV

Roll No.....

MA 405: 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. In an inventory model, the lead time is the time;
(a) between the receipt of the material and the usage of the material
(b) taken to place the order of the material
(c) between placing the order and the receipt of material
(d) none of the above
- vii. In an inventory model, the rent for the stores where materials are kept falls under;
(a) holding cost (b) set-up cost
(c) ordering cost (d) none of these
- viii. 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

ix. 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) $rt - s^2 < 0, r > 0$

x. Which of the following(s) is/are found in Genetic Algorithms?

- (a) selection (b) crossover
(c) mutation (d) all of the above

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 'agents' and 'intelligent agents' along with significance of these terms in computational intelligence.

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 Write down the Kuhn-Tucker conditions to get an optimal solution of the following Non-linear programming problem:

05

Maximize $Z = x_1 + x_2$

Subject to: $x_1x_2 - 2x_2 \geq 3$; $3x_1 + 2x_2 \leq 24$ and $x_1, x_2 \geq 0$

Q.4B A commodity is to be supplied at a constant rate of 200 units per day. Supplies of any amount can be obtained at any required time, but each ordering costs Rs. 50; cost of holding the commodity in inventory is Rs. 2 per unit per day while the delay in the supply of the item induces a penalty of Rs. 10 per unit per day. Find the optimal order quantity and reorder cycle time in this case of shortage based inventory model.

05

OR

Q.4B Write down the step by step algorithm of Genetic algorithm by using flow chart.

05

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

05

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

05

OR

Q.5B Explain the significance and various forms of nature inspired algorithms by highlighting its engineering applications. 05

Q.6A A company that operates for 50 weeks in a year is concerned about its stock of copper cable. This costs Rs. 240 a meter and there is a demand for 8,000 meters a week. Each replenishment costs Rs. 1,050 for administration and Rs. 1,650 for delivery, while holding costs are estimated at 25% of value/cost of item held a year. Assuming no shortages are allowed, what should be the economic order quantity for the company? 05

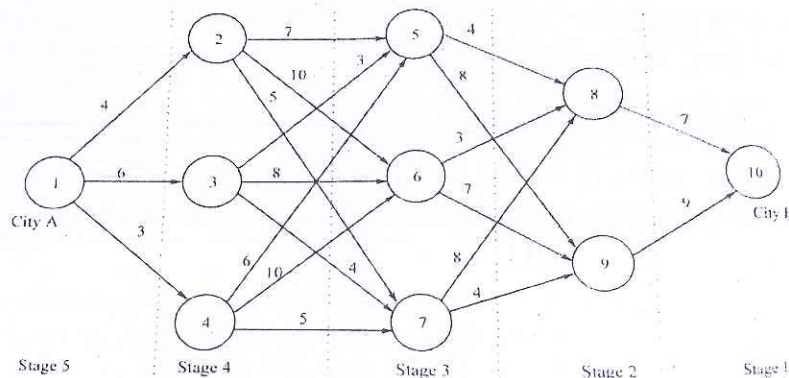
Q.6B Use graphical method to solve the following linear programming problem. 05
 Maximize $Z = 15x_1 + 10x_2$
 subject to: $4x_1 + 6x_2 \leq 360$, $3x_1 \leq 180$, $5x_2 \leq 200$; $x_1, x_2 \geq 0$

Q.7A 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.

Q.7B 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



OR

Q.7B Solve the following assignment problem using Hungarian method.

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	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

Q.8A A small project is composed of nine activities whose time estimates are listed in the table below:

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

- Draw the project network diagram.
- Find the expected duration and variance of each activity.
- Find the critical path and expected project length.
- Find the probability of expected completion time of the project if the original scheduled time of completing the project is 41.5 days.

Q.8B Solve the following LP problem by simplex method.

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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.8B Consider x_1 and x_2 as the quantities of bulbs and tube lights manufactured by a company. The bulbs with a quantity demand of $1500 - 5p_1$ carry a unit price of p_1 , tube lights with a quantity demand of $3800 - 10p_2$ carry a unit price of p_2 . The total cost functions for these two products are given by $200 + 0.1x_1^2$ and $300x_2 + 0.1 - x_2^2$ respectively. The production takes place on two assembly lines. While bulbs are assembled on assembly line A, tube lights are assembled on assembly line B. Because of the limitations of the assembly line capacities, the daily production is limited to a maximum of 80 bulbs and 60 tube lights. The production of both types of products requires electronic components. The production of each of these sets requires five units and six units of electronic equipment components respectively. The electronic components are supplied by another manufacturer, and the supply is limited to 600 units per day. The company has 160 employees. While the production of one unit of bulb requires one man-day labour, 2 man-day labour are required for the production of one unit of tube lights. How many units of bulbs and tube lights should the company produce to maximize the total profit? Formulate the problem as a non-linear programming problem.