B.TECH / ME /7TH SEM/ MECH 4103/2017
OPERATIONS RESEARCH
(MECH 4103)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The expected value of perfect information(EVPI) is
(a) equal to expected regret of the optimal decision under risk
(b) the utility of additional information
(c) maximum expected opportunity loss
(d) none of the above.

(ii) A solution which satisfies all the constraints of an LPP except the non-negativity constraints is called
(a) optimal solution (b) feasible solution
(c) infeasible solution (d) semi-feasible solution.

(iii) The occurrence of degeneracy while solving a Transportation Problem means
(a) total supply equals total demand
(b) some allocations become negative
(c) number of allocations is less than m+n-1
(d) the solution so obtained is not feasible.

(iv) In Vogel's approximation method, the opportunity associated with a row is given by
(a) the difference between the smallest cost and the next smallest cost in the row
(b) the difference between the smallest unused cost and the next smallest unused cost in the row
(c) the difference between the smallest cost and the next smallest unused cost in the row
(d) none of the above.

(v) The solution to a transportation problem with m-rows (supplies) and n-columns (destination) is feasible if number of positive allocations are
(a) m + n (b) m × n (c) m + n - 1 (d) m + n +1.

(vi) The method used for solving assignment problem is
(a) stepping stone method (b) modified distribution method
(c) Hungarian method (d) enumeration method.

(vii) When λ=the mean arrival rate & μ= mean service rate, Traffic intensity is
(a) λ/μ (b) μ/ λ (c)1-λ/μ (d) 1- μ/λ.

(viii) Utilisation factor is the proportion of total time a server actually spends with the customers and it is also called
(a) traffic intensity
(b) probability that the server is busy
(c) degree to which the capacity of the service station is utilised
(d) all of above.

(ix) Essential characteristics of a decision model are
(a) states of nature (b) decision alternatives
(c) payoff (d) all of the above.

(x) Any problem with optimizing function and constraints can be divided into a number of sub problems with the help of constraints, then the type of problem can be solved by
(a)integer programming
(b)branch and bound algothirm
(c) non linear programming with constraints
(d)dynamic programming approach

Group - B

2. (a) A newspaper vendor has the following probabilities of selling a magazine:

No .of copies sold	10	11	12	13	14
Probability	0.30	0.25	0.20	015	0.10

Cost of a copy is 30 paise and sale price is 50 paise. He cannot return unsold Copies. How many copies should he order?

(b) The optimistic, most likely and pessimistic times of the activities of a project are given below. Activity 40-50 must not start before 22 days, while activity 70-90 must end by 35 days. The scheduled completion time of the project is 46 days. Draw the network and determine the critical path.

Activity	$t_o - t_m - t_p$	Activity	$t_o - t_m - t_p$
10-20	4-8-12	50-70	3-6-9
20-30	1-4-7	50-80	4-6-8
20-40	8-12-16	60-100	4-6-8
30-50	3-5-7	70-90	4-8-12
40-50	0-0-0	80-90	2-5-8
40-60	3-6-9	90-100	4-10-16

6 + 6 = 12

3. (a) The following matrix gives the pay off in Rs. of different strategies (alternatives) S_1, S_2,S_3 against conditions (events) N_1, N_2 ,N_3 and N_4:

	N_1	N_2	N_3	N_4
S_1	4.000	-100	6,000	18,000
S_2	20,000	5.000	400	0
S_3	20,000	15,000	-2,000	1,000

Indicate the decisions taken under the following approach:
(i) pessimistic (ii) optimistic (iii) regret and (iv) equal probability

(b) A network consists of the following activities :

Activity :	1-2	1-3	2-3	2-5	3-4	3-6	4-5 ,	4-6	5-6	6-7
Duration : (weeks)	15	15	3	5	8	12	1	14	3	14

Determine the earliest start time & latest completion time of the activities, critical path & total duration of the project.

6 + 6 =12

Group - C

4. (a) Solve the following LPP using Simplex method. Min $Z = X_1 - 3X_2 + 2X_3$
Subject to,
$3X_1 - X_2 + 2X_3 \le 7$
$-2X_1 + 4X_2 \le 12$
$-4X_1 + 3X_2 + 8X_3 \le 10$
$X_1, X_2, X_3 \ge 0$

(b) Find the initial solution using VAM

	Warehouse					
		D_1	D_2	D_3	D_4	Supply
Factory	F_1	19	30	50	10	7
	F_2	70	30	40	60	9
	F_3	40	8	70	20	18
	Demand	5	8	7	14	

8 + 4 = 12

5. (a) The demands for 2 weeks for a product are 800 and 1000. In a week the company can produce up to 700 units in regular time at Rs. 100/product. It can employ overtime and produce up to an extra 300 units in a week at Rs. 120/product. The cost of carrying a product from one week to next is Rs. 15/product/week. How should they produce to meet the demand at minimum cost?

(b) Solve the following LPP using graphical method.
Maximize Z = 10X+9Y
Subject to 3X+3Y≤21; 4X+3Y≤24; X, Y≥0

(c) Following is the table of amount of annual sales (in lakhs of rupees) of assigning 4 sales persons to 4 different sales regions. Assign each salesman to a sales region such that total sale can be maximized.

		Sales region			
		1	2	3	4
Salesman	1	10	22	12	14
	2	16	18	22	10
	3	24	20	12	18
	4	16	14	24	20

3 + 3 + 6 = 12

Group - D

6. (a) Write notes on : (i) operating characteristics of a queuing system (ii) arrival distribution of a queuing system (iii) service distribution of a queuing system

(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 queue length (iii) average time a customer spends in the system (iv) average time a customer waits before being served.

6 + 6 = 12

7. (a) In a Bank, 20 customers on the average are served by a cashier in an hour. If the service time has exponential distribution, what is the probability that (a) it will take more than 10 minutes to serve a customer? (b) a customer shall be free within 4 minutes ?

(b) Customer arrives at a one window drive-in bank, according to a Poisson distribution with mean 10 per hour. Service time per customer is exponential with mean 5 minutes. The space in front of the window, including that for the serviced car can accommodate a maximum of three cars. Other cars can wait outside this space. (i) What is the probability that an arriving customer can drive directly to the space in front of the window? (ii) What is the probability that an arriving customer will have to wait outside the indicated space? (iii) How long an arriving customer is expected to wait before starting service?

4 + 8 = 12

Group - E

8. (a) Solve the following problem by using the method of Lagrangian multiplier. Minimize $Z= x_1^2+x_2^2+x_3^2$, subject to constraints
(i) $x_1+ x_2+3x_3=2$
(ii) $5x_1+2x_2+x_3=5$ and $x_1, x_2\geq 0$.

(b) In a non-linear programming problem, determine whether the following function is a concave or convex.
$f(x)=x_1^4+2x_1^2-5x_1$

6 + 6 = 12

9. (a) In a non-linear programming problem, find the output Q which maximises profit Z given by the relationship,
$Z= 5000+ 1200Q -Q^2$.

(b) Find the point of maximum value of the revenue function and also the maximum revenue of a non-linear programming problem
where, $f(x)= 400x-4x^2$.

6 + 6 = 12