Ref. No.: Ex/ME/T/424K/2018

B. MECHANICAL 4th YEAR 2ND SEM. EXAMINATION, 2018

OPERATIONS RESEARCH **Time: Three hours** **Full Marks:100**

Answer any Five Questions

1a) Define Operations Research. List out the applications of operations research. What is the role of O.R in Engineering? **(2+3+3)**

1b) What is analytic and iterative procedure? **(3)**

1c) What are the limitations for Operations Research? **(3)**

1d) What is linear programming? What are the characteristics of linear programming problem? **(2+4)**

2) The following table gives the activities in a construction project and other relevant information:

Activity	Immediate Predecessor	Time (months)		Direct cost(Rs)	
		Normal	Crash	Normal	Crash
A	-	4	3	60	90
B	-	6	4	150	250
C	-	2	1	38	60
D	A	5	3	150	250
E	C	2	2	100	100
F	A	7	5	115	175
G	D,B,E	4	2	100	240

Indirect costs vary as follows:

Months	15	14	13	12	11	10	9	8	7	6
Costs(Rs)	600	500	400	250	175	100	75	50	35	25

i. Draw an arrow Diagram. **(05)**

ii. Determine the project duration which will result in minimum total project cost. **(15)**

3a) In a railway marshalling yard goods trains arrive at a rate of 30 trains follows an exponential distribution and the service time distribution also exponential with an average 36 minutes. Calculate:

i. The mean queue size (line length). **(10)**

ii. The probability that the queue size exceeds 10.

3b) Rewrite the following LPP in standardized form for application of simplex method:

Maximize $Z= 8x_1-6x_2+7x_3+2x_4$

Subject to $4x_1+3x_2+6x_3+x_4 \leq 40$

$-x_1+2x_2+3x_3+x_4 \leq 5$

$9x_1-5x_2+7x_3-x_4 \geq 60$

$6x_2+2x_3+4x_4 =47$

$x_1,x_2,x_3,x_4 \geq 0$ **(05)**

3c) What are the advantages of linear programming? **(05)**

4a) Given the simplex tableau, write the maximization LPP from which it would have been derived, where S_1, S_2 and S_3 are the slack variables. **(05)**

Basis		x_1	x_2	x_3	x_4	S_1	S_2	S_3	b_i
S_1	0	2	2	3	0	1	0	0	100
S_2	0	3	0	2	2	0	1	0	120
S_3	0	1	1	1	4	0	0	1	90
c_j		4	5	2	1	0	0	0	

4b) Solve the following problem by MODI method: **(15)**

	D_1	D_2	D_3	D_4	Supply
S_1	19	30	50	10	7
S_2	70	30	40	60	9
S_3	40	8	70	20	18
Demand	5	8	7	14	
V_j	V_1	V_2	V_3	V_4	

5a) Objective questions(Answer all) **(10)**

i) Operations research approach is

(a) multi-disciplinary (b) scientific (c) intuitive (d) all of the above

ii) Operation research analysts do not

(a) predict future operations (b) build more than one model

(c) collect relevant data (d) recommend decision and accept

iii) Managerial decisions are based on

(a) an evaluation of quantitative data (b) the use of qualitative factors

(c) numbers produced by formal models (d) all of the above

iv) Constraints in an LP model is

(a) limitations (b) requirements

(c) balancing limitations and requirements (d) all of the above

v) Non-negativity conditions is an important component of LP model because

(a) variables value should remain under the control of decision-maker

(b) value of variables make sense and correspond to real-world problems

(c) variables are interrelated in terms of limited resources

(d) none of the above

vi) Maximization of objective function in LP model means

(a) value occurs at allowable set of decisions (b) highest value is choosen among allowable decisions

(c) neither of above (d) both (a) and (b)

vii) Which of the following statement is true with respect to the optimal solution of an LP problem

(a) every LP problem has optimal solution.

(b) optimal solution of an optimal solution always occurs at an extreme point.

(c) at optimal solution all resources are used completely.

(d) if an optimal solution exists, there will always be at least one at a corner.

viii) An iso-profit line represents

(a) an infinite number of solutions all of which yield at same profit.

(b) an infinite number of solutions all of which yield the same cost.

(c) an infinite number of optimal solutions.

(d) a boundary of the feasible region.

ix) If an iso-profit line yielding the optimal solution coincides with a constraint line, then

(a) the solution is unbounded (b) the solution is infeasible

(c) the constraint which coincides is redundant (d) none of the above

x) While plotting constraint is a graph paper, terminal points on both the axes are connect by a straight line because

(a) the resources are limited in supply (b) the objective function is a linear function

(c) the constraints are linear equations or inequalities (d) all of the above

5b) In the modification of a plant layout of a factory four new machines m_1, m_2, m_3, m_4 are to be installed in a machine shop. There are five vacant places A, B, C, D& E available. Because of limited space, Machine m_2 can't be placed at C and m_3 can't be placed at A. The cost matrix is

	Location					
		A	B	C	D	E
Machine	m1	9	11	15	10	11
	m2	12	9	-	10	9
	m3	-	11	14	11	7
	m4	14	8	12	7	8

Find the optimal assignment schedule. **(10)**

6a) A job shop has four men available for work on four separate jobs. Only one man can work on any one job. The cost of assigning each man to each job is given in below table. The objective is to assign men to jobs such that the total cost of assignment is a minimum.

		Jobs			
	To From	1	2	3	4
Men	A	20	25	22	28
	B	15	18	23	17
	C	19	17	21	24
	D	25	23	24	24

6b) Solve the game whose payoff matrix to the player A is given in the table: **(10)**

		B		
		I	II	III
A	I	1	7	2
	II	6	2	7
	III	5	2	6

7a) Obtain the dual of the following LP problem:

Max. $Z= 2x_1+3x_2+x_3$

Subject to $4x_1+3x_2+x_3=6$

$x_1+2x_2+5x_3=4$

and $x_1,x_2,x_3 \geq 0$ **(10)**

7b) State the advantages of duality in LP. **(5)**

7c) Write an explanatory note on sensitivity analysis. **(5)**