Registration no: | | | | | | | | | | |

Total Number of Pages: 2 **M.TECH**

 P2MDCC07

2nd Semester Regular Examination – 2016-17

OPTIMUM DESIGN OF MECHANICAL SYSTEMS

BRANCH(S): MACHINE DESIGN, MECH. SYSTEM DESIGN, SYSTEM DESIGN

Time: 3 Hours

Max marks: 100

Q.CODE: Z835

Answer Question No.1 which is compulsory and any four from the rest.

The figures in the right hand margin indicate marks.

Q1 **Answer the following questions:** (2 x 10)

a) What is dynamic programming?
b) How do you identify the optimum solution in the simplex method?
c) What are the advantages of sequential linear programming method?
d) What do you mean by bounded variable?
e) What are the advantages of Random search method?
f) State four applications of linear programming.
g) What is an active constraint?
h) What is the difference between a slack and a surplus variable?
i) What happens when m = n in a (standard) LP problem
j) What is the difference between linear and nonlinear programming problems?

Q2 a) Maximize $Z = 3.6x_1 - 0.4x_1^2, + 1.6x_2 - 0.2x_2^2$ subject ot the constraint $2x_1 + x_2 \le 10..and..x_1, x_2 \ge 0$ using Kuhn-Tucker conditions. (10)

b) A steel company has three open-hearth furnaces and five rolling mills. Transportation costs (rupees per quintal) for shipping steel from furnaces to rolling mills are shown in the following table : (10)

Mills / Furnaces	M1	M2	M3	M4	M5	Supply
F1	4	3	3	2	6	10
F2	6	4	5	2	1	12
F3	6	5	4	7	7	14
Demand	4	4	6	8	8	

Find the optimal shipping schedule.

Q3 a) Determine the maximum and minimum values of the function and saddle point if any: (10)

$$f(x_1, x_2, x_3) = x_1 + 2x_2, + x_1x_2 - x_1^2 - x_2^2 - x_3^2$$

b) How the optimization problems are classified? Write short notes on each type. (10)

Q4 Obtain the dual problem of the following LP Maximize $Z=2x_1 +5x_2+6x_3$ (10)

a) subject to constraints $5x_1 + 6x_2 –x_3 \leq 3$, $-2x_1 + x_2 + 4x_3 \leq 4$, $x_1 - 5x_2 +3x_3 \leq 1$, $-3x_1 - 3x_2 +7x_3 \leq 6$ and $x_1, x_2, x_3 \geq 0$

b) Explain in detail Sequential unconstrained minimization techniques and Approximation techniques. State clearly the difrence between the two. (10)

Q5 a) Solve the following by graphical approach (10)

Maximize $Z=2x_1 + x_2$ subject to constraints

$x_1 + 2x_2 \leq 10$, $x_1 + 2x_2 \leq 6$, $x_1 - x_2 \leq 2$, $x_1 - 2x_2 \leq 1$ and $x_1, x_2 \geq 0$

b) What is dynamic programming? What are the applications of dynamic programming? Discuss the difference between linear programming and dynamic programming.

Solve the following LP problem by dynamic programming approach

Max $Z=3x_1 + 5x_2$ subject to constraints

$x_1 \leq 4$, $x_2 \leq 6$

$3x_1 + 2x_2 \leq 18$ and $x_1, x_2 \geq 0$

Q6 a) Use penalty method to solve the following LPP (10)

Maxsimize $Z = X1 + 2X2$

Subject to $X1 - 5X2 \leq 10$

$2X1 - X2 \geq 2$

$X1 + X2 = 10$

$X1, X2 \geq 0$

b) A steel company produces three types of parts A, B and C for a washing maching. It purchases casting of parts and then finishes parts on drilling , shaping and polishing machines. The selling price of A, B and C are Rs 8, Rs 10 and Rs. 14 respectively. The casting of parts A, B and C costs Rs 5 , Rs 6 and Rs. 10 respectively. The shop posses only one of each type of machines. Cost per hour to run these machines are Rs 20 for drilling , Rs 30 for shaping and Rs 30 for polishing. The capacities for each part on each machine are shown below (10)

Machine	Capacity per hour		
	A	B	C
Drilling	25	40	25
Shaping	25	20	20
Polishing	40	30	40

How many parts of each type the shop should produce per hour in oder to maximize profit for an hour’s run? Formulate problem as a linear programming model.

Q7 **Write short notes on the followings.** (5 x 4)

a) Different engineering applications of optimization.

b) Direct methods of optimization.

c) Kuhn-Tucker conditions

d) Constrained and unconstrained problems