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

Total Number of Pages: 02

M.TECH
CEPE204

2^{nd} Sem Mtech Regular/ Back Examination – 2015-16
STRUCTURAL OPTIMISATION
BRANCH(S): STRUCTURAL ENGINEERING
Time: 3 Hours
Max marks: 70
Q.CODE:W777
Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: (2 x 10)

a) Define a local and global maximum.
b) State a linear and non-linear optimization problem.
c) Write the condition for linear independence of a set of vector a_1, a2,…,a_k.
d) When a function is called concave and convex function.
e) Determine whether the following junction is convex or concave $f(x) = -2x^2+8x+4$.
f) Determine whether the following function is positive definite or, negative definite or neither, $f(x) =-x_1^2+4x_1x_2+4x_2^2$.
g) Define Lagrange function and language multiplier.
h) What are the necessary and sufficient conditions for a stationary point X to be minimum?
i) When a point is called saddle point. Give an example.
j) Write down the characteristic of linear programming.

Q2 a) State Lagrangian method to find an optimum of function of n variables subject to m (m≤n) constraints. (5)

b) Obtain optimum solution of the following non-linear programming problem, (5)

Max $f(x)=2x_1+x_2+10$

Subject of constraints;

$X_1+ 2X_2=3$

$X_1,X_2\geq 0$

Q3 a) Find the dimension of a cylindrical tin (with top and bottom) made up of sheet metal to maximize its volume such that the total surface area is equal to $A_0 = 24\pi$. (10)

Q4 Use the Wolfe's method to solve the given quadratic programming problem (10)

Maximize $z=4x_1+6x_2-2x_1^2-2x_1x_2-2x_2^2$

Subjected to constraints

$X_1+2X_2\leq 2$ and

$X_1,X_2\geq 0$.

Q5 a) State when the function f(x) is positive definite and negative definite or saddle point. (5)

b) Find the maximum or minimum of function $f(x)=x_1+2x_3+x_2x_3-x_1^2-x_1^2-x_2^2-x_3^2$. (5)

Q6 a) Write quadratic form of a function (5)

$Q(x) = (x_1, x_2, x_3)^T$ and matrix

$$A = \begin{bmatrix} 1 & 0 & 1 \\ 2 & 7 & 6 \\ 3 & 0 & 2 \end{bmatrix}$$

Why the matrix A can be assumed to be symmetric?

b) Write down when a quadratic form is said to be (5)

1) Positive definite,
2) Positive semi-definite,
3) Negative definite,
4) Negative semi-definite,
5) In-definite

Q7 a) What are necessary as well as sufficient Kuhn-Tucker conditions for obtaining an absolute (or global) maximum of f ($\overline{X}$) at $\overline{X}$? Also (10)

Maximize $Z = 12x_1 + 21x_2 + 2x_1x_2 - 2x_1^2 - 2x_2^2$

Subjected to constraints

1) $X_2 \leq 8$
2) $X_1 + X_2 \leq 10$.

Q8 (10)

For the rigid frame shown in fig. 1, plastic moments may develop at the point of peak moments (numbered 1 through 7). Assuming that the weight is a linear function of plastic moment capacity of beam (M_b) and column (M_c), form the optimization statement under minimum weight condition. Take w=Weight/unit length/moment. For the structure to be safe, the energy absorbing capacity of the frame (U)>the the energy imparted by externally applied load (E) for various collapse mechanisms. $P_1=3$, $P_2=1$, $h=8$, $l=10$

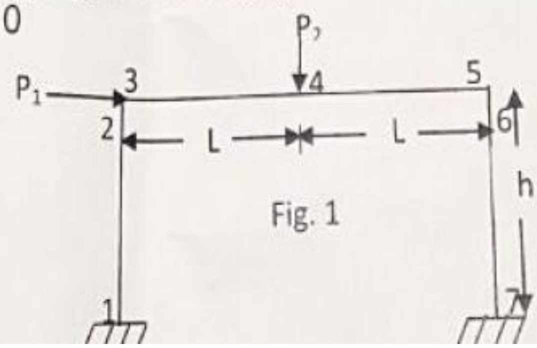

Fig. 1