Paper Code: MME-201	**Roll No.**										

M.Tech.
(SEM II) EVEN SEMESTER EXAMINATION, 2015-16
OPTIMIZATION FOR ENGINEERING DESIGN

[Time: 3 hrs.] **[Max. Marks: 100]**

Note: (i) Answer all questions.
(ii) All questions carry equal marks.

1. Attempt any two parts of the following:- **[10x2=20]**

(a) What are the optimization techniques used in the engineering problems? Illustrate with three suitable examples.

(b) Determine the maximum and minimum values of the function $f(x) = 12x^5 - 45x^4 + 40x^3 + 5$

(c) The efficiency of a screw jack is given by $\eta = tan\alpha \cot(\alpha + \phi)$, where α is the lead angle and ϕ is a constant. Find the value of α for which the efficiency of the screw jack is maximum.

2. Attempt any two parts of the following:- **[10x2=20]**

(a) Define the concave and convex functions. Test whether the following functions are concave or convex

(i) $f(x) = x^2 + 10x + 1$
(ii) $f(x) = \exp(-x), \quad x > 0$

(b) Define the positive definite and negative definite matrices. Determine whether each of the following matrices is positive definite or negative definite

(i) $A = \begin{bmatrix} 3 & 1 & -1 \\ 1 & 3 & -1 \\ -1 & 1 & 5 \end{bmatrix}$

(ii) $B = \begin{bmatrix} 4 & 2 & -4 \\ 2 & 4 & -2 \\ -4 & -2 & 4 \end{bmatrix}$

(c) A rectangular beam is to be cut from a circular log of radius r. Find the cross-sectional dimensions of the beam to

(i) Maximize the cross-sectional area of the beam
(ii) Maximize the perimeter of the beam section.

3. Attempt any two parts of the following:- **[10x2=20]**

(a) Profit per acre of a farm is given by

$$P = 20x + 16y + 4xy - 4x^2 - 3y^2$$

where x and y denote respectively the labor cost and the fertilizer cost. Find the values of x and y to maximize the profit.

(b) Find the dimensions of a closed cylindrical soft drink can that can hold soft drink of volume V for which the surface area (including the top and bottom) is a minimum.

(c) A funnel, in the form of a right circular cone is to be constructed from a sheet metal. Find the dimensions of the funnel for minimum lateral surface area when the volume of the funnel is specified as 200 cm^3.

4. Attempt any two parts of the following **[10x2=20]**

(a) Define a uni-modal function. Find the minimum of the function $f(x) = x(x - 1.5)$ in the interval (0,1) to within 10% of exact value using Fibonacci search method. Perform 10 steps.

(b) Use searching method to minimize $f(x) = (100 - x)^2$ given the starting point x_0=30 and a step size $|\Delta| = 5$.

(c) Find the minimum of the function

$$f(x, y) = 2x^2 + 4xy^3 - 10xy + y^2$$

5. Attempt any two parts of the following:- **[10x2=20]**

(a) State Bellman's optimality principle. Solve

Maximize $x_1 x_2 x_3 \ldots . x_n$
Subject to $x_1 + x_2 + \cdots + x_n = k$
and $x_j \geq 0 \quad for\ j = 1,2, \ldots . n$

(b) Define Geometric programming problem (GPP). It has been decided to shift grain from a warehouse to a factory in an open rectangular box of length x meters, width y meters and height z meters. The bottom, sides and the ends of the box cost respectively Rs 100, Rs 150 and Rs 200 per m^2. It cost Rs 1000 for each round trip of the box. Assuming that the box will have no salvage value, formulate the problem as a Geometric programming problem (GPP).

(c) Find the point where the Himmelblan function
$H(x, y) = (x^2 + y - 11)^2 + (x + y^2 - 7)^2$ where, $0 \leq x \leq 5$ and $0 \leq y \leq 5$, attains minimum by Box method. Take the initial point (1,1) and stepsize $(\Delta x, \Delta y) = (2,2)$. Perform five iterations