Form A : Paper-setting Blank

Ref. No. ...*EX/PG/CE/T/1210B/2018*

........*M.E Civil Engineering 1st Year*... EXAMINATION, *2018*

(~~1st~~/ 2nd Semester / ~~Repeat / Supplementary / Annual / Bi-Annual~~)

SUBJECT ...***Structural Optimization***

(Name in full)

PAPER ....*XX*...................

Full Marks 100

(60 marks for part I)

Time: ~~Two hours~~/Three hours/~~Four hours/Six hours~~

Use a separate Answer-Script for each part

No. of Questions	PART I	Marks
	Answer any four questions	
1.	Find a suitable scaling of variables to reduce the condition number of the Hessian matrix of the following function to 1. $f(x,y) = 6x_1^2 - 6x_1x_2 + 2x_2^2 - x_1 - 2x_2$	15
2.	Minimize $f(x_1,x_2) = 2x_1^2 + 2x_1x_2 + x_2^2 + x_1 - x_2$ from the starting point $X = \begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$. Use **Powell's method**. Given, probe length is 0.01.	15
3.	Minimize $f(x,y) = 2x^2 + 2xy + y^2 + x - y$ Take the points defining the initial simplex as $X_1 = \begin{Bmatrix} x \\ y \end{Bmatrix} = \begin{Bmatrix} 4.0 \\ 4.0 \end{Bmatrix}$, $X_2 = \begin{Bmatrix} x \\ y \end{Bmatrix} = \begin{Bmatrix} 5.0 \\ 4.0 \end{Bmatrix}$ *and* $X_3 = \begin{Bmatrix} x \\ y \end{Bmatrix} = \begin{Bmatrix} 4.0 \\ 5.0 \end{Bmatrix}$ And $\alpha = 1.0,\ \beta = 0.5$ *and* $\gamma = 2.0$. *For convergence, take* ε *as* 0.2	15
4.	Minimize $f(x_1,x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$. Starting from $X_1 = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$. Use **Conjugate gradient method.**	15
5.	Find the minimum of $f = x^2 - 1.5x$ in the interval (0.0, 1.0) to within 10% of the exact value. Use **Dichotomous search** method.	15

M.E.CIVIL ENGINEERING FIRST YEAR SECOND SEM. EXAM. -2018

Subject: STRUCTURAL OPTIMIZATION **Time: Three Hours** **Full Marks 100**

PART-II (Marks-40)

Use a separate Answer-Script for each part

No. of questions	Answer question no.1 and any three from question no. 2	Marks (4+12x3)=40
1.	How can you test positive definiteness of a matrix	4
2.	Answer any three.	12 x 3 =36
a)	Figure 1. Shows two frictionless rigid bodies A and B connected by three linear elastic spring constants k_1, k_2, and k_3. The springs are at their natural positions when the applied force P is zero. Find the displacements x_1 and x_2 under the force P by using the principle of minimum potential energy.	

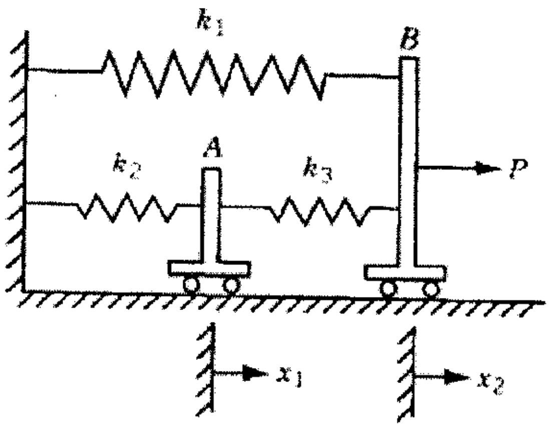

Fig. 1.

b)	A beam of uniform rectangular cross-section is to be cut from a log having a circular cross-section of diameter 2a. The beam has to be used as a cantilever beam (the length is constant) to carry a concentrated load at the free end. Find the dimensions of the beam that correspond to the maximum (bending) stress carrying capacity.	
c)	Prove that for multivariable optimization with no constraints a sufficient condition for a stationary point X* to be an extreme point if the matrix of second partial derivatives (Hessian matrix) of f(X) evaluated at X* is (i) Positive definite when X* is a relative minimum point and (ii) Negative definite when X* is a relative maximum point	
d)	Using Simplex method Maximize $Z=3X_1+2X_2$ Subjected to $X_1 + X_2 \leq 4$ $X_1 - X_2 \leq 2$ $X_1, X_2 \geq 0$.	