Total No. of Questions – [06] Total No. of Printed Pages: 02

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F. Y. M. TECH. (Mechanical – Design Engineering)
(SEMESTER – II)
COURSE NAME: OPTIMIZATION TECHNIQUES IN DESIGNS
COURSE CODE: MEPA12205C
(PATTERN 2020)

Time: [3 Hours] [Max. Marks: 60]

(*) Instructions to candidates:

1) **All Questions are compulsory**
2) **Figures to the right indicate full marks.**
3) **Use of scientific calculator is allowed**
4) **Use suitable data where ever required**

Q.1) Find the maximum of the function f (X) = 2x1 + x2 + 10 subject to g(X) = x1 + $2x_2^2$= 3 using the Lagrange multiplier method. Also find the effect of changing the right-hand side of the constraint on the optimum value of f . (10)

Q.2) Solve the following L.P.P. by two phase simplex method:

Maximize z = 5x1 - 4x2 + 3x3;

s.t. 2x1 + x2 - 6x3 = 20,

6x1 + 5x2 + 10x3 < 76,

8x1 -3x2 + 6x3 < 50,

x1, x2, x3 ≥ 0. (10)

Q.3) Minimize y = f(x1, x2) = x12 + x22 - x1x2 - x1 + x2 in the range of -10.0 ≤ x1,x2 ≤10.0 using Random walk method. Consider the initial solution. $X_1 = \begin{Bmatrix} x_1 \\ x_2 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$. Take step length λ = 1.0 ; random numbers $\begin{Bmatrix} r_1 \\ r_2 \end{Bmatrix} = \begin{Bmatrix} -0.2 \\ 0.3 \end{Bmatrix}$. Find the value of the search direction and objective function in the first iteration. (10)

Q.4) A beam of rectangular cross-section of height 'h' m and width 'b' m and length 'L'=1.0 m is supported at two ends, as shown in Fig. 2.

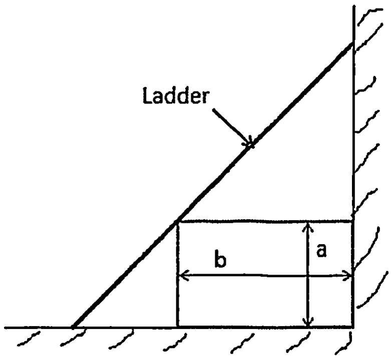


Figure 1

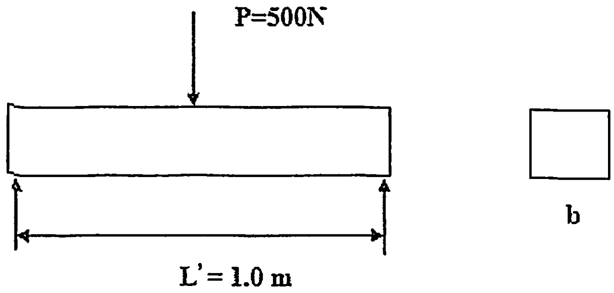


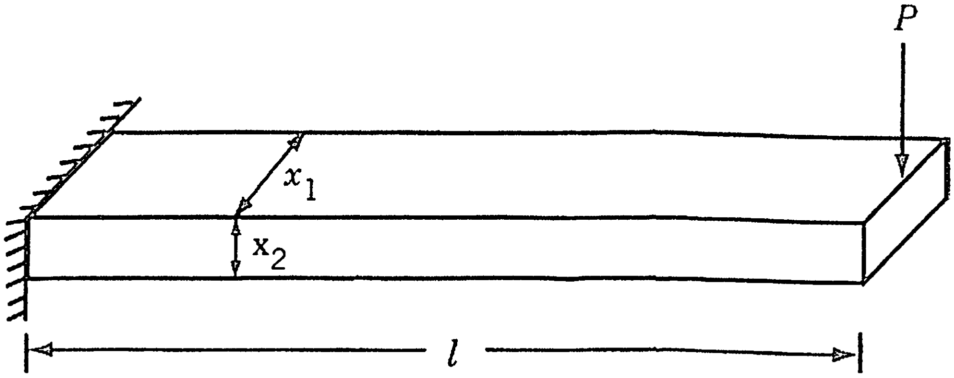
Figure 2

A concentrated load of magnitude P = 500 N is acting at its mid-point. The beam should be as light as possible. However, it should be able to withstand the above loading. Assume density of the beam material ρ = 7.6 × 103 kg/m3 and allowable bending stress σallowable= 800 MPa; b and h are allowed to vary in the ranges given below.

$$0.006 \le b \le 0.210$$
$$0.006 \le h \le 0.180$$

Use Simulated Annealing to solve this optimization problem. Assume initial temperature of molten metal T0 = 4400 °K; initial solution selected at random $\begin{Bmatrix} b \\ h \end{Bmatrix}_0 = \begin{Bmatrix} 0.01 \\ 0.01 \end{Bmatrix}$ and termination criterion $\epsilon = 0.001$. Let us assume the random numbers as follows: 0.5, 0.7, 0.3, 0.4, 0.8 and so on. Find the change in objective function (i.e., energy) at the end of the first two iterations. (10)

Q.5) Formulate the problem of determining the cross-sectional dimensions of the cantilever beam shown in Fig. for minimum weight. The maximum permissible bending stress is σy . (10)



Q.6) Topology optimization followed by a detailed sizing and shape optimization used to provide efficient aircraft component designs satisfying manufacturing, stability and stress constraints. Please comment on the statement. (10)