Total No. of Questions :6]

SEAT No. :

P3912

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M.E. (Mechanical-Design Engineering)

OPTIMIZATION TECHNIQUES

(2013 Credit Pattern) (Semester - III) (602213)

Time : 3 Hours] *[Max. Marks :50*

Instructions to the candidates:

1) ***Attempt any five questions.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and stream table is allowed.***
4) ***Figures to the right indicate full marks.***
5) ***Assume suitable data if necessary.***

Q1) a) Explain in brief classification of optimization problem. **[5]**

b) A uniform column of rectangular cross section is to be constructed for supporting a water tank of mass M as shown in Fig. 1. It is required to minimize the mass of the column for economy, and to maximize the natural frequency of transverse vibration of the system for avoiding possible resonance due to wind. Formulate the problem of designing the column to avoid failure due to direct compression and buckling. Assume the permissible compressive stress to be σ_{max}. **[5]**

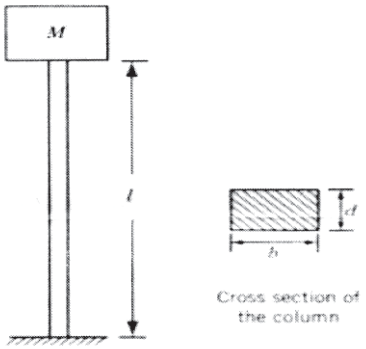

Fig.1

OR

P.T.O.

b) In a two-stage compressor, the working gas leaving the first stage of compression is cooled (by passing it through a heat exchanger) before it enters the second stage of compression to increase the efficiency. The total work input to a compressor (W) for an ideal gas, for isentropic compression, is given by **[5]**

$$W = c_p T_1 \left[\left(\frac{p_2}{p_1} \right)^{\left(\frac{k-1}{k}\right)} + \left(\frac{p_3}{p_2} \right)^{\left(\frac{k-1}{k}\right)} - 2 \right] \frac{k}{k-1}$$

where C_p is the specific heat of the gas at constant pressure, k is the ratio of specific heat at constant pressure to that at constant volume of the gas, and T1 is the temperature at which the gas enters the compressor. Find the pressure, p2, at which inter-cooling should be done to minimize the work input to the compressor. Also determine the minimum work done on the compressor. **[5]**

Q2) a) Define the following:

i) Design vector.

ii) Design constraints

iii) Constraint surface

iv) Objective function

v) Saddle point

b) What are the advantages and disadvantages of simplex method? Also, state its applications. **[5]**

OR

b) Find the Extreme point of the function **[5]**

$$f(x_1 x_2) = x_1^3 + x_2^3 + 2x_1^2 + 4x_2^2 + 6$$

Q3) a) Minimize the function **[5]**

$$f(x) = 4x^3 + x^2 - 7x + 14$$

Using Golden Section Method, in the interval of [0, 1] with n=5.

b) Explain the Random search methods and advantages of random search methods. **[5]**

Q4) a) Explain any two in details: **[6]**

i) Neural-Network-based methods.

ii) Simulated Annealing.

iii) Genetic algorithms.

b) Minimize $f(x_1, x_2) = x_1 - x_2 + 2x_1^2 + 2x_1x_2 + x_2^2$ from the starting point $X_1 = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$ using Powell's Method. **[4]**

Q5) a) What are the different methods involved in problem formulation and parameterization of design? Explain one method in details. **[5]**

b) Write a short note on Bi-directional evolutionary structural optimization based on Von mises stress. **[5]**

Q6) a) Write a short note on Bi-directional evolutionary optimization method. **[5]**

b) Write a short note on Topology optimization as design tool. **[5]**

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