[5060]-590

M.E. (Mechanical - Design Engineering)
OPTIMIZATION TECHNIQUES
(2013 Pattern) (Semester - III) (Credit System)

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

Instructions to the candidates:-

   1) Answer 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) Define engineering optimization? What are engineering applications of optimization? **[5]**

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

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

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, p_2 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]**

OR

c) Explain necessary condition for single variable optimization. **[5]**

Q2) There grades of coal A, B and C contain phosphorus and ash as impurities. In a particular industrial process, fuel up to 100 ton (maximum) is required which should contain ash not more than 3% and phosphorus not more than 0.03%. It is desired to maximize the profit while satisfying these conditions. There is unlimited supply of each grade. The percentage of impurities and the profits of the grades are given below.

Coal	Phosphorus (%)	Ash (%)	Profit in rupees per ton
A	0.02	3.0	12.00
B	0.04	2.0	15.00
C	0.03	5.0	14.00

Find the proportions in which the three grades be used. **[10]**

Q3) a) Write a short note on Exhaustive search method. **[4]**

b) Minimize the function

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

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

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

i) Fuzzy optimization

ii) Simulated Annealing

iii) Genetic algorithms

b) Minimize the function

$f(\lambda) = 0.65 - \dfrac{0.75}{1+\lambda^2} - 0.65\lambda \tan^{-1}\left(\dfrac{1}{\lambda}\right)$ Using quasi-Newton method with

the starting point $\lambda_1 = 0.1$ and the step size $\Delta\lambda = 0.01$ in central difference formulas. Use $\varepsilon = 0.01$ for checking the convergence. **[5]**

Q5) a) List the different solution methods in topology optimization and explain two of them in details. **[5]**

b) Write a short note on combining topology and shape design. **[5]**

Q6) a) Write a short note on Topology optimization as design tool. **[5]**

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

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