Dr. Sewraj

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
TEST -3 EXAMINATION- DEC- 2018
M.TECH 1ST Sem

COURSE CODE: Modelling, Simulations and Computer Applications MAX. MARKS: **35**

COURSE NAME: 11M1WCE114

COURSE CREDITS: 3 MAX. TIME: **2Hrs**

Note: *All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means.*

Q1. Four identical helical springs are used to support a milling machine weighing 5000 lb. Formulate the problem of finding the wire diameter (d), coil diameter (D) and the number of turns (N) of each spring (Fig.1) for minimum weight by limiting the deflection to 0.1 inch and the shear stress to 10,000 psi in the spring. In addition, the natural frequency of vibration of the spring is to be greater than 100 Hz. Assume that the material is spring steel with $G = 12 \times 10^6$ psi and $\rho = 0.3$ lb/in^3 and the shear stress correction factor is $K_s \approx 1.05$. **[CO1,5]**

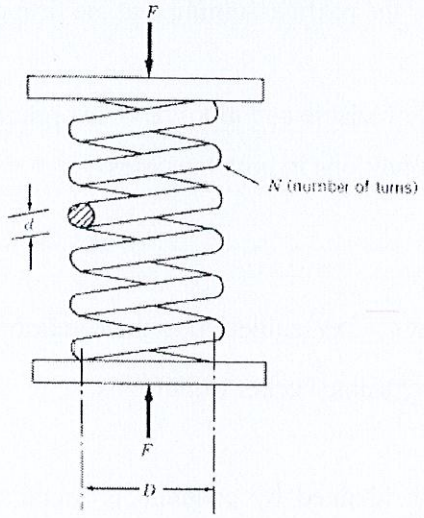

Fig. 1

Q2. Maximize $Z = 3X_1 + 2X_2$, subject to the constraints : **[CO2,6]**

$2X_1 + X_2 \leq 2$, $3X_1 + 4X_2 \geq 12$, $X_1, X_2 \geq 0$. Using "Big M" method

Q3. A manufacturing firm produces two products, A and B using two limited resources. The maximum amounts of resources 1 and 2 available per day are 1000 and 250 units respectively. The production of 1 unit of product A requires 1 unit of resource 1 and 0.2 unit of resource 2 and the production of 1 unit of product B requires 0.5 unit of resource 1 and 0.5 unit of resource 2. The unit costs of resources 1 and 2 are given by the relations $(0.375 - 0.00005u_1)$ and $(0.75 - 0.0001u_2)$ respectively where u_i denotes the number of units of resource i used (i = 1, 2). The selling prices per unit of products A and B, pA and pB, are given by

$$p_A = 2.00 - 0.0005x_A - 0.00015x_B \qquad \textbf{[CO3,6]}$$

$$p_B = 3.50 - 0.0002x_A - 0.0015x_B$$

where x_A and x_B indicate, respectively, the number of units of products A and B sold. Formulate the problem of maximizing the profit assuming that the firm can sell all the units it manufactures.

Q4. Discuss in detail single variable and multivariable optimization technique. Also elaborate the necessary and sufficient conditions in both the cases. **[CO4,6]**

Q5. Minimize $F= x_1^2+ 2 x_2^2+ 3x_3^2$ subjected to the condition $g_1= x_1- x_2- x_3\leq 12$ and $g_2= x_1+2 x_2- 3x_3\leq 8$ using Kuhn Tucker Conditions **[CO2,7]**

Q6. The ultimate strength attained by concrete is found to be based on a certain empirical relationship between the ratios of cement and concrete used. Our objective is to maximize strength attained by hardened concrete, given by $f(X) = 20+ 2X_1- X_1^2+ 6X_2- (3/2\ X_2^2)$, where X_1 and X_2 are variables based on cement and concrete ratios. **[CO3,5]**