Seat No.: ________ Enrolment No.___________

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER– III • EXAMINATION – SUMMER 2015

Subject Code: 730801 **Date: 30/04/2015**

Subject Name: Engineering Optimization

Time: 2:30 pm to 5:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** (i) Define Constrained and Unconstrained optimization problems. **04**

(ii) Define objective function and design constraints. **03**

(b) The step-cone pulley shown in Fig.1 is to be designed for transmitting a power of at least 0.75 hp. The speed of input shaft is 350 r.p.m. and the output speed requirements are 750, 450, 250, 150 rpm for a fixed centre distance of ñaò between the input and output shafts. The tension on the tight side of the belt is to be kept more than twice that on the slack side. The thickness of the belt is ñtò and the coefficient of friction between the belt and the pulley is µ. Formulate the problem of finding the width and diameters of the steps for minimum weight. **07**

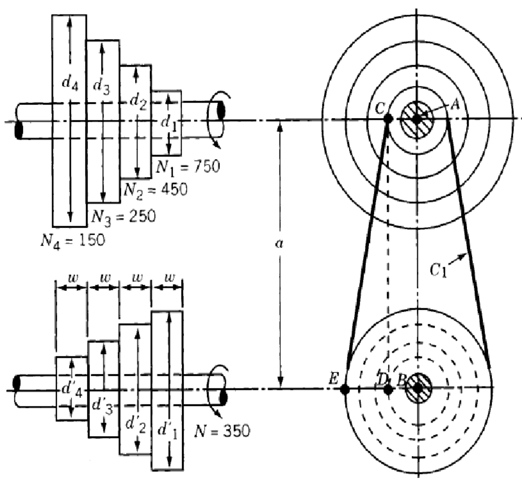

Fig 1.0 Step-cone pulley.

Q.2 **(a)** Formulate a problem of a uniform column of tubular section as shown in fig 2.0 , with hinge joints at both ends, to carry a compressive load P = 2500 kgf for minimum cost. The column is made up of a material that has a yield stress (ů$_y$) of 500 kgf/cm^2 , modulus of elasticity (E) of 0.85×10^6 kgf /cm^2, and weight density of 0.0025 kgf /cm^3. The length of the column is 250 cm. The stress induced in the column should be less than the buckling stress as well as the yield stress. The mean diameter of the column is restricted to lie between 2 and 14 cm, and columns with thicknesses outside the range 0.2 to 0.8 cm are not available in the market. The cost of the column includes material and construction costs and can be taken as 5W + 2d, where W is the weight in kilograms force and d is the mean diameter of the column in centimeters. **07**

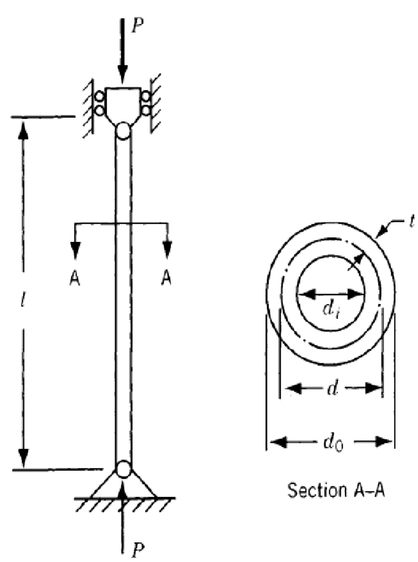

Fig 2.0 Tubular column under compression

(b) Explain the difference between Elimination and Interpolation methods of Optimization. **07**

OR

(b) What is a saddle point solution? What is its significance in constrained optimization? **07**

Q.3	**(a)**	What are the characteristics of a direct search method? Explain Golden section Method of Optimization	**07**
	(b)	Minimize the function f(x) = 0.65 ï [0.75/(1+x)^2)] ï 0.65 x tan-1(1/x) using the golden section method with n = 6.	**07**

OR

Q.3	**(a)**	State Kuhn-Tucker conditions giving a suitable example	**07**
	(b)	Minimize $f(x) = 2x^4-x^3+5x^2-12x+1$ using Newton-Raphson method with starting point X_o=0.0. Use Ů=0.01	**07**
Q.4	**(a)**	Explain exterior penalty function method of optimization.	**07**
	(b)	Minimize f (x_1, x_2) = x_1 ī x_2+ $2x_1^2$+ $2x_1x_2$+ x_2^2 starting from the point X_1= {0 0} T up to three iterations using method of steepest descent.	**07**

OR

Q.4	**(a)**	Explain interior penalty function method of optimization	**07**
	(b)	Minimize $f = X_1X_2^{\ 2}X_3^{\ -1} + 2X_1^{\ -1}X_2^{\ -3}X_4 + 10X_1X_3$ Subject to $3X_1^{\ -1}X_3X_4^{\ -2} + 4X_3X_4 \le 1$ $5X_1X_2 \le 1$ Using Geometric Programming.	**07**
Q.5	**(a)**	Discuss complementary Geometric Programming and explain degree of difficulty.	**07**
	(b)	Explain different MATLAB functions for solving optimization problems	**07**

OR

Q.5	**(a)**	Stating working principle of genetic algorithms, explain three operators of the same.	**07**
	(b)	Formulate the problem of minimum weight design of a helical spring under axial load as a geometric programming problem. Consider constraints on the shear stress, natural frequency, and buckling of the spring.	**07**

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