NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL ENGINEERING

PART II - ENGINEERING DESIGN PRINCIPLES I - TIE 2107

FIRST SEMESTER EXAMINATION - NOVEMBER/DECEMBER 1999

Time Allowed: 3 Hours

Answer <u>FIVE</u> questions

Draw neat sketches to support your solutions.

Tables supplied:-   Shaft & Hole Tolerances   T1,T2,
**   Types of Fits   T3**
**   Standard Eyebolts   T4**
**   Standard Metric Threads   T5**

Qu. 1   a)   What are the values of maximum clearance, hole tolerance and
                shaft tolerance for the following dimensions of mated parts according
                to basic hole system?
                (H11 hole, c11 shaft, 34.000mm basic size).   [8]

        b)   A 20mm shaft rotates in a bearing in a pump. Recommend suitable
                fits and tolerances. Dimension both the shaft and bearing bore in
                accordance with the basic hole standard.   [9]

        c)   A cast steel hub having a minimum diameter of 100mm is to be shrink
                fitted on a shaft which has a maximum diameter of 100.150mm.
                Assuming a room temperature of 21°C, a coefficient of linear
                expansion for steel of $11.34 \times 10^{-6} K^{-1}$ and a desired diametral
                clearance of 0.05mm, to what minimum temperature should the hub
                be heated in order to permit assembly without interference?   [8]

Qu.2   a)   Recommend suitable fits for a shaft and gear assembly if the
                following data applies:
                common diameter d_c=100mm, outer diameter d_0 = 200mm, length of
                wheel l =120mm.   Maximum permissible torque transmitted =
                4000Nm, yield strength σ_y = 390MPa, elastic Modulus E = 2.1 x
                10^5MPa, coefficient of friction is f = 0.15, safety factor s = 2. Both
                gear and shaft are of same material.

$$\left[Take\ \tan gential\ stress\ at\ contact\ surface\ as:\ \sigma_{tco} = p_c \left(\frac{d_o^2 + d_c^2}{d_o^2 - d_c^2} \right) \right] [25]$$

Qu. 3   (a)   A vertical two start square threaded screw of a 100mm mean diameter and 20mm pitch supports a vertical load of 18KN. The axial thrust on the screw is taken by a collar bearing of 250mm outside diameter and 100mm inside diameter. Find the force required at the end of a lever which is 400mm long in order to lift and lower the load. The coefficient of friction for the vertical screw and nut is 0.15 and that for collar bearing is 0.20.   [20]

        b)   Would the screw in Qu. 3 be overhauling   [5]

Qu. 4   In order to pick up a heavy electromoter (mass 480kg), using an overhead crane, two eyebolts are installed as shown in figure FQ4.   Determine the safety factor of the bolts in operation, if $\propto = 75°$ and yield stress is 200MPa.   [25]

Qu. 5   Design a close coiled helical compression spring for a service load ranging from 2250N to 2750N. The axial deflection of the spring for the load range is 6mm. Assume a spring index of 5. The permissible shear stress intensity is 420 N/mm^2 and modulus of rigidity, G = 84 KN/mm^2. Neglect the effect of stress concentration. Draw a fully dimensioned sketch of the spring, showing details of the finish of the end coils.   [25]

Qu. 6   An eccentrically loaded welded joint of a steel bracket to a column is shown in Figure FQ6. The joint can either be double bevel butt or double fillet. Which of the two welds will take up a greater load if the bracket plate is 10mm thick, length of weldment l = 150mm, x = l, yield strength of material is 320MPa.   [25]
[Take $\alpha_{\tau\perp}$ = 0.75, $\alpha_{\tau||}$ = 0.65, $\alpha_{\perp}$ = 0.85, α_{τ} = 0.7]

END OF EXAM