

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL & MANUFACTURING ENGINEERING

ENGINEERING DESIGN APPLICATIONS 1 – TIE 2107

SUPPLEMENTARY EXAMINATIONS OCTOBER 2009

Time: Three hours

Instructions:

Answer Five Questions

QUESTION 1

Explain the Design process.

[20]

QUESTION 2

a) Define the following terms with regard to design

(i) Factor of safety

[4]

(ii) Reliability

[3]

(iii) Mechanical design

[3]

b). With the aid of a sketch show the terminology of screw threads.

[10]

QUESTION 3

a) Show that in power screws the torque required to lower the load is given by ;

$$T = Fd_m / 2 (\pi \mu d_m - l) / (\mu d_m + \pi l)$$

[5]

b) Two shafts are connected by a means of a coupling to transmit 5hp at 1440rpm.

The flanges of the coupling are fastened by means of four bolts at a radius of 30mm. permissible shear stress in the bolts is $\tau = 3 \text{ kg/mm}^2$. Design the bolt. [10]

c) Show that the resultant load in the bolts in bolted joints in tension is given by;

$$F_b = k_b P / (k_m + k_b) + F_i$$

[5]

QUESTION 4

Design a spindle for a milling machine to transmit from the motor to the cutter. The maximum power to be transmitted is 5H.P at 800 r.p.m. The angular deflection of the shaft for this service should not exceed 0.25° per metre length of spindle. The modulus of rigidity of the material is $0.84 \times 10^4 \text{ kg/mm}^2$. Determine also shear stress in the shaft. [20]

QUESTION 5

- a) What are the design considerations of a power screw drive? [5]
- b) Outline a procedure that can be adopted in designing of power screws [10]
- c) A square key is to be used to key a gear to a 35mm diameter shaft. The hub length of the gear is 60mm. both shaft and key are to be made of the same material, having an allowable shear stress of 55MPa. What are the minimum dimensions of the sides of the key if 395Nm of torque is to be transmitted? [5]

QUESTION 6

Show that for belt drives the relations between tensions in the belt are given by $T_1/T_2 = e^{\mu\theta}$ [20]

END OF EXAM