



KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (ENERGY AND MANUFACTURING) ENGINEERING

SET 408: ENGINEERING DESIGN

DATE: Wednesday 7th December, 2011

TIME: 2.00p.m – 4.00 p.m.

INSTRUCTIONS:

Attempt any THREE of the following FIVE Questions.

- Q.1) (a) Discuss SIX conditions a design product must meet to ensure acceptability. (3 marks)
- (b) Concisely describe any THREE criteria for material selection in a design exercise. (3 marks)
- (c) What is the significance of standardization in industry? (2 marks)
- (d) Discuss THREE types of standards used in industry. (3 marks)
- (e) The nuts of bolts can be produced at the rate of 30 units per hour on an automatic machine, or 10 units per hour on a manual machine. The set up time for the automatic machine is 3 hrs and the labour cost for either operation is 1000/= per hour including overheads.
- (i) Show these operations graphically. (3 marks)
- (ii) Find and indicate the Break Even Point. (3 marks)
- (iii) Beyond the Break Even Point, which method is advisable? (3 marks)

(Total 20 marks)

- Q.2) (a) A bronze alloy shaft of 50 mm diameter and 600 mm long is bored for part of its length to a diameter of 25 mm and subjected to a twisting moment.

- (i) If the design requirement is that the angle of twist in the length of 25mm bore and in that of the solid shaft are to be equal, calculate the length that has to be bored. (5 marks)
 - (ii) Calculate the total angle of twist if the shaft transmits 20 kW at 450 rpm. (5 marks)
 - (iii) Compare the maximum shear stresses produced in the two portions of the shaft. (4 marks)
- (b) It is required to design a square key for fixing a gear on a shaft of 25mm diameter. The shaft transmits 15 kW power at 700 rpm to the gear. The key is made of steel whose $\tau_{yt}=460 \text{ N/mm}^2$ and the safety factor is 3. The Yield Strength in tension is assumed to be equal to the Yield Strength in tension. Assume, by the distortion energy theory
- $$\tau_y = 0.577 \sigma_y$$

Calculate the dimensions of the key. (6 marks)

(Total 20 marks)

- Q.3)
- (a) Discuss FIVE advantages of welded joints compared to rivetted joints. (5 marks)
 - (b) By means of neat well labelled sketches, describe FIVE types of welded joints. (5 marks)
 - (c) A welded joint (fig. 1) is subjected to an eccentric force of 8.05kN. Determine the size of welds if the permissible shear stress for the weld is $95 \times 10^6 \text{ N.m}^2$. Assume static loading. (10 marks)
- Q.4)
- (a) Define the following terms
 - (i) Stress concentration
 - (ii) Stress concentration factor

(iii) Endurance limit

(iv) Notch sensitivity. (4 marks)

(b) Name any FOUR regions where fatigue failures is likely to occur in an engineering structure. (4 marks)

(c) A plate made of hot rolled steel, of $\sigma_{ut} = 440 \times 10^6 \text{ N/m}^2$ is shown in fig. 2.

It

is subjected to completely reversed axial load of 30KN.

The notch sensitivity factor (q)=0.8 and the expected reliability is 90%. Determine the plate thickness for infinite life. (6 marks)

(d) A machine part made of steel, $\sigma_{ut} = 630 \times 10^6 \text{ N/M}^2$, is shown at fig.2.

It is subjected to completely reversed axial force of 50 KN. The expected reliability is 90%, the factor of safety is 2 and the notch sensitivity factor is 0.8. Calculate the plate thickness for infinite life. (6 marks)

For questions 4(c) and 4(d) use tables 1-5 which are attached.

(Total 20 marks)

Q.5) (a) Distinguish between the functions of friction clutches and gears in power transmission. (2 marks)

(b) Distinguish between a rigid and flexible crumpling. (2 marks)

(c) (i) Working from first principles and using uniform pressure theory show that, torque transmitted by friction T,

$$\text{is given by } T = \frac{\mu p}{3} \frac{(D^3 - d^3)}{(D^2 - d^2)}$$

(6 marks)

Where μ = coefficient of friction of the mating surfaces

P = intensity of pressure (N/m^2)

D = outer diameter of friction disk (m)

d = inner diameter of friction disk (m)

(ii) A plate clutch consists of a pair of contacting surfaces. The inner and the outer diameters of friction disk are 100 mm and 200 mm

respectively. The coefficient of friction is 0.2 and the permissible intensity of pressure is 1N/mm^2 . Assuming the uniform pressure criterion, calculate the power transmitting capacity of the clutch at 750 rpm. (6 marks)

- (d) A rigid coupling is to transmit 60 KW power at 320 rpm. There are six bolts. The outer diameter of the flange is 210 mm while the recess diameter is 160mm. the coefficient of friction between the flanges is 0.15. the bolts are made of steel, $\tau_{yt}=380\times 10^6\text{N/m}^2$ and the factor of safety is 3. Calculate the diameter of each bolt. (4 marks)

(Total 20 marks)
