



# TECHNICAL UNIVERSITY OF MOMBASA

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Select Faculty/School/Institute

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## UNIVERSITY EXAMINATION FOR:

BSC

EMG 2413 : MACHINE DESIGN

END OF SEMESTER EXAMINATION

**SERIES:** APRIL 2016

**TIME:** 2 HOURS

**DATE:** Pick Date Select Month Pick Year

### Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of Choose No questions. Attempt Choose instruction.

**Do not write on the question paper.**

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### Question ONE

a.) Explain the following terms

- i.) Adhesives
- ii.) Seals
- iii.) O-rings
- iv.) Bill of materials
- v.) Level Code

(5 marks)

b.) Explain the function of seals with specific examples

(5 marks)

c.) Show that for a key,  $\sigma_{\text{crushing}} = 2\tau$

(5 marks)

Where  $\tau$ =shear stress,  $\sigma_{\text{crushing}}$ =stress in crushing

d.) Explain the difference between splines and keys

(2 marks)

e.) A splined connection is to be used to permit relative motion between the shaft and hub of connected member. The splines are 12 in number and are made with straight sides. The allowable normal bearing pressure on splines is to be limited to  $6 \text{ N/mm}^2$ . The height of each spline is 6 mm and is cut on 63 mm

standard size shaft. The length of the hub is 45 mm. Determine the torque carrying capacity of the shaft based on permissible pressure between sides of the splines. ( 4 marks)

f.) A simply supported shaft carries two masses 1 and 2. The static deflection at load points is 0.009 and 0.021mm respectively. Use Dunkley's equation to determine critical speed of the shaft. ( 4 marks)

### Question TWO

- a.) State the main six elements of Bill of Materials ( 3 marks)
- b.) Diagrammatically explain the difference between lap joint and a butt riveted joint. ( 4 marks)
- c.) Design a butt joint for two mild steel tie bars of dimensions 300 mm by 15 mm. Take strength in double shear as 1.875. Allowable stresses are  $\tau=85$ ,  $\sigma_t=120$  and  $\sigma_{crushing}=240 \text{ N/mm}^2$ . ( 15 marks)

### Question THREE

- a.) State and explain the three theories of adhesion ( 6 marks)
- b.) State and explain conditions under which a well-designed hydrodynamically lubricated bearing experiences boundary lubrication. ( 4 marks)
- c.) State and explain Petroff's law ( 3 marks)
- d.) A 200 mm long and 70 mm diameter journal bearing supports a load of 3000 N at 700 rpm. If room temperature is 30°C, what should be viscosity of oil to limit the bearing surface to 70°C? Diametral clearance is =0.07 mm. Energy dissipation coefficient based on projected area of the bearing =200W/m<sup>2</sup> (12 marks)

### Question FOUR

- a.) Discuss five types of welded joints clearly stating their engineering applications. Use illustrations. (5 marks)
- b.) Show that for a parallel fillet weld, Weld strength is  $1.414wL\tau$  where L is length of area joined, w is width and  $\tau$  is shear stress. ( 5 marks)
- c.) A bracket 40 mm is welded to a machine frame. Maximum load at a point A 50 mm from the wall/weld is 35mm N. Height of the bracket between the welds is 75 mm. Find the size of the weld at the top and bottom ( 10 marks)
- d.) Explain various factors that affect the strength of a welded joint ( 5 marks)

### Question FIVE

- a.) Adhesives can be classified into three main types. State and explain ( 6 marks)
- b.) What is surface preparation, Explain why the surface of adherents must be well prepared before application of adhesives ( 3 marks)
- c.) Design a shaft to transmit power from an electrical motor to a pump shaft through a pulley by means of a horizontal belt. The pulley weighs 20 kg and is located 200 mm from the center of the nearest bearing.

Diameter of the is 200 mm. Maximum power transmitted is 1.1 kw at 120 rpm. The angle of lap is of belts is  $180^\circ$  and coefficient of friction between the belt and pulley is 0.3. Shock factors in bending and torsion are 1.5 and 2 respectively. Allowable shear stress in the shaft is  $35 \text{ N/mm}^2$ . The pulley is mounted overhung on the shaft. ( 16 marks)