



MACHAKOS UNIVERSITY

University Examinations for 2019/2020 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMM 317: DESIGN OF MACHINE AND MACHINE ELEMENTS

DATE: 2/12/2020

TIME: 8.30-10.30 AM

INSTRUCTIONS

Answer Question One and Any Other Two Questions

QUESTION ONE (30 MARKS)

- a) With the aid of sketches describe the following types of gears
- i. Bevel gears (3 marks)
 - ii. Helical gears (3 marks)
 - iii. Spur gears (3 marks)
 - iv. Worm and worm wheel (3 marks)
- b) A triple threaded worm has a lead of 75 mm. The worm wheel has 48 teeth and is cut with a hob of normal module $m_n=7$ mm perpendicular to the teeth.
Calculate
- i. Speed ratio (2 marks)
 - ii. Centre distance if the shafts are at 90° (8 marks)
- c) Differentiate between rolling contact and sliding contact bearings (2 marks)
- d) List any four (4) purposes of couplings in power transmission (2 marks)
- e) Explain how solid shafts are manufactured (2 marks)
- f) Describe a cam and give two applications of the same (2 marks)

QUESTION TWO (20 MARKS)

- a) Identify any four specific types of transmission shafts and explain their applications. (8 marks)
- b) State four desirable properties for materials for shafts (4 marks)
- c) Find the diameter of a solid steel shaft to transmit 20 kW at 120 R.P.M. The ultimate shear stress for the steel may be taken as 280 MPa and a factor of safety as 8. (4 marks)
- d) If a hollow shaft is to be used in place of **the solid shaft in Q2(c)**, find the inside and outside diameter when the ratio of inside to outside diameters is 0.5. (4 marks)

QUESTION THREE (20 MARKS)

- a)
 - i Using a suitable sketch, describe a woodruff key (4 marks)
 - ii State the major advantage round keys have over other type of keys (1 mark)
- b)
 - i Differentiate between dynamic and static seals (2 marks)
 - ii Why is it important to minimize the size of a cam? (3 marks)
- c) A 360 mm radius brake drum contacts a single shoe as shown in Figure Question 3(c) and sustains 300 Nm torque at 10 rev per second. If the coefficient of friction of 0.3 determine:-
 - i. The total normal force N on the shoe. (2 marks)
 - ii. The required force F to apply brake for clockwise rotation. (2 marks)
 - iii. The required force F to apply brake for anticlockwise rotation. (2 marks)
 - iv. The dimension c required to make the brake self-locking, assuming the other dimensions remain as shown. (2 marks)
 - v. The rate of heat generated. (2 marks)

QUESTION FOUR (20 MARKS)

- a) With the aid of sketches describe the design and operation of the following machine elements
 - i. Cone clutch (3 marks)
 - ii. Dog-clutch or jaw-clutch (3 marks)
- b) A single plate clutch with both sides of the plate effective is required to transmit 25 KW at 1600 rpm. The outer diameter of the plate is limited to 300 mm and the intensity of pressure between the plates is not to exceed 0.07 N/mm². Assuming uniform pressure and coefficient

of friction as 0.3, find the inner diameter of the plate and the axial force necessary to engage the clutch. (10 marks)

c) Explain the meaning of the following terms applied to bearing

i. Pre-loading (2 marks)

ii. Hydro-dynamically lubricated bearings (2 marks)

QUESTION FIVE (20 MARKS)

a) With aid of sketches describe 5 types of flat belt drives (10 marks)

b) An engine running at 150 rpm drives a line shaft by means of pulleys and a 5mm thick canvas belt. The engine pulley is 750 mm in diameter and the pulley on line shaft is 450 mm in diameter. A 900 mm pulley on the line shaft drives a 150mm diameter pulley keyed to a dynamo shaft. Find the speed of the dynamo when

i. There is no slip (5 marks)

ii. There is a 2% slip at each drive (5 marks)

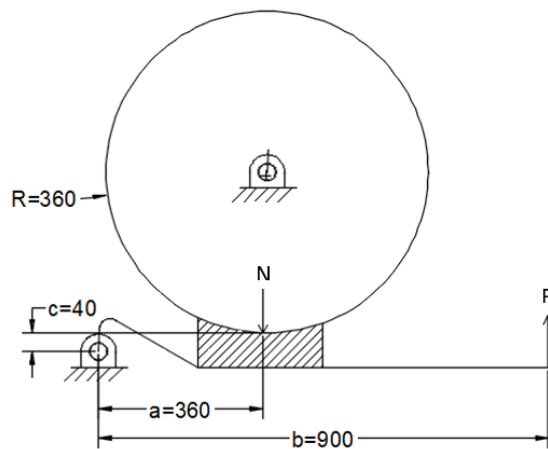


Figure Question 3(c): All dimensions in mm