



MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

**THIRD YEAR SECOND SEMESTER EXAMINATIONS FOR THE DEGREE OF
BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING**

EMM 317: DESIGN OF MACHINE AND MACHINE ELEMENTS

DATE: 22nd May 2019

TIME: 8:30-

10:30

INSTRUCTIONS

This paper contains FIVE questions

Question ONE is compulsory and carries 30 Marks

Questions TWO – FIVE carries 20 Marks each. Attempt any two.

QUESTIONS ONE

- a) Describe in details the life cycle of an engineering project **(9 Marks)**
- b) Derive the equation for ratio of belt tensions between slack and tight side in a flat belt and pulley system. **(5 Marks)**
- c) Define obsolescence and differentiate between planned and perceived obsolescence **(4 Marks)**
- d) Differentiate between rolling contact and sliding contact bearings **(3 Marks)**
- e) List any four (4) purposes of couplings in power transmission **(2 Marks)**
- f) Explain how solid shafts are manufactured **(3 Marks)**
- g) Describe a cam and give two applications of the same **(4 Marks)**

QUESTIONS TWO

- a) A marine type flange coupling is used to transmit 4 MW at 150 rpm. The allowable shear stress in the shaft and bolts may be taken as 50 MN/m². The number of bolts on the flange are to be 10 and the pitch circle diameter of the bolts is 1.6 the diameter of the shaft. Design the shaft, key and the bolts **(9 Marks)**
- b) Differentiate between shaft and axle **(2 Mark)**
- c) A solid shaft is to be replaced by a hollow shaft of the same diameter and material with inside diameter equal to 50% of the outside diameter. Determine:
- i. The percentage reduction in torque capacity of hollow shaft **(3 Mark)**
 - ii. The percentage saving in weight of hollow shaft **(3 Mark)**
 - iii. The percentage increase in shear stress for equal strength of solid and hollow shaft **(3 Mark)**

QUESTIONS THREE

- 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)**
(iii) State the advantage of splined shafts over shafts having a single keyway **(1 Mark)**
- b) (i) Differentiate between dynamic and static seals **(2 Marks)**
- c) (ii) Explain clearly the main considerations made before design and selection of a dynamic seal **(5 Marks)**
- d) (i) Define the term 'cam pressure angle'. Illustrate your answer with a suitable diagram **(4 Marks)**
(ii) Why is it important to minimize the size of the cam? **(3 Marks)**

QUESTION FOUR

- a) 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/mm^2 . Assuming uniform pressure and coefficient of friction as 0.3.
- (i) Find the inner diameter of the plate and the axial force necessary to engage the clutch. **(7 Marks)**
 - (ii) Assuming the same dimensions and same total axial thrust, determine the maximum torque that can be transmitted when uniform wear conditions are assumed **(2 Marks)**
- b) Describe the meaning of hydro-dynamically lubricated bearings **(2 Marks)**
- c) Discuss any six properties desired for sliding contact bearing materials **(6 Marks)**
- d) Discuss the effects of anti-friction bearing misalignment on their life **(3 Marks)**

QUESTION FIVE

- a) Differentiate between helical and bevel gears **(2 Marks)**
- b) State any three advantages of using worm and worm wheel **(3 Marks)**
- c) Define the term “Module” as used in spur gears **(1 Mark)**
- d) A spur wheel with involute teeth gear rotates together externally. The pitch circle diameter are 100 mm and 250 mm and the smaller wheel has 16 teeth. The pressure angle is 20° and the addendum is 0.3 of the circular pitch. Determine
- (i) The length of approach **(3 Marks)**
 - (ii) The length of recess **(3 Marks)**
 - (iii) The arc of contact **(3 Marks)**
 - (iv) The minimum number of teeth in contact at any one time **(2 Marks)**
 - (v) The maximum velocity of sliding between the teeth when the driver rotates at 150 rpm. **(3 Marks)**