(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2021/2022 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE

OF

BACHELOR OF SCIENCE IN MECHANICAL AND INDUSTRIAL ENGINEERING

COURSE CODE: MIE 242

COURSE TITLE: MECHANICS OF MACHINES II

DATE: 26/04/2022 **TIME:** 15:00 – 17:00

INSTRUCTIONS TO CANDIDATES

This paper contains **FOUR** Questions
Answer **question ONE (1)** and any **OTHER TWO** questions

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over. ▶

1. (a) Differentiate between Spur and Helical gears, giving **two** advantage for each (4 marks)

   (ii) Give **three** advantages of Gear drive   (3 marks)

   (iii) Briefly explain why knife-edge follower mechanism is rarely used in practice

                                                                              (2 marks)

   (b) (i) Define the following terms, giving one example for each:

   (i) Mechanism (ii) Structure   (4 marks)

   (c) Define the following pairs of terms clearly indicating their differences,

   (i) Addendum (iii) dedendum   (2 marks)

   (d) With reference to gears, explain the meaning of the following terms

   (i) Module (ii) Circular pitch   (iii) pressure angle   (6 marks)

   (e) The crank and connecting rod of a steam engine are 0.3 m and 1.5 m in length. The crank rotates at 180 r.p.m. clockwise. Determine the velocity and acceleration of the piston when the crank is at 40 degrees from the inner dead centre position. Also, determine the position of the crank for zero acceleration of the piston.   (10 marks)

2. (a) There are four gears A, B, C and D in a reverted gear train. A is the driver, D is the driven and B and C are on the same shaft. Draw a neat sketch of reverted gear train. The overall speed ration of the above gear train is 16. The module pitch of gears A and B is 4 mm and of C and D is 2.5 mm. Calculate the suitable number of teeth for the gears if the distance between the shafts is approximately 200 mm.   (10 marks)
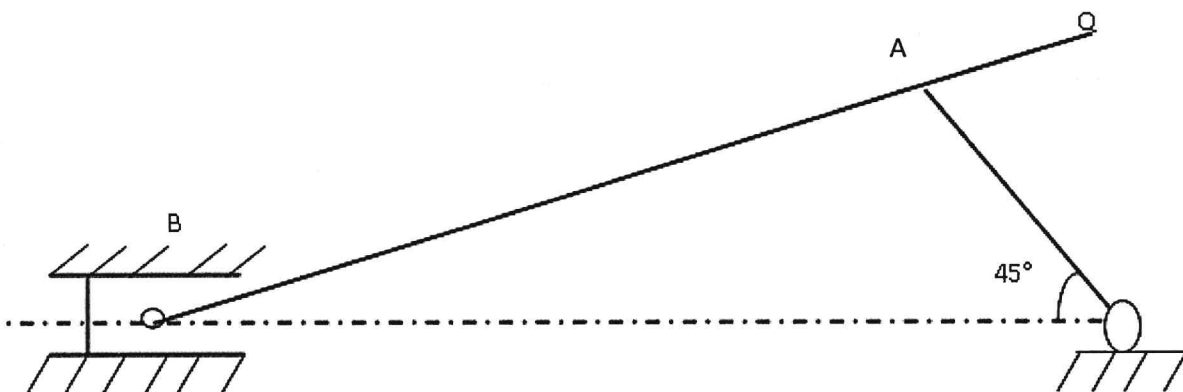

Fig. Q2

(b) The slider-crank mechanism shown in **Fig. Q2** has a crank of length 75 mm rotating at 600 rev/min. If the connecting rod is 300 mm and point Q is 50 mm from A, use graphical method to determine the linear velocity of the piston B and that of point Q when the crank angle θ is 45° from the inner dead centre (10 marks)

3. (a) (i) Draw a neat sketch of a typical cam-follower profile and identify each section. What is the significant of the upper dwell in an engine mechanism (4 marks)

(ii) Briefly explain the characteristics of a parabolic (constant acceleration) displacement cam-follower mechanism and explain where they are commonly used (3 marks)

(ii) Using a ketch, name and explain the working principle of the whit worth quick--return mechanism (3 marks)

(b) A vertical petrol engine 10 cm diameter and 12 cm stroke has a connecting rod 25 cm long. The mass of the piston is 1.2 kg. The speed is 1800 r.p.m. On the expansion stroke with a crank 25° from top dead centre, the gas pressure is 680 kN/m². Determine: (i) Net force on the piston, F_P (ii) Resultant load on the gudgeon pin F_Q (iii) Thrust on the cylinder walls F_N (iv) the Turning moment on the crank shaft, M (10 marks)

4. (a) A certain epicyclic gear consists of a fixed annulus wheel A concentric with a sun wheel S geared through a planet wheel P which can rotate freely on a pin carried by an arm L which rotates about an axis co-axial with that of S and A. If T_S and T_A are the number of teeth on S and A respectively, show that the ratio of speeds of L and S is (7 marks)

$$\frac{T_S}{T_S + T_A}$$

(b) An epicyclic train has two planet wheels diametrically opposite each other, each of 60 teeth, a sun wheel with 80 teeth, the former meshing with internal teeth of a fixed annulus of 200 teeth. If the input shaft carrying the sun wheel transmits 4 kW at 300 rpm and the output shaft carries the planet gears, determine:

    (i)   The speed of the output shaft
    (ii)   The torque transmitted if the overall efficiency is 90% (11 marks)

(c) If the annulus in part (b) above is rotated independently, what should its speed be in order to make the output shaft rotate at 20 rpm? (2 marks)