



MUEO

MOI UNIVERSITY

OFFICE OF THE DEPUTY VICE CHANCELLOR
(ACADEMICS, RESEARCH & EXTENSION)

UNIVERSITY EXAMINATIONS

2016/2017 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER EXAMINATION

FOR THE DEGREE OF

BACHELOR OF ENGINEERING

IN

INDUSTRIAL AND TEXTILE ENGINEERING

COURSE CODE: MIT 234

COURSE TITLE: INDUSTRIAL MECHANICS

DATE: 9TH JUNE, 2017 **TIME:** 2.00 P.M. – 5.00 P.M.

INSTRUCTION TO CANDIDATES

- SEE INSIDE.

THIS PAPER CONSISTS OF (3) PRINTED PAGES

PLEASE TURN OVER

Instructions.

1. This paper contains seven questions. All questions have equal marks
2. Attempt any five questions only.
3. Exam duration is three hours only.

Constants.

- Modulus of rigidity, $C = 84 \text{ GPa}$
- Young's modulus, $E = 200 \text{ GPa}$
- Density of cast iron $= 7.2 \text{ Mg/m}^3$
- Gravitational constant, $g = 9.81 \text{ m/s}^2$
- $\text{Pi} = 3.14$

QUESTION ONE

- a) A uniform rod of length 20m has a square cross-section of side 0.1m and is made from an alloy with a density of 3.0 kg/m^3 . Calculate its moment of inertia about an axis perpendicular to its length and through:
- (i) Its center of gravity, **3 marks**
 - (ii) One end. **4 marks**
- b) A steel cylinder of 500 mm outside diameter and 200 mm inside diameter is set in rotation about its axis. If the cylinder is 900 mm long and has a density of $7,800 \text{ kg/m}^3$, calculate the torque required to give it an angular acceleration of 0.5 rad/s^2 . **2 marks**
- c) A carding engine cylinder has a mass of 200kg and its radius of gyration is 50 cm.
- i. What is its K.E at 180 rev/min? **5 marks**
 - ii. If the moment of inertia of the cylinder is 50% of that of the entire machine, what torque and maximum power are required to accelerate the engine from rest to its operating speed of 180 rev/min in 30 seconds? **2 marks**

QUESTION TWO

- a) Differentiate between:
- (i). Kinematics and Dynamics. **3 marks**
 - (ii). Static and Dynamic balancing. **3 marks**
- b) What happens when the moving parts in an engine are not in complete balance? **3 marks**
- c) A shaft carries four masses A, B, C, and D. The masses are 15 kg, 10 kg, 18 kg, and 12 kg, and their radius of rotations are 4 cm, 5 cm, 6 cm, and 3 cm respectively. The angular positions of the masses B, C and D are 60° , 130° and 270° from the mass A. Find the magnitude and position of the balancing mass at a radius of 10 cm. **8 marks**

QUESTION THREE

With respect to vibrations in machines discuss the following:

- a) Causes **6 marks**
- b) Harmful effects **2 marks**
- c) Remedies **6 marks**

QUESTION FOUR

- a) With the help of illustrations, differentiate amongst the three main types of vibrations **6 marks**
- b) A flywheel is mounted at a height of 0.6 m from the bottom on a vertical shaft of diameter 50 mm and of length 1.5 m, fixed at both ends. The flywheel has a mass of 450 kg, and a radius of gyration 0.5 m. Find the natural frequencies of:
- (i) Longitudinal vibration. **4 marks**
 - (ii) Torsional vibration. **4 marks**

QUESTION FIVE

- a) A shaft is supported in bearings at A and B, 2.2 m apart (see Figure Q5a). A rotor of total mass 40 kg is mounted at a point 1.2 m from bearing A. Given that the centre of gravity of the rotor is offset 2 mm from the axis of rotation O. Establish the:
- Dynamic loads on the bearings when the shaft rotates at 600 rpm **4 marks**
 - Maximum and minimum bearing reactions, specifying whether the reaction is downward or upward. **7 marks**

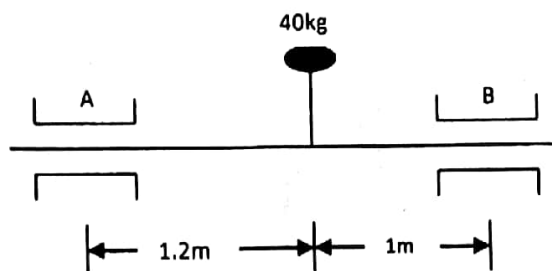


Figure Q5a

- b) Give a simple explanation of the *Coriolis* force and its effect. **3 marks**

QUESTION SIX

- a) A heavy machine roller has a mass of 500 kg, a radius of gyration of 20 cm and an operating speed of 90 rpm:
- What is its Kinetic energy at its operating speed? **2 marks**
 - If the moment of inertia of the cylinder is 80 % of that of the entire machine, what torque and maximum power are required to accelerate the engine from rest to its operating speed in 10 seconds? **6 marks**
- b) The 50 kg block moves between vertical guides as shown in Figure Q 6b. The block is pulled 40 mm down from its equilibrium position and released. Assuming a static load of magnitude $P = 12$ kN in your calculation, determine the:
- Period of the vibration **2 marks**
 - Maximum velocity of the block **2 marks**
 - Maximum acceleration of the block **2 marks**

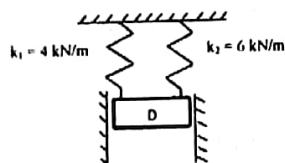


Figure Q 6b

QUESTION SEVEN

- a) Discuss the classification of gears **6 marks**
- b) There are four gears A, B, C, and D in a reverted gear train. A is the driver, D is the driven and B, C are on the same shaft. The speed ratio of the gear train is 16. The module pitch of gears A and B is 4 mm and of C and D is 2 mm. **2 marks**
- Draw a labelled sketch of the reverted gear train. **2 marks**
 - Calculate the suitable number of teeth for the gears if the distance between the shafts is approximately 150 mm. **6 marks**