THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

INSTITUTIONAL BASED PROGRAMME

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING - YEAR III

EME 4303 MECHANICS OF MACHINES I

SEMESTER I EXAMS

SERIES NOVEMBER 2011

TIME 2HOURS

INSTRUCTION TO CANDIDATES

You should have the following for this examination
- *Drawing instruments*
- *Scientific Calculator*

This paper consists of <u>FIVE</u> questions, question <u>ONE</u> is compulsory,
Answer question <u>ONE</u> and any other <u>TWO</u> question
Maximum marks for each part of a question are as shown.

Question 1

a) Describe the following types of friction:

    i.   Static friction

(2 marks)

    ii.   Dynamic friction

(2 marks)

b) A body, resting on a rough horizontal plane required a pull of 180 N inclined at 30º to the plane just to move it. It was found that a push of 220 N inclined at 30º to the plane just moved the body. Determine the weight of the body and the coefficient of friction.

(12 marks)

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c) A shaft which rotates at a constant speed of 160 r.p.m. is connected by belting to a parallel shaft 720 mm apart, which has to run at 60, 80 and 100 r.p.m. The smallest pulley on the driving shaft is 40 mm in radius. Determine the remaining radii of the two stepped pulleys for an open belt. Neglect belt thickness and slip.

(14 marks)

Question 2

The mean diameter of the screw jack having pitch of 10 mm is 50 mm. load of 20 kN is lifted through a distance of 170 mm. Find the work done in lifting the load and efficiency of the screw jack when:

  i.   the load rotates with the screw, and
  ii.   the load rests on the loose head which does not rotate with the screw.

The external and internal diameters of the bearing surface of the loose head are 60 mm and 10 mm respectively. The coefficient of friction for the screw as well as the bearing surface is 0.08.

(20 marks)

Question 3

a) Describe Kutzbach's and Grubler's criteria for plane mechanisms.

(4 marks)

b) A point moves with simple harmonic motion. When this point is 0.75 metre from the mid path, its velocity is 11 m/s and when 2 metres from the centre of its path its velocity is 3 m/s. Find its angular velocity, periodic time and its maximum acceleration.
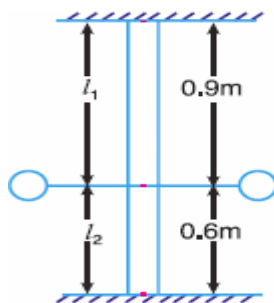
(16 marks)

Question 4

A flywheel is mounted on a vertical shaft as shown in Figure 1. The both ends of the shaft are fixed and its diameter is 50 mm. The flywheel has a mass of 500 kg. Find the natural frequencies of longitudinal and transverse vibrations. Take E = 200 GN/m2.   (20 marks)

Question 5

Four masses m1, m2, m3 and m4 are 200 kg, 300 kg, 240 kg and 260 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively and the angles between successive masses are 45°, 75° and 135°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m.

(20 marks)

Figure 1