TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATIONS FOR DEGREE IN

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EMG 2208: MECHANICS OF MACHINES I

END OF SEMESTER EXAMINATIONS
YEAR 2 SEMESTER 2
SERIES: DECEMBER 2013
TIME: 2 HOURS

INSTRUCTIONS:

1. You should have the following for this examination:
   - Answer Booklet
   - Scientific calculator
   - Drawing Instruments

2. This paper consists of **FIVE** Questions
3. Answer any **THREE** Questions.

This paper consists of FOUR printed pages

QUESTION 1

For the mechanism shown in Figure Q1 Link DE is constrained by guides to move vertically, being driven by crank ABC, with an angular velocity of 5 rad/s and an angular accelerating of -35rad/s^2, and a sliding block at D. What is the acceleration of DE? **(20marks)**

QUESTION 2

a) A body of mass *M* on a plane at 20^o to the horizontal and do which the coefficient of friction is μ, is acted upon by a force applied upwards and parallel to the plane. When this force has a value of

60N,the body slides steadily downwards, when the value is 175N, the body moves steadily upwards. Deduce from these results the values of M and μ. **(6marks)**

b) A body of mass 50kg on a plane inclined at 20° to the horizontal, the friction coefficient is 0.15 is to be moved by a force, P, directed at an angle of 15° to the plane, i.e. at 35° to the horizontal. Determine.

i) The value of P which will cause steady upward movement.
ii) The value to which P must be reduced before downward movement becomes possible.

(14marks)

QUESTION 3

a) Show that the ratio of belt tension for V-grooved pulley is given by:

$$\frac{T_1}{T_2} = e^{\mu\theta Co\sec\beta}$$

Where

- T_1 and T_2 are belt tensions of the pulley system.
- θ –angle of lap
- μ - coefficient of friction
- β - semi-angle of the groove

(8marks)

b) An electric motor transmits power by 3V-belts, each of 320mm^2 cross-sectional areas, the total angle of groove being 45°. The density of the belt material is 1.65 Mg/m^3 and the maximum allowable working stress in the belt is 2MN/m^2. μ =0.2. The angle of lap on the motor pulley is 145°. If the speed of the motor pulley is 1400 rev/min calculate:-

i) The power which can be transmitted
ii) The corresponding diameter of the motor pulley**.**

(12marks)

QUESTION 4

a) A gear box with the input and output shafts in the same line is required to have a drive ratio of approximately 4 to 1. The gears are to have a module of 3 and the intermediate shaft is to have its centre parallel to the input and output shafts but offset by 67.5mm. If no gear is to have less than 15 teeth, suggest suitable teeth numbers. **(10marks)**

b) An epicyclic train of the form shown in figure Q.4(b) has a fixed annulus with 80 teeth and a sun wheel with 40 teeth.

i) What will be the number of teeth required for a planet wheel.
ii) Determine the gear ratio the sun and the arm

(12marks)

QUESTION 5

a) An engine reciprocating mechanism of Figure Q5 has a crank shaft radius, *r* and *a* connecting rod of length, *L*. If the crank shaft is rotating at an angular speed *w* anti-clockwise show that the acceleration of the piston a_p is given by:

$$a_p = w^2 r(\cos\theta + \frac{r}{l}\cos 20)$$

Where θ is the angle that the crank makes with the horizontal?

(10marks)

b) An engine mechanism has a crank shaft radius of rotation of 120mm and a connecting rod of 400mm. If the crank rotates at 4 rev/s, and make an angle of 30° with the inner dead centre position determine.

i) The velocity and accelerative of the piston
ii) The velocity and acceleration of the connecting rod.

(10marks)