TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY SPECIAL/SUPPLEMENTARY EXAMINATION 2013/2014

SECOND YEAR SECOND SEMESTER UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (BSME)

EMG 2208 : MECHANICS OF MACHINES I

TIME: 2 HOURS **SERIES:** MARCH, 2014

INSTRUCTIONS TO CANDIDATES

1. You are required to have the following for these examinations:
   - Answer Booklet
   - Scientific Calculator
   - Drawing Instrument

2. This paper has **FIVE** Questions.
3. Answer **ANY THREE** Questions.
4. All Questions carry Equal marks.
5. This paper consists of **THREE** ***Printed pages.***

Q.1 In the mechanism shown in Figure Q1, the crank AB 75mm long and rotates uniformly clockwise at 8rad/s. Given that BD=DC=DE and BC = 300mm. Draw the velocity and acceleration diagrams. State the velocity and the acceleration of the pistons.

(20 marks)

Q.2 (a) For power screw raising a load w, show that the torque T is given by:

$$T = \frac{wd}{2}\frac{\tan\alpha + \mu}{1 - \mu\tan\alpha}$$

Where: d = the mean thread diameter
α = helix angle of the thread
μ = coefficient of friction

(8 marks)

Q.3 (a) For a flat belt pulley system show that the power transmitted is given by:

$$Power = (T_1 - T_c)\left(1 - \frac{1}{e^{u\theta}}\right)V$$

Where:
T_C	=	Centrifugal tension
T_1	=	Tension on the light side
μ	=	Coefficient of friction
Θ	=	Angle of lap
V	=	The linear velocity of the belt

(10 marks)

(b) A belt drive consists of a V-belt working on a grooved pulley, with an angle of lap of 160°. The cross-sectional area of the belt is 650mm^2, the groove angle is 30° and μ = 0.15. The density of the belt material is 1.2Mg/m^3 and its maximum safe stress is 8MN/m^2 of cross-section.

Determine the power that can be transmitted at a belt speed of 25m/s.

(10 marks)

Q.4 (a) With the aid of sketches explain the following gear trains:

(i) Reverted compound gear train
(ii) Expicyclic gear train

(6 marks)

(b) Figure Q4(b) shows an epicyclic gear train in which the wheel D is held stationary by the shaft A and the arm B is rotated at 200rev/min. The wheels E and F are fixed together and rotate freely on the pin carried by the arm. The wheel G is rigidly attached to the shaft C.

The numbers of teeth are as follows E = 20, F = 40, and G = 30. If the gearing transmits 7.5kw determine:

(i) Speed of shaft C, stating the direction of rotation relative to that of B.
(ii) The torque transmitted that will be required to hold shaft A stationary if all frictional losses are neglected.

(14 marks)

Q.5 (a) A horizontal engine has a cylinder diameter 100mm and a stroke of 140mm. The connecting rod has a length of 250mm and the crankshaft rotates at 30 rev/s. The reciprocating parts have a mass of 1.2kg. When the crank is at 20^{o} from the inner deed centre and the net pressure on the piston is 0.8MPa determine:

(i) The resultant load on the gudgeon pin
(ii) The thrust on the cylinder wall

(10 marks)

(b) A vertical engine has a cylinder of diameter 260mm and a stroke of 450mm. The connecting rod has a length 900mm and the crankshaft rotates at 6rev/s. If the reciprocating parts have a mass of 180kg, what is the crankshaft torque when the crank is at 45^{o} from the inner dead centre and the net pressure on the piston is 1mPa?

(10 marks)