THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 03
FINAL EXAMINATION 2009/2010
MEX 3230 – MECHANICS OF MACHINES
DATE : 10 MARCH 2010
TIME : 0930 HRS - 1230 HRS
DURATION : 03 HOURS

ANSWER ANY FIVE (05) QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS.

Question 01:

a) Obtain an expression for the path of contact in terms for addendum circle radius (r_A), pitch circle radius (r) and pressure angle (φ). (08 marks)

b) Two gears having 50 and 60 involute teeth are in mesh. Their pressure angle (Φ) and module (m) are 20^0 and 10 mm respectively. The line of contact on each side of the pitch point is half the maximum possible length. Find the height of addendum for each gear wheel and the length of the arc of contact.

(12 marks)

Question 02:

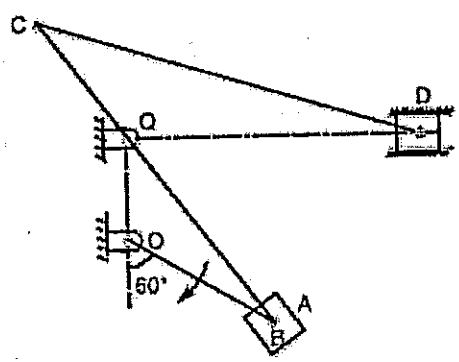


Fig.Q2

Fig.Q2 shows a Whitworth Quick Return motion Mechanism. The various dimensions in the mechanism are as follows.

OQ=100 mm OA=200mm
QC=150mm and CD=500mm.

The crank OA makes an angle 60^0 with the vertical and rotates at 120 rpm. in the clockwise direction. Locate all the instantaneous centers and find the velocity of ram D.

(20 marks)

Question 03:

A belt drive consists of two V-belts in parallel, on grooved pulleys of the same size. The angle of the grove is 30^0. The cross-sectional area of each belt is 750 mm^2 and μ= 0.12. The density of the belt material is 1200 kg/m^3 and the maximum safe stress in the belt material is 7 MPa. Calculate the power that can be transmitted between the pulleys 300 mm diameter rotating at 1500 rpm. Find also the shaft speed in rpm at which the power transmitted would be the maximum.

(20 marks)

Question 04:

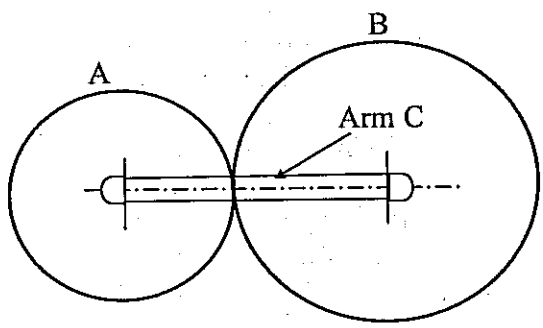


Fig.Q4

In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 rpm. in the anticlockwise direction about the center of the gear A which is fixed, determine the speed of gear B.

If the gear A, instead of being fixed, makes 300 rpm in the clockwise direction, what will be the speed of gear B?

(20 marks)

Question 05:

a) Write the difference between static balance and dynamic balance.

(05 marks)

b) A line shaft carries four rotors ***A, B, C*** and ***D*** each 200 mm apart from one another. Out of balance forces produced by the rotors ***A, B*** and ***C*** are 600 N, 1000 N and 500 N respectively at the shaft speed of 500 rev/min. If the shaft is dynamically balanced find the directions of the out of balance forces of rotors ***B, C*** and ***D*** relative to the rotor ***A***. Also determine the magnitude of the out of balance force produced by rotor ***D***.

(15 marks)

Question 06:

Show that at equilibrium, the height of the governor of a Porter type is given by;

$$h= (1+M/m)\, g/\omega^2$$

Where M = mass of sleeve, m = mass of ball, ω = speed of the governor

(10 marks)

A Porter governor has equal arms, each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift, and 200 mm when the governor is at maximum speed. Find the minimum and maximum speeds and range of speed of the governor.

(10 marks)

Question 07:

A plate clutch consists of a flat driven plate gripped between a driving plate and pressure plate, so that there are two active driving surfaces, each having an inner diameter 200 mm and an outer diameter 350 mm. μ = 0.4. The working pressure is limited to 170 kN/m^2. Assuming the pressure is uniform, calculated the power which can be transmitted at 1000 rev/min. If the clutch wears out in manner that the intensity of pressure is inversely proportional to the radius, calculate the power which can now be transmitted at 1000 rev/min and the maximum intensity of pressure on the friction surfaces when the total axial force on the pressure plate remains unaltered.

(20 marks)

Question 08:

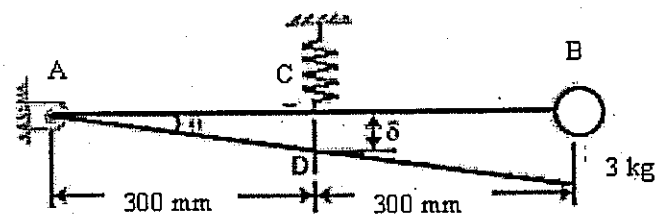


Fig.Q8

A uniform thin rod as shown in Fig.Q8 has a mass of 1.5 kg and carries a concentrated mass of 3 kg, at B. The rod is hinged at A and is maintained in a horizontal position by a spring of stiffness 2 kN/m at C.

Find the frequency of oscillation, neglecting the effect of the mass of the spring.

(20 marks)

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