THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 03
FINAL EXAMINATION 2006/2007
MEX 3230/MED1201– MECHANICS OF MACHINES
DATE :22nd MARCH 2007
TIME :0930 HRS - 1230 HRS
DURATION :03 HOURS

WRITE YOUR INDEX NUMBER CLEARLY	
WRITE YOUR REGISTRATION NUMBER	

READ THE FOLLOWING INSTRUCTIONS CAREFULY BEFORE ANSWERING THE QUESTION PAPER

Part – B

1. *Part – B consists of* ***eight*** *questions. Answer* ***only five*** *questions.*
2. *All questions carry equal marks.*
3. *Time allocation for Part B is* ***2 hrs and 15 minutes.***
4. *Do not spend more than* ***20 – 25 minutes*** *for each question.*
5. *Hand over* ***Part B*** *separately.*

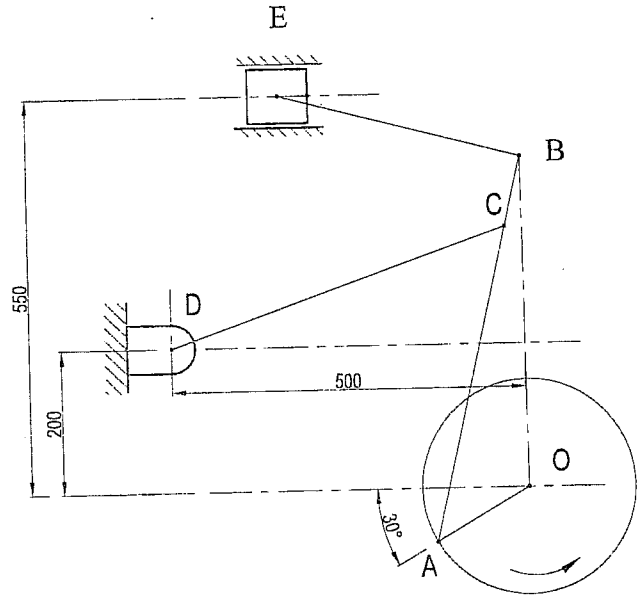
Part B

QUESTION 01

a) What is the instantaneous center of a kinematic system?

b) Fig.Q1 shows the mechanism of a radial valve gear. The crank OA turns at a uniform speed of 150 r.p.m. and is pinned at A to rod AB. The point C in the rod is guided in a circular path with D as the center and DC as the radius. The point E moves horizontally. The dimensions of various links are:

OA = 150 mm; AB = 550 mm; AC = 450 mm; DC = 500 mm; BE = 350 mm. Determine velocity and acceleration of the ram E for the given position of the mechanism.



All dimensions in mm

Fig.Q1

QUESTION 02

A single plate clutch, effective on both sides, is required to transmit 25 kW at 3,000 r.p.m. Determine the outer and inner radii of frictional surface if the coefficient of friction is 0.25, the ratio of radii is 1.25 and the maximum pressure is not exceed 0.1 N/mm^2. Also, determine the axial thrust to be provided by springs. Assume uniform wear.

QUESTION 03

a) Give three advantages of epicyclic gear systems over the other gear systems.

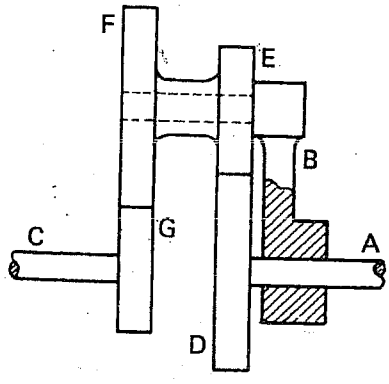


Fig.Q3

b) Fig.Q3 shows an epicyclic gear train in which the wheel ***D*** is held stationary by the shaft ***A***. The arm ***B*** is rotated at 200 rev/min. The compound gear ***E*** and ***F*** rotates freely on the pin carried by the arm. The wheel ***G*** is rigidly attached to the shaft ***C***.

Find the speed of the shaft ***C***, stating the direction of rotation relative to that of ***B***.
The numbers of teeth are as follows: *E*, 20; *F*, 40; *G*, 30.
If the gearing transmits 7.5 kW, what will be the torque required to hold the shaft ***A*** stationary if all frictional losses are neglected?

QUESTION 04

a) A block of weight '***W***' lies on a plane inclined at an angle 'α' to the horizontal. Prove that the magnitude of a horizontal force ***H*** required to slide the block directly up the plane without acceleration is $W \tan(\alpha + \lambda)$, where 'λ' is the friction angle between the block and the plane.

b) A turn buckle, with right hand single start threads at one end and left hand single start threads at the other end of the power screw, is used to couple two wagons. Its thread pitch is 12 mm and mean diameter 40 mm. The coefficient of friction between the nut and screw is 0.16. Determine the work done in drawing the wagons together a distance of 240 mm, against a steady load of 2,500 N. Assume square threads.

QUESTION 05

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 1,200 kg/m^3 and the maximum safe stress in the material is 7 MPa. Calculate the power that can be transmitted between pulleys of 300 mm diameter rotating at 1,500 r.p.m. Determine the rotational speed (in r.p.m.) at which the power transmitted would be maximum.



QUESTION 06

a) For a pair of spur gears, derive an expression for the path of contact (L) in terms of addendum circle radius (R), pitch circle radius (r) and pressure angle (φ).

c) A pinion having 18 teeth engages with an internal gear having 72 teeth. If the gears have involute profiled teeth with 20^0 pressure angle, 4 mm module and the addendum on pinion and gears are 8.5 mm and 3.5 mm respectively, find the length of the path of contact.

QUESTION 07

A,B,C and *D* are four masses carried by a rotating shaft at radii 100 mm, 125 mm, 200 mm and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of *B, C* and *D* are 10 kg, 5 kg and 4 kg respectively.

Find the required mass *A* and the relative angular settings of the four masses, so that the shaft shall be in complete balance.

QUESTION 08

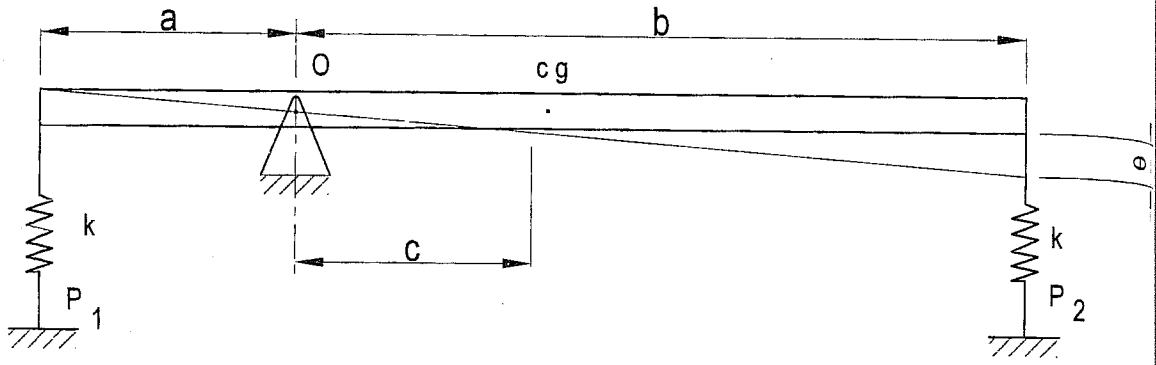


Fig.Q8

Fig.Q8 shows a uniform bar AB, which is pivoted at ***O*** and attached to two springs of equal stiffness ***k*** at each end. The bar is horizontal in the equilibrium position with spring forces P_1 and P_2. Show that the natural frequency of oscillation of the bar is

$$\omega_n = \sqrt{\frac{k\left(a^2 + b^2\right)}{J_o}}$$

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