The Open University of Sri Lanka
Faculty of Engineering Technology

Study Programme	:	Diploma in Technology/Bachelor of Technology (Engineering)
Name of the Examination	:	Final Examination
Course Code and Title	:	**MEX4276 Mechanics of Machines**
Academic Year	:	2014/15
Date	:	28th August 2015
Time	:	0930hrs – 1230hrs
Duration	:	3 hours

General instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of 8 questions.
3. Answer any 5 questions. All questions carry equal marks.

Question No.01:

The dimensions of the mechanism, as shown in Fig.Q1, are as follows:

AB = 0.45 m ; *BD* = 1.5 m; *BC* = *CE* = 0.9 m

The crank ***AB*** turns uniformly at 180 rev/min. in the clockwise direction and the blocks at ***D*** and ***E*** are working in frictionless guides. Draw the velocity diagram for the mechanism and find the velocities of the sliders ***D*** and ***E*** in their guides.

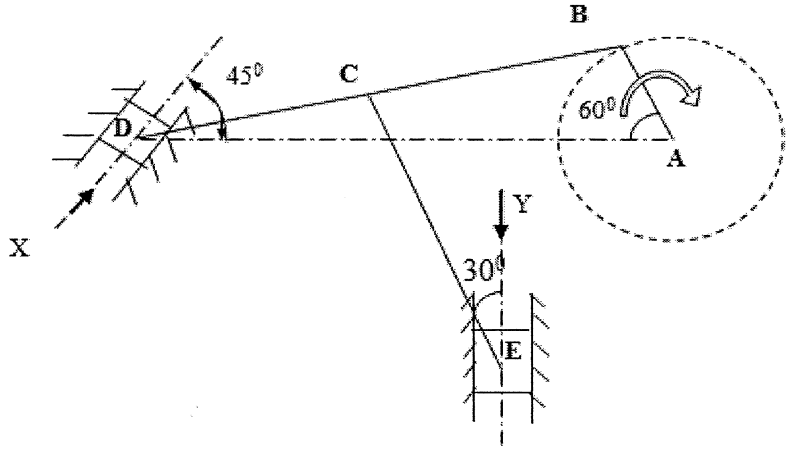


Fig.Q1 **(20 marks)**

Question No.02:

a) Obtain an expression for the path of contact in terms for addendum circle radius, pitch circle radius and pressure angle.

(08 marks)

b) Two gears having 50 and 60 involute teeth are in mesh. Their pressure angle (Φ) and module (m) are 20° 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 No.03:

a) A plate clutch consists of a flat driven plate gripped between a driving plate and a pressure plate so that there are two active driving surfaces, each having an inner diameter 150 mm and an outer diameter 200 mm. The coefficient of friction $\mu = 0.25$. The working pressure is limited to 180 kN/m^2. Assuming the pressure is uniform, calculate the power which can be transmitted at 1000 rev/min.

(10 marks)

b) If the clutch becomes worn so that the intensity of pressure is inversely proportional to the radius and the total axial force on the pressure plate remains unaltered, calculate the power which can now be transmitted at 1000 rev/min and the maximum intensity of pressure on the driving surfaces.

(10 marks)

Question No.04:

A mass of 10 kg is connected at C to the arm BC of the link ABC. The mass at C is also supported by a spring having stiffness of 5 N/mm as shown in Fig.Q4. The link ABC is smoothly pivoted at B. The link is held at A by a spring of stiffness of 10 N/mm and a damper. Set up the equation of motion for small angular displacement of the mass, and hence determine the natural frequency of the system. Also determine the required value of damping coefficient of the damper for critical damping of the system.

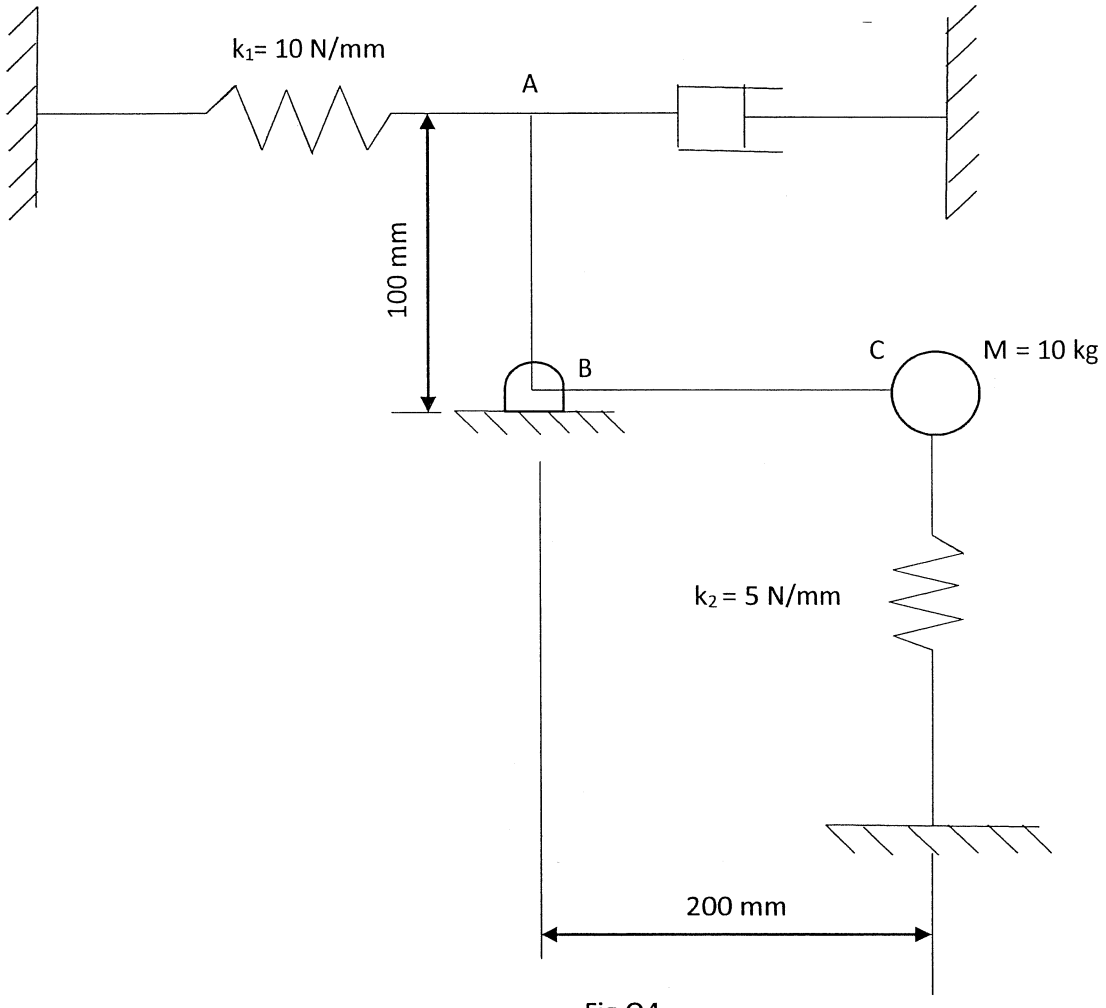


Fig.Q4

(20 marks)

Question No.05:

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

(05 marks)

b) An epicyclic gear unit consists of three gears **A, B** and **C** as shown in Fig.Q5. The gear **A** has 60 internal teeth and gear **C** has 24 external teeth. The gear **B** meshes with both **A** and **C** and is carried on arm **EF** that rotates about the axis of A at 20 rev/min. If the gear **A** is fixed, determine the speeds of gears **B** and **C**.

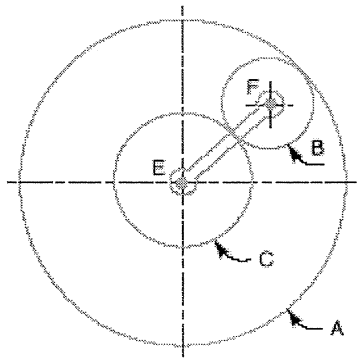


Fig.Q5

(15 marks)

Question No.06:

a) What are the requirements for complete balance of a system of masses attached to a rotating shaft?

(05 marks)

b) *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.

(15 marks)

Question No.07:

a) Show that the speed N in a Porter type governor shown in Fig. Q7(a), can be written by;

$$N^2 = \frac{m + {}^{M}/_{2}\,(1+q)}{m} \times \frac{895}{h}$$

Where M = mass of sleeve (kg),
m = mass of ball (kg),
N = rotation of the governor (rev/min),
h = height of the governor (m)
q = tanβ/tanα

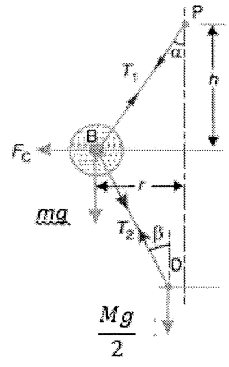


Fig. Q7(a)

(12 marks)

b) A Porter governor shown in Fig.Q7(b) has equal arms each 300 mm long and pivoted on the axis of rotation. Each ball has a mass of 4 kg and the mass of the central load on the sleeve is 20 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 its maximum speed. using the expression obtained in part(a),find the minimum and maximum speeds of the governor.

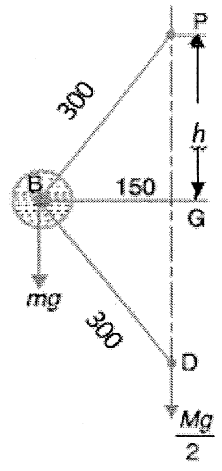


Fig.Q7(b)

(08 marks)

Question No.08:

a) Explain the function of a flywheel.

(05 marks)

b) The turning moment diagram for a petrol engine is drawn as in Fig.Q8 to the following scales:

Turning moment 1mm = 6 Nm; ***Crank angle 1 mm = 1^0.***

The turning moment diagram repeats itself at every half revolution of the engine and the areas above and below the mean turning moment line taking in order are

+285, -685, +50, -340, +960, -270 mm^2.

The rotating parts are equivalent to a mass of 50 kg at a radius of gyration of 150 mm. Determine the coefficient of fluctuation of speed when the engine runs at 900 rev/min.

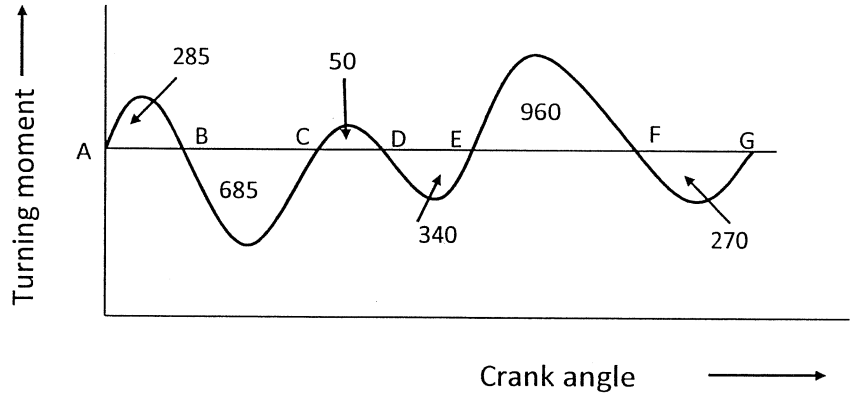


Fig.Q8

(15 marks)

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