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	:	2015/16
Date	:	27th November 2016
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 link mechanism shown in Fig.Q1 the crank OA is 100 mm long rotating at 120 rpm. clockwise direction about O. The connecting rod AB is 400 mm long. At a point C on AB, which is 150 mm from A, the rod CE 350 mm long is attached. This rod CE slides in a slot in a trunnion at D. The end E is connected by a link EF 300 mm long to the horizontally moving slider F.

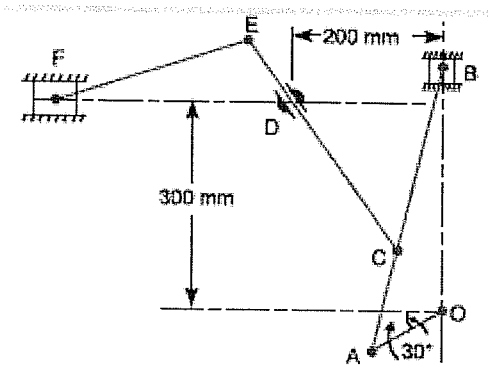


Fig.Q1

Determine,

i) Velocity of horizontally moving slider F
ii) Velocity of sliding of CE in the trunnion
iii) Angular velocity of CE.

(20 marks)

Question No.02:

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

(08 marks)

b) A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20^0 pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact and the contact ratio.

(12 marks)

Question No.03:

The two arms of a Porter governor are each 250 mm long and pivoted on the governor axis. The mass of each ball is 5 kg and the mass of the central sleeve is 30 kg. The radius of rotation of the balls is 150 mm when the sleeve begins to rise and reaches a value of 200 mm at the maximum speed.

Determine

i) the speed range of the governor.
j) the modified speed range, if the friction at the sleeve is equivalent to 20 N of load at the sleeve.

(20 marks)

Question No.04:

The turning moment diagram shown in Fig.Q4 has following scales:

Turning moment 1mm = 6 Nm; Crank angle 1 mm = 10^0

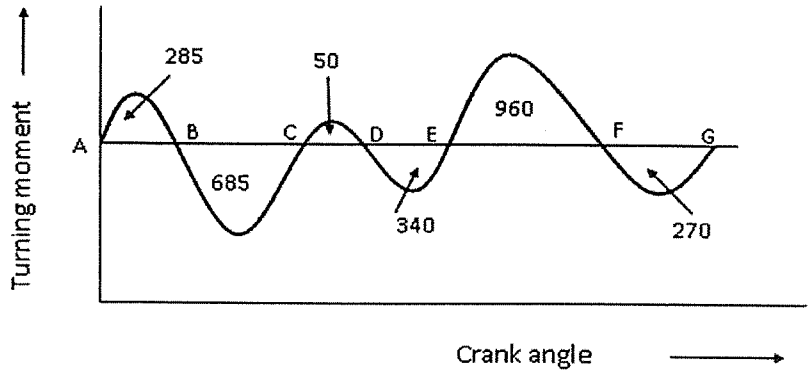


Fig.Q4

The turning moment diagram repeats in 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 as shown in Fig.Q4.

The rotating parts are equivalent to a mass of 40 kg at a radius of gyration of 150 mm. Determine the coefficient of fluctuation of speed when the engine runs at 1,200 rpm.

(20 marks)

Question No.05:

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 r.p.m. in the anticlockwise direction about the center of the gear **A** which is fixed, determine

(I) the speed of gear **B**.

(ii) If the gear A instead of being fixed, makes 300 r.p.m. in the clockwise direction, what will be the speed of gear **B**?

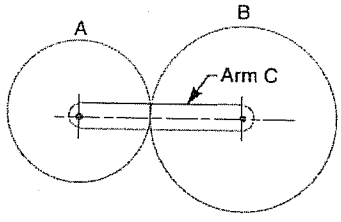


Fig.Q5

(20 marks)

Question No.06:

a) Starting from first principles derive the expression $^{T_1}/_{T_2} = e^{\mu\emptyset}$ for a flat belt drive.

(05 marks)

b) An open flat belt running over to pulleys 240 mm and 600 mm diameter connects two parallel shafts 3 m apart and transmits 4 kW from the smaller pulley that rotates at 300 rpm. Coefficient of friction between the belt and the pulley is 0.3 and the safe working tension is 10 N per mm width.
Determine,

i) minimum width of the belt
ii) initial belt tension
iii) length of the belt required

(15 marks)

Question No.07:

Four masses A, B, C, and D are completely balanced. Masses C and D make angles of 90^0 and 195^0 respectively with that of mass B in the counter-clockwise direction. The rotating masses A, B, C, D have their masses m_a , $m_b = 25$ kg , $m_c = 40$ kg, $m_d = 35$ kg, and radii $r_a = 150$ mm, $r_b = 200$ mm, $r_c = 100$ mm, $r_d = 180$ mm. Planes B and C are 250 mm apart.

Determine

(i) The mass A and its angular position with that of mass B

(ii) The positions of all the planes relative to plane of mass A

(20 marks)

Question No.08:

A damped vibrating system shown in Fig. Q8 has a natural frequency of 5 Hz for the following data:

m = 10 kg, $J_0 = 5$ kgm^2, $r_1 = 10$ cm, and $r_2 = 25$ cm. When the system is disturbed by giving it an initial displacement, the amplitude of free vibration is reduced by 80% in 10 cycles.

Determine the values of stiffness (k) and damping constant (c).

(20 marks)

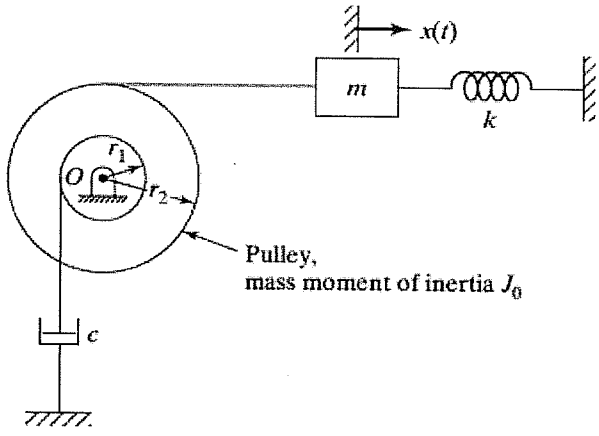


Fig. Q8

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