THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF ENGINEERING TECHNOLOGY
DIPLOMA IN TECHNOLOGY – LEVEL 03
FINAL EXAMINATION 2010/2011
MEX 3230 – MECHANICS OF MACHINES
DATE :09TH MARCH 2011
TIME :0930 HRS - 1230 HRS
DURATION :03 HOURS

Answer any FIVE (05). All questions carry equal marks.

QUESTION 01:

The link mechanism shown in Fig.Q1 has the crank AB rotating at 200 r.p.m. anti-clockwise direction and drives the slider G horizontally. The swivel joint at S permits the link ES to slide through it freely.

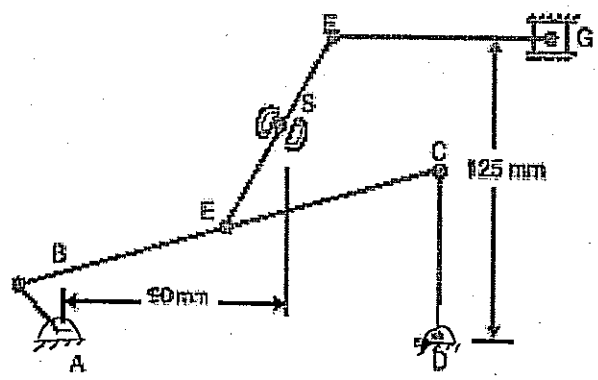


Fig.Q1

The links has folloing dimensions. *AB*=25 mm; *BC*=175 mm; *CD*=60 mm; *AD*=150 mm; *BE=EC*; *EF=FG*=100 mm. For the configuration shown in the figure in that the angle *BAD* is 135^0, determine by using instantaneous center method or graphical method the following quantities:

i Velocity of *G*
ii Angular velocity of *EF*, and
iii Velocity of sliding of *EF* in the swivel block *S*

QUESTION 02:

i) Explain the terms
natural frequency
forced vibration, and
damped vibration.

ii) The mechanical system shown in Fig.Q2 has a rotating drum with its moment of inertia 'I' kgm^2. A spring of stiffness 'k' N/m is attached to the drum at the radius 'r' m and a weight of mass 'M' kg is attached to the drum by an inelastic string wound around the drum at its outer radius 'R' m.

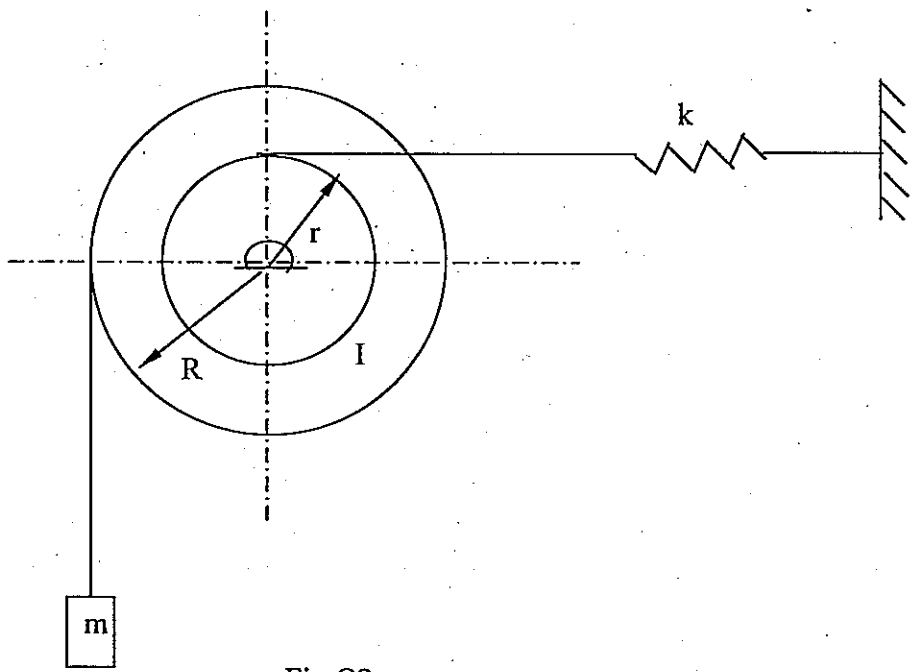


Fig.Q2

For small oscillations of the drum around its axis, show that the frequency of vibration of the system is,

$$N = \frac{1}{2\pi}\sqrt{\frac{kr^2}{I+mR^2}} \text{ cycles per second}$$

QUESTION 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 for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent to 20 N of load at the sleeve, determine the modified speed range.

QUESTION 04:

Three rotating masses A=14 kg, B=11 kg, and C=21 kg, are carried on a horizontal shaft with their centers of masses at 275 mm, 400 mm, and 150 mm respectively, from the shaft axis. The angular positions of B and C are 60^0 and 135^0 respectively from A measured in the same direction. The distance between the planes of rotation of A and B is 1.35 m and between those of A and C is 3.6 m, with B and C being on the same side of A. Two balancing masses are required to be fitted, each with its center of mass 225 mm from the shaft axis, and in planes midway between those of A and B and of B and C in order to make the given system of rotating masses dynamically balanced. Determine the magnitude and angular position of each balancing masses with respect to A.

QUESTION 05:

A screw jack is used to lift a load W. When the applied force is released, and if the load is to be sustained, show that $\alpha < \lambda$, where

α = helix angle of the thread
λ = friction angle

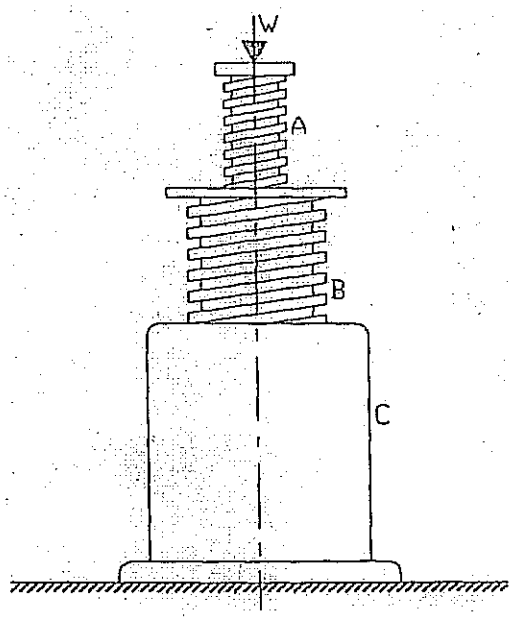


Fig.Q5

An arrangement of a differential screw jack is shown in Fig.Q5. The screw B engages with a nut fixed in base C and carries a right handed screw thread of pitch 9.5 mm. Its mean diameter is 57 mm. The screw B is prevented from rotating, but it can move with the load vertically. The screw A, which also has a right handed thread of 6 mm pitch on a mean diameter of 30 mm. The screw A can rotate relative to B. If the coefficient of friction for each thread is 0.15, find the torque necessary to be applied to B to raise a load (W) of 5,000 N.

QUESTION 06:

Deduce an expression for the length of arc of contact for two involute spur gear wheels of unequal size in terms of the pressure angle, the pitch circle radius and the addendum radius.

If the two wheels have 24 and 30 teeth and a standard addendum of 1 module with pressure angle of 20^0, find the length of the arc of contact in terms of the module.

QUESTION 07:

Two pulleys, one 450 mm diameter and the other 200 mm diameter, are on parallel shafts 1.95 m apart and are connected by a flat crossed belt. Find the length of the belt required and the angle of contact between the belt and each pulley.

What power can be transmitted by the belt when the larger pulley rotates at 200 rev/min if the maximum permissible tension in the belt is 1 kN, and the coefficient of friction between the belt and pulley is 0.25?

QUESTION 08:

An epicyclic gear consists of three gears A, B and C as shown in Fig.Q8. The gear A has 72 internal teeth and gear C has 32 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 18 r.p.m. If the gear A is fixed, determine the speed of gears B and C.

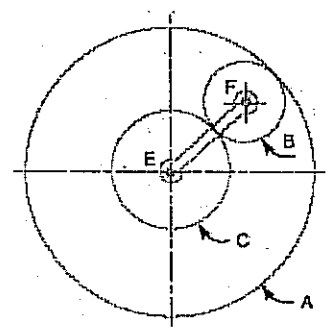


Fig.Q8

ALL RIGHTS RESERVED