2074
B.E. (Mechanical Engineering)
Third Semester
MEC-303: Kinematics of Machines

Time allowed: 3 Hours   **Max. Marks: 50**

NOTE: *Attempt* <u>*five*</u> *questions in all, including Question No. 1 which is compulsory and selecting two questions from each Part.*

x-x-x

Q1. (a) Define Inversion of Mechanism. Write any two inversions for double slider crank chain.

(b) What is function of a dynamometer. Differentiate between absorption and transmission dynamometer.

(C) Define synthesis of mechanism. What are various types of synthesis.

(d) Define pitch of a kinematic chain. Write relation between pitch & pitch circle diameter.

(e) The power is transmitted from a pulley 1 m diameter running at 200 r.p.m. to a pulley 2.25 m diameter by means of a belt. Find the speed lost by the driven pulley as a result of creep, if the stress on the tight and slack side of the belt is 1.4 MPa and 0.5 MPa respectively. The Young's modulus for the material of the belt is 100 MPa.   (2×5=10 Marks)

Part- A

Q2. (a) How are kinematic pairs classified. Write examples also.   (4 Marks)

(b) In a slider crank mechanism, the lengths of crank and connecting rod are 200 mm and 800 mm respectively. Locate all the instantaneous centres of the mechanism for the position of the crank when it has turned 30^0 from the inner dead centre position. Also find the velocity of the slider and the angular velocity of the connecting rod if the crank rotates at 40 rad/s.   (6 Marks)

Q3. (a) Design a slider crank mechanism to co-ordinate three position of the input link and the slider for the following angular and linear displacements of the input link and the slider respectively:

$\Theta_{12} = 40^0$, $S_{12} = 180$ mm, $\Theta_{13} = 120^0$, $S_{13} = 300$ mm

Take eccentricity of slider as 20 mm.   (6 Marks)

(b) What is Chebyshev spacing? Write its significance.   (4 Marks)

Q4. (a) Define the terms 'coefficient of fluctuation of energy' and 'coefficient of fluctuation of speed' in the case of flywheel.   (4 Marks)

(b) A punching press is used to punch 40 mm diameter holes in a plate of 15 mm thickness at the rate of 30 holes per minute. It requires 6 N-m of energy per mm^2 of the sheared area. If the punching takes 1/10 of a second and the r.p.m. of the flywheel varies from 160 to 140, find the mass of the flywheel having radius of gyration of 1 metre.   (6 Marks)

P.T.O.

Part-B

Q5. (a) Define the terms: sensitiveness and hunting incase of governors. (2 Marks)

(b) The arms of a Hartnell governor are of equal length. When the sleeve is in the mid position, the masses rotate with a circle with a diameter of 150 mm (the arms are vertical in the mid-position). Neglecting friction, the equilibrium speed for this position is 360 r.p.m. Maximum variation of speed, taking friction into account, is to be 6% of the mid-position speed for a maximum sleeve movement of 30 mm. the sleeve mass is 5 kg and the friction at the sleeve is 35 N.

Assuming that the power of governor is sufficient to overcome the friction by 1% change of speed on each side of the mid-position, find (neglecting the obliquity of the arms)

    (i)   Mass of each rotating ball
    (ii)   Spring Stiffness
    (iii)   Initial compression of the spring.   (8 Marks)

Q6. (a) Describe the construction and working of Bevis Gibson flashlight dynamometer with the help of a neat sketch. (5 Marks)

(b) Define efficiency of a screw jack. Prove that the maximum efficiency (η_{max}) for a screw jack is given as:

$$\eta_{max} = \frac{1 - Sin\emptyset}{1 + Sin\emptyset}$$

Where $\emptyset$ is angle of friction. (5 Marks)

Q7. (a) Describe with the help of a neat sketch the principles of operation of an internal expanding shoe. Derive the expression for the braking torque. (5 Marks)

(b) A torsion dynamometer is fitted on a turbine shaft to measure the angle of twist. It is observed that the shaft twists 1.5° in a length of 5 metres at 500 r.p.m. The shaft is solid and has a diameter of 200 mm. If the modulus of rigidity for the shaft material is 85 GPa, find the power transmitted by the turbine. (5 Marks)

x-x-x