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ME 131304

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2017

B.Tech. 3rd Semester End-Term Examination

Mechanical

MECHANISM AND MACHINES – I

Full Marks – 100   Time – Three hours

The figures in the margin indicate full marks
for the questions.

Answer Q.No.1 and any *six* from the rest.

(10 × 1 = 10)

1. (a) In a structure the degree of freedom is
     (i)   1
     (ii) 2
     (iii) Infinite
     (iv) 0

    (b) Which of the following is an inversion of double slider crank chain
     (i)   Beam engine
     (ii) Elliptical trammel
     (iii) Watt's indicator mechanism
     (iv) Quick return motion mechanism

[Turn over

(c) The total number of instantaneous centres for a mechanism containing n links is given by

(i) $\dfrac{n-2}{n}$

(ii) $\dfrac{n(n-1)}{2}$

(iii) n

(iv) $\dfrac{n}{2}$

(d) In a self locking brake, the force required to apply the brake is

(i) Minimum

(ii) Zero

(iii) Maximum

(iv) None of the above

(e) If three bodies move relatively to each other then according to Kennedy's theorem their instantaneous centre will lie on

(i) Parabolic curve

(ii) Ellipse

(iii) Circle

(iv) Straight line

(f) Train value of a gear train is

(i) Always less than unity

(ii) Always greater than unity

(iii) Equal to reciprocal of speed ratio

(iv) Equal to speed ratio of gear train

(g) In a simple gear train, there are even number of idlers between the driver and the driven

(i) The direction of rotation of driver and driven are same

(ii) The direction of rotation of driver and driven are opposite

(iii) Both (i) and (ii)

(iv) None of the above

(h) The maximum fluctuation of energy of flywheel

(i) Is directly proportional to coefficient of fluctuation of speed

(ii) Is directly proportional to square of angular velocity of flywheel

(iii) Is directly proportional to moment of inertia of flywheel

(iv) All of the above

(i) A slider at 10 cm/s on a link which is rotating at 60 rpm is subjected to Coriolis' acceleration of magnitude

    (i) $40 \pi^2 \ cm/s^2$

    (ii) $0.4 \pi \ cm/s^2$

    (iii) $40 \pi \ cm/s^2$

    (iv) $4 \pi \ cm/s^2$

(j) Hydraulic press is a

    (i)   Rigid link

    (ii)   Flexible link

    (iii)   Fluid link

    (iv)   None of the above

2. (a) What is meant by a resistant body? Write down the differences between machine and mechanism.

    (b) What is meant by completely constrained motion? How pairs are classified. Explain.

    (c) What are the various inversions of slider crank mechanism? Explain any two inversions with examples.   (3 × 5 = 15)

3. (a) The crank of a reciprocating engine revolves at a uniform speed of 310 rpm in clockwise direction. The crank and connecting rods are 15 cm and 65 cm respectively. Find the velocity of the piston and angular velocity of the connecting rod at crank position 60° from inner dead centre.

(b) Determine the Corioliscomponent of acceleration.

(c) What is meant by rubbing velocity? What is the Arnold–Kennedy theorem of three centres? Explain.   (3 × 5 = 15)

4. (a) What do you mean by Helix angle of a thread?

(b) Define Mechanical advantages (MA), velocity ratio (VR) and mechanical efficiency for a simple machine.

(c) A single plate clutch, effective on both sides, is required to transmit 25 kW at 3000 r.p.m. Determine the outer and inner radii of frictional surface if the coefficient of friction is 0.255, the ratio of radii is 1.25 and the maximum pressure is not to exceed $0.1 \ N/mm^2$. Also determine the axial thrust to be provided by springs. Assume the theory of uniform wear.   (2+3+10)

5. (a) Define coefficient of fluctuation energy and coefficient of fluctuation speed.

(b) The turning moment diagram for a multi cylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm= 3° horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, as follows.

+52, –124, +92, –140,+85,–72 and +107 mm², when the engine is running at a speed of 600 r.p.m. If the total fluctuation of speed is not to exceed ± 1.5% of the mean, find the necessary mass of the flywheel of radius 0.5 m. (5+10=15)

6. (a) A band brake acts on 3/4th of circumference of a drum of 450 mm diameter which is keyed to the shaft. The band brake provides a breaking torque of 225 Nm. One end of band is attached to the fulcrum pin of the lever and the other end to a pin 100mm from the fulcrum. If the operating force is applied at 500 mm from the fulcrum and the co efficient of friction is 0.25, find the operating force when the drum rotates in the (i) anticlockwise direction and (ii) clockwise direction.

   (b) Explain torsion dynamometer with a neat sketch. (10+5)

7. (a) Derive the gear ratio of a compound gear train.

   (b) An epicyclic gear train consists of an arm and two gears A and B having 30 and 40 teeth respectively. The arm rotates about the centre of the gear A at a speed of 80rpm in counter clockwise direction.

   Determine the speed of the gear B if

   (i) Gear A is fixed.

   (ii) The gear A rotates at 240 rpm clockwise instead of being fixed.

   (c) An epicyclic gear train consists of three gears A, B and C as shown in the figure. 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 an arm EF, which rotates about the centre of A at 18 rpm. If gear A is fixed, determine the speeds of gears B and C. (3 × 5 = 15)
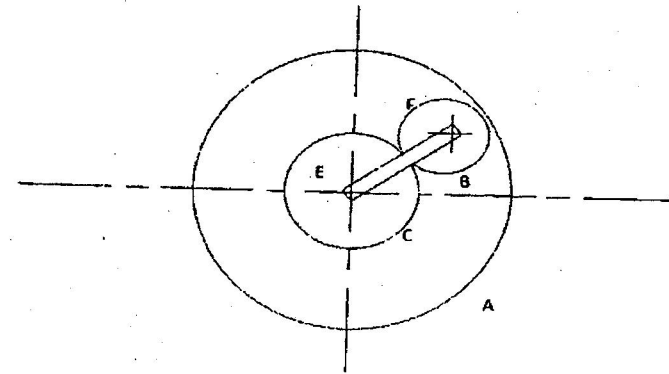
8. (a) Write a short note on Braking of a vehicle.

   (b) Describe Prony brake dynamometer.

   (c) Explain pivot and collar friction. (3 × 5 = 15)

9. (a) What is crowning of Pulley? Why it is provided and pulleys?

   (b) A leather belt is required to transmit 7.5 kW from a pulley 1.2 m in diameter, running at 250 r.p.m. The angle embraced is 165° and the coefficient of friction between the belt and the pulley is 0.3. If the safe working stress for the leather belt is 1.5 MPa, density of leather 1 Mg/m³ and thickness of the belt 10 mm, determine the width of the belt taking Centrifugal tension into account. (2+3+10=15)