Total No. of printed pages = 4

ME 181304

2024

B.Tech. 3rd Semester End-Term Examination

THEORY OF MACHINES

Full Marks – 70 Time – Three hours

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

Answer question No. 1 and any *four* from the rest.

1. Answer the following MCQ : 1×10

(i) In a governor, if the equilibrium speed is constant for all radii of rotation of balls, the governor is said to be

(a) stable (b) unstable

(c) dead weight (d) isochronous

(ii) Cam size depends on

(a) prime cycle (b) pitch cycle

(c) base cycle (d) Outer cycle

(iii) Which is spring controlled governor -

(a) Hartnell (b) Hartung

(c) Pickering (d) All of the mention

(iv) The motion between a pair which takes place in ———— is known as incompletely constrained motion

(a) One direction only

(b) Two directions only

(c) More than one direction

(d) None of these

(v) The friction moment in a clutch with uniform wear as compared to friction moment with uniform pressure is:

(a) more

(b) less

(c) equal

(d) more or less depending on speed

(vi) The maximum fluctuation of energy of a flywheel is

(a) directly proportional to coefficient of fluctuation of speed

(b) directly proportional to square of the angular velocity of the flywheel

(c) directly proportional to moment of inertia of the flywheel

(d) all of the above

(vii) The type of gear used to connect two parallel co-planar shafts is

(a) Straight spur gear (b) Straight bevel gear

(c) Cross helical gear (d) Spiral gear

(viii) The purpose of a link is to:

(a) transmit motion

(b) guide other links

(c) act as a support

(d) all of the above

(ix) If the axes of the first and last gear of a compound gear train are coaxial, the gear train is called

(a) simple (b) compound

(c) reverted (d) epicyclic

(x) Pressure angle of a cam is defined as the angle between the line of motion of the follower and the:

(a) tangent on the pitch curve

(b) normal on the pitch curve

(c) normal on the cam profile

(d) tangent on the cam profile

2. (a) Draw and explain one inversion of the four bar chain. 2 + 3

(b) In a four bar chain ABCD, AD is fixed and 120 mm long. The crank AB is 30 mm long and rotates at 100 rpm clockwise, while the link CD = 60 mm oscillates about D. BC and AD are of equal length. Find the angular velocity of link CD when angle BAD=60°.

Also, draw the acceleration diagram 6 + 4

3. (a) The arms of a porter governor are 300 mm long. The upper arms are pivoted on 8 the axis of rotation and the lower arms are attached to the sleeve at a distance of 35 mm from the axis of rotation. The load on the sleeve is 54 kg and the mass of each ball is 7 kg. Determine the equilibrium speed when the radius of the balls is 225 mm. What will be the range of speed for this position, if the frictional resistances to the motion of the sleeve are equivalent to a force of 30 N? 8

(b) Write all the names of different types of governors with examples. 3

(c) Derive the expression for height of watt governor in terms of rpm N. 3

(d) What is the hunting of governor? 1

4. (a) Name and draw all the three types of followers according to their shape in the cam-follower arrangement. 5

(b) What is the purpose of use of a cam-follower arrangement? 2

(c) Draw the cam profile for the following conditions: 8

Follower type: roller follower, in line. Roller diameter = 5mm, roller rises by 25 mm with SHM in 180° of cam rotation, falls by half the distance instantaneously, and returns with uniform velocity in 180° of cam rotation. Take base circle radius = 20 mm

5. (a) A double shoe brake, as shown in figure 1, is capable of absorbing a torque of 1400 N-m. The diameter of the brake drum is 350 mm and the angle of contact for each shoe is 100°. if the coefficient of friction between the brake drum and the lining is 0.4, determine: 8

(i) Spring force necessary to set the brake

(ii) Width of the brake shoes, if the bearing pressure on the lining material is not to exceed 0.3 N/mm.

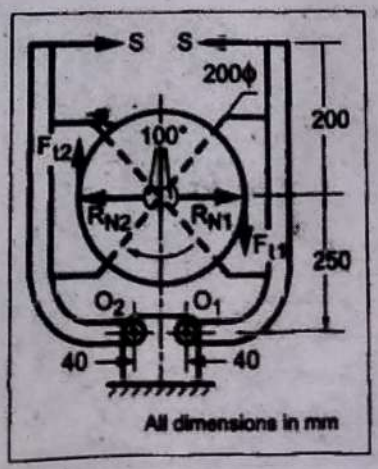

Fig 1

(b) A leather belt connects a 1.20 m diameter pulley on a shaft running at 25 rad/s with another pulley running at 50 rad/s, the angle of lap on latter pulley being 150°. The maximum permissible load is 1200 N and the coefficient of friction between the belt and pulley is 0.25. If the initial tension in the belt may have any value between 800 N and 960 N, what is the maximum power which the belt can transmit? 7

6. (a) Turning moment curve for one revolution of a multi-cylinder engine above and below line of mean resisting torque are given by –0.32, +4.06, –2.71, +3.29, –3.16, +2.32, –3.74, +2.71 and –2.45 sq. cm.

The vertical and horizontal scales are 1 cm= 60,000 kg-cm and 1 cm = 24° respectively. The fluctuation of speed is limited to ± 1.5 percent of mean speed which is 250 rpm. The hoop stress in rim material is limited to 56 kg/cm^2. Neglecting effect of boss and arms, determine suitable diameter and cross-section of flywheel rim. Density of rim material is 0.0072 kg per cubic cm. Assume width of rim equal to four times its thickness. 10

(b) Derive the relation for energy stored in a flywheel. 5

7. (a) Draw and write short notes mentioning their uses about simple, compound, epicyclic and reverted gear trains. 2 × 4

(b) An epicyclic gear consists of three wheels A, B and C as shown in the fig 2. Wheel A has 72 internal teeth, C has 32 external teeth. The wheel B gears with both A and C and is carried on an arm which rotates about the centre of A at 18 rpm. If the wheel A is fixed, determine the speed of wheels B and C. 7

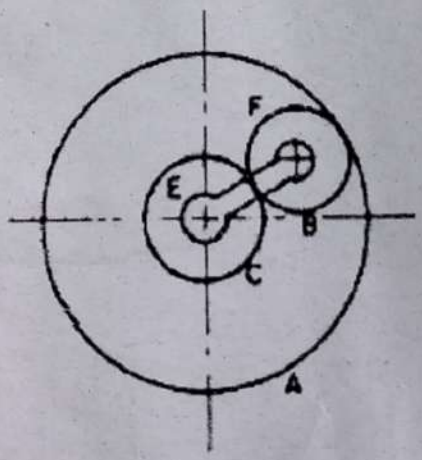

Fig 2