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Total Number of Pages: 02

Course: IDD (B.Tech and M.Tech)
Sub_Code: MEPC2004

4th Semester Regular Examination: 2024-25
SUBJECT: Kinematics and Dynamics of Machines
BRANCH(S): AUTO, MANUTECH, MECH, MMEAM
Time: 3 Hours
Max Marks: 100
Q.Code: S352

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 Answer the following questions:

(2 x 10)

- Explain Grubler's criterion for determining degree of freedom for mechanisms.
- Define I) Module II) Addendum
- What do you mean by the term turning moment diagram?
- Explain the term train value. How is it related to velocity ratio?
- Define the term coefficient of fluctuation of speed.
- What is the difference between a governor and a flywheel?
- State laws of static friction.
- Define slip of the belt.
- What are the different types of mechanical brakes?
- Differentiate between static and dynamic balancing.

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)

(6 x 8)

- Sketch and explain any one inversion of a double slider crank chain.
- State and explain Aronhold-Kennedy theorem.
- Derive an expression for the length of the arc of contact in a pair of meshed spur gears.
- How the velocity ratio of epicyclic gear train is obtained by tabular method?
- Draw the turning moment diagram for a four stroke cycle I.C engine.
- Derive the following relations for the maximum fluctuation of energy (ΔE), $\Delta E = 2 \times E \times K_s$ Where $K_s =$ Coefficient of fluctuation of speed $E = K \cdot E$ of flywheel corresponding to mean speed.
- Derive an expression for the height of Watt governor and prove that the height of the governor is inversely proportional to the square of the speed of governor.
- What is a screw jack? Show that for an ideal screw-jack, the efficiency is independent of the weight lifted.
- Derive an expression for the length of crossed belt drive.
- A number of masses (say four masses) are attached to a shaft which is rotating at an angular speed of ω rad/sec. If all the masses are in the same plane, then describe the analytical method of balancing these four masses by a single mass only.

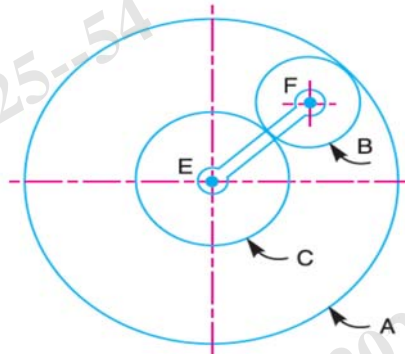
- k) What do you mean by controlling force and controlling force curve?
 l) Find an expression for the braking torque for a single shoe brake when brake drum is rotating (I) clockwise (II) anticlockwise and Friction force is at a distance “b” above the fulcrum.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

(16 x 2)

- Q3** An epicyclic gear 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 p.m.. If the gear A is fixed, determine the speed of gears B and C. (16)



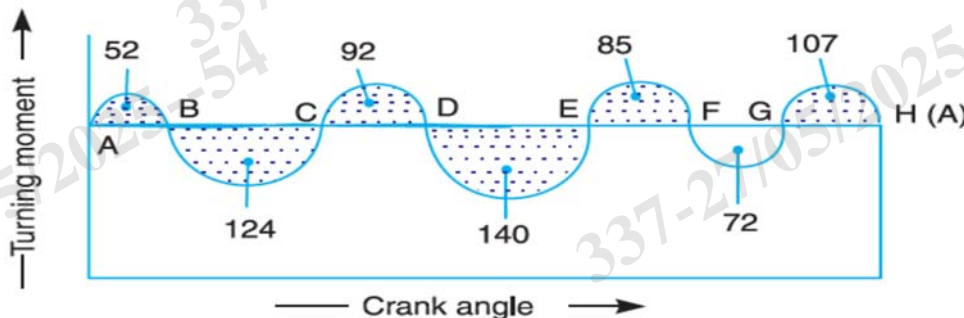
- Q4** Prove that the ratio of tensions in the tight and slack sides of a band and block brake is given by (16)

$$\frac{T_n}{T_o} = \left(\frac{1 + \mu \tan \theta}{1 - \mu \tan \theta} \right)^n$$

Where θ = Half of the angle subtended by each block on the centre of the drum

T_n = Tension on tight side after n blocks, T_o = Tension on slack side

- Q5** 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 are as follows, + 52, - 124, + 92, - 140, + 85, - 72 and 107 mm², when the engine running at a speed of 600 rpm. If the total fluctuation of speed is not to exceed $\pm 1.5\%$ of the mean, find the necessary mass of the flywheel of radius 0.5 m. (16)



- Q6 a)** Derive an expression for magnitude and direction of Coriolis component of acceleration. (10)
b) Four masses m_1 , m_2 , m_3 , and m_4 are 200 kg, 300 kg, 240 kg, and 260 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m, and 0.3 m respectively and the angles between successive masses are 45°, 75°, and 135°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m. (6)