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Question Paper Code: 1103368

B.E. / B.Tech. DEGREE EXAMINATIONS, NOV/ DEC 2024

Third Semester

Aerospace Engineering

U20AS302 - MECHANICS OF MACHINES

(Regulation 2020)

Time: Three Hours

Maximum: 100 Marks

Answer ALL questions

PART – A

(10 x 2 = 20 Marks)

1. Name any two inversions of the 4 bar chain.
2. Why a roller follower is preferred to that of a knife –edge follower?
3. Define module of gears.
4. What do you understand by the term 'Interference' as applied to gears?
5. What are the disadvantages of V-belt drive over flat belt?
6. In an open belt drive of horizontal type, the slack side of belt should be kept on the top side of pulleys. Explain.
7. An unbalanced couple of 300 Nm is noticed on a shaft of 200 cm length. Find the dynamic reactions at the bearings.
8. Explain the effect of gyroscopic couple.
9. Explain the damping factor.
10. Explain the significance of the critical speed of the shaft.

PART – B

(5 x 16 = 80 Marks)

11. (a) The crank and connecting rod of a theoretical steam engine are 0.5 m and 2 m long respectively. The crank makes 180 rpm in the clockwise direction. When it has turned 45° from the inner dead centre position, determine:
 1. Velocity of piston
 2. Angular velocity of connecting rod
 3. Velocity of point E on the connecting rod 1.5 m from the gudgeon pin
 4. velocities of rubbing at the pins of the crank shaft, crank and crosshead when the diameters of their pins are 50 mm, 60 mm and 30 mm respectively.

5. Position and linear velocity of any point G on the connecting rod which has the least velocity relative to crank shaft.

(16)

(OR)

- (b) A cam is to give the following motion to the knife-edged follower: To raise the follower through 30 mm with uniform acceleration and deceleration during 120° rotation of the cam, Dwell for the next 30° of the cam rotation, To lower the follower with simple harmonic motion during the next 90° rotation of the cam, Dwell for the rest of the cam rotation. The cam has minimum radius of 30 mm and rotates counter-clockwise at a uniform speed of 800 rpm. Draw the profile of the cam if the line of stroke of the follower passes through the axis of the camshaft.

(16)

12. (a) Two involute gears in a mesh have a module of 8mm and pressure angle of 20° . The larger gear has 57 while the pinion has 23 teeth. If the addendum on pinion and gear wheels are equal to one module, Determine i. Contact ratio (No. of pairs of teeth in contact) ii. Angle of action of pinion and gearwheel. iii. Ratio of sliding to rolling velocity at the

- Beginning of the contact.
- Pitch point.
- End of the contact.

(16)

(OR)

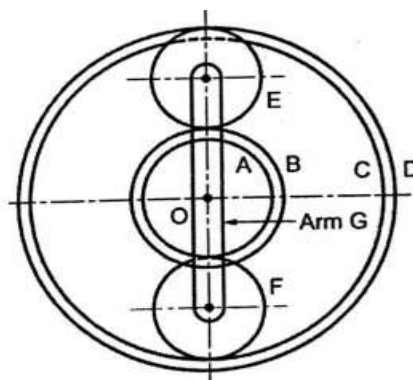
- (b) In the epicyclic gear train shown in Fig. the compound wheels A and B as well as interval wheels C and D rotate independently about the axis O. The wheels E and F rotate on the pins fixed to the arm a. All the wheels are of the same module. The number of teeth on

the wheels are $T_A = 52$, $T_B = 56$, $T_E = 36 = T_F$

Determine:

- The speed of C if the wheel D fixed and arm a rotates at 200 rpm Clockwise.
- The speed of C, if the wheel D rotates at 200 rpm counter clockwise and the arm a rotates 20 rpm counter clockwise.

(16)



13. (a) (i) A 150 mm diameter valve, against which a steam pressure of 2 MN/m^2 is acting, is closed by means of a square threaded screw 50 mm in external diameter with 6 mm pitch. If the coefficient of friction is 0.12; find the torque required to turn the handle. (8)
- (ii) The mean diameter of a square threaded screw jack is 50 mm. The pitch of the thread is 10 mm. The coefficient of friction is 0.15. What force must be applied at the end of a 0.7 m long lever, which is perpendicular to the longitudinal axis of the screw to raise a load of 20 kN and to lower it? (8)

(OR)

- (b) A flat belt, 8 mm thick and 100 mm wide transmits power between two pulleys, running at 1600 m/min. The mass of the belt is 0.9 kg/m length. The angle of lap in the smaller pulley is 165° and the coefficient of friction between the belt and pulley is 0.3. If the maximum permissible stress in the belt is 2 MN/m^2 ,
Find: (i) Maximum power transmitted and
(ii) Initial tension in the belt. (16)
14. (a) The four masses m_1 , m_2 , m_3 and m_4 are respectively, 200 kg, 300 kg, 240 kg and 260 kg. The corresponding radii of rotation are 20 cm, 15 cm, 25 cm and 30 cm and the corresponding angles, are 45° , 75° and 135° . Find the position and magnitude of the balance mass required if the radius of rotation is 20 cm. (16)

(OR)

- (b) (i) A vehicle with a rotating wheel is moving in a straight line. When the vehicle turns, the gyroscopic effect of the rotating wheels creates a force that acts perpendicular to the direction of the turn, influencing the vehicle's stability. The angular velocity of wheel rotation, $\omega = 50 \text{ rad/s}$,
mass of wheel, $m = 10 \text{ kg}$, radius of wheel, $r = 0.3 \text{ m}$, vehicle speed around the turn, $v = 20 \text{ m/s}$ and the radius of the turn, $R = 100 \text{ m}$.
Calculate the gyroscopic couple effect on the wheel. (10)
- (ii) Compare the functions of flywheel and governor. And list down the types of governors. (6)
15. (a) A body having a mass of 15 kg is suspended from a spring which deflects 12 mm under the weight of the mass. Determine the frequency of free vibration. What is the viscous damping force needed to make the motion a periodic at a speed of 1 mm/s. if, when damped to this extent, a disturbing force having a maximum of 100 N and at a frequency of 6 Hz is made to act on the body, what is the amplitude of the ultimate motion? (16)

(OR)

- (b) A body having a mass of 15 kg is suspended from a spring which deflects 12 mm under the weight of the mass. Determine the frequency of free vibration. What is the viscous damping force needed to make the motion a periodic at a speed of 1 mm/s. if, when damped to this extent, a disturbing force having a maximum of 100 N and at a frequency of 6 Hz is made to act on the body, what is the amplitude of the ultimate motion? (16)

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