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TME-503

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4076

Roll No.

B. Tech.

**(SEM. V) EXAMINATION, 2008-09
DYNAMICS OF MACHINE**

Time : 3 Hours]

[Total Marks : 100

Note : Attempt for 100 marks. Assume suitably missing data if any. All questions are of equal marks.

Attempt any two parts of each of the following questions.

- 1 (a) Discuss inertia force analysis in a four bar mechanism. 10
- (b) A single cylinder, single acting, four stroke gas engine develops 25 kW at 320 rpm. The work done by the gases during expansion stroke is three times the work done on the gases during the compression stroke. The work done during the suction and exhaust strokes being negligible. The fluctuation of speed is not to exceed $\pm 2\%$ of the mean speed. The turning moment diagram during compression and expansion is assumed to be triangular in shape. Find the weight of the flywheel if its radius of gyration is 0.5m. 10

- 5 (a) A gyrowheel of mass 0.6 kg and radius of gyration 20 mm is mounted in a pivoted frame. The axis of the pivots passes through the centre of rotation of the wheel, but the centre of gravity "G" of the frame is 10 mm below the centre of rotation "O". The frame has a mass of 0.25kg and the speed of rotation of the wheel is 3000 rpm in counter clockwise direction. If the vehicle travels at 15 m/s in a curve of 60 m radius, find the inclination of the gyrowheel from the vertical, when
 - (i) the vehicle moves forward taking a left hand turn along curve and
 - (ii) the vehicle moves in opposite direction.
- (b) Prove that the sensitiveness of a Proell governor is greater than that of a Porter governor. 10
- (c) Derive equations for acceleration with respect to braking of a vehicle when vehicle moves
 - (i) on a level track
 - (ii) down track
 - (iii) brakes are applied to rear wheel only and
 - (iv) brakes are applied to front wheels only.



(c) A shaft has three eccentrics of mass 1 kg each. 10
 The central plane of eccentrics is 50 mm apart. The distance of the centers from the axis of rotation are 20 mm, 30 mm, and 20 mm and their angular positions are 120° apart. Find the amount of out-of-balance force and couple at 600 rpm. If the shaft is balanced by adding two masses at radius of 70 mm and at a distance of 100 mm from the central plane of the middle eccentric. Find the amount of the masses and their angular position.

2 (a) The three cylinders of an air compressor 10
 have their axes 120° to one another and their connecting rods are couple to a common crank. The stroke is 100 mm and the length of each connecting rod is 150 mm. The mass of reciprocating parts per cylinder is 2 kg. Find the maximum primary and secondary forces acting on the frame of the compressor when running at 3000 rpm.

(b) The lengths of crank and connecting rod of a 10
 vertical reciprocating engine are 400 mm and 2m respectively. The crank is rotating clockwise at a speed of 400 rpm. The mass of the connecting rod is 250 kg and the distance of its centre of gravity from cross-head pin centre is 1.2 m. Find the torque exerted on crank-shaft due to the inertia of moving parts analytically when crank has turned through 40° from the top dead centre and piston is moving downwards. The radius of gyration of connecting rod about an axis passing through its centre of gravity is 900 mm.

(c) Develop axial force required to engage cone 10
 clutch through neat sketch.

3 (a) What do you mean by friction circle ? 10

(b) Discuss effect of initial tension on power 10
 transmission in belt drive.

(c) The radius of rotation of the balls of a 10
 Hartnell governor is 100 mm at the minimum speed of 300 rpm. Neglecting gravity effects, determine the speed after the sleeve has lifted by 50 mm. Also, determine the initial compression of the spring, governor effort and power. Take length of ball arm of lever = 150 mm, length of sleeve arm = 100 mm, weight of each ball = 40 N and stiffness of spring = 25 N/mm.

4 (a) Explain the term "Damped Vibration". 10
 Prove that the equation of motion for a damped

$$\text{vibration is given by } \ddot{x} + \frac{C}{M}\dot{x} + \frac{S}{M}x = 0,$$

where x , C , M and S has standard notation.

(b) Develop equations for calculating axial force 10
 and frictional forces in double-shoe brake.

(c) An engine developing 50 kW at 1200 rpm 10
 is fitted with a cone clutch. The cone angle is 12° and a maximum mean diameter of 500 mm. The coefficient of friction is 0.25. The normal pressure on the clutch face is not to exceed 0.1 MPa. Determine : (i) the axial force (spring) to engage the clutch, and (ii) the face width required.

