Code No: 155BA **R18**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**B. Tech III Year I Semester Examinations, September - 2021**
**DYNAMICS OF MACHINERY**
**(Common to ME, MCT)**

**Time: 3 hours** **Max. Marks: 75**

**Answer any five questions**
**All questions carry equal marks**
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1.a) When and why the correction couple is applied while considering the inertia of the connecting rod of a reciprocating engine?

b) The length of the connecting rod of a gas engine is 500 mm and its center of gravity lies at 165 mm from the crank pin center. The rod has a mass of 80 kg and a radius of gyration of 182 mm about an axis through the center of mass. The stroke of piston is 225 mm and the crank speed is 300 rpm. Determine the inertia force on the crankshaft when the crank has turned $30^0$ from the inner-dead center. [7+8]

2. A rear engine car is traveling along a curved track of 100 m radius. The moment of inertia of each of the four wheels is 2.2 kg-m $^2$. The effective diameter of the wheel is 600 mm. The mass moment of the engine rotating parts is 1.25 kg-m $^2$. The gear ratio between the engine and the back axle is 3.2. The engine axis is parallel to the rear axle, and the crank shaft rotates in the same sense as that of the road wheels. The center of gravity is at equal distance from all the four wheels, and it is 530 mm above the road level. The track width of the car is 1.6 m. Determine the limiting speed of the vehicle if all the four wheels maintain contact with the road surface. [15]

3.a) Explain the function of a flywheel from the crank effort diagram.

b) In a reciprocating engine, the length of stroke is 30 cm and connecting rod is 60 cm long between centers. When the piston has travelled 8 cm from the inner dead center, find the i) angular position of the crank; ii) velocity and acceleration of the piston; iii) angular velocity of connecting rod, if the engine speed is 240 rpm. [6+9]

4. The equation of turning moment curve of a three-crank engine is (5000 + 1500 sin 3θ) N-m, where θ is the crank angle in radians. The moment of inertia of flywheel is 1000 kg-m$^2$ and the mean speed is 300 rpm. Calculate the (a) power of the engine, and (b) maximum fluctuation of speed of the flywheel in percentage when the (i) resisting torque is constant, and (ii) resisting torque is (5000 + 600 sin θ) N-m. [7+8]

5.a) What is meant by the expression 'friction circle'? Deduce an expression for the radius of friction circle in terms of the radius of the journal and the angle of friction.

b) A flat foot step bearing 300 mm in diameter supports a load of 8 kN. If the coefficient of friction is 0.1, and the speed of the shaft is 80 rpm, find the power lost in friction, assuming uniform wear. [7+8]

6.a) Describe with a neat sketch the method of operation of rope brake dynamometer.

b) A band brake used for a winch is wound round a drum of 0.75 m diameter, keyed to the shaft. The two ends of the band are attached to the pins on the opposite sides of the fulcrum of the brake lever at distances of 25 mm and 100 mm from the fulcrum. The angle of lap on the drum is $240^0$ The coefficient of friction is 0.25. Find the torque which can be applied by the brake when a force of 500 N applied to the lever upwards at a distance of 1 m from the fulcrum. Consider clockwise direction of rotation. [8+7]

7. The following data refer to two cylinder locomotive with cranks at $90^0$: Reciprocating mass per cylinder = 300 kg; Crank radius = 0.3 m; Driving wheel diameter = 1.8 m; Distance between cylinder center lines = 0.65 m; Distance between the driving wheel central planes = 1.55 m. Determine the (a) fraction of the reciprocating masses to be balanced, if the hammer blow is not to exceed 46 kN at 96.5 kmph, (b) variation in tractive effort, and (c) maximum swaying couple. [5+5+5]

8.a) How do you find the natural frequency of free longitudinal vibrations by the (i) Energy method, and (ii) Rayleigh's method? Explain.

b) A shaft 40 mm diameter and 2.5 m long has a mass of 15 kg/m length. It is simply supported at the ends and carries three masses 90 kg, 140 kg and 60 kg at 0.8 m, 1.5 m and 2 m respectively from the left support. Taking $E = 20\ GN/m^2$, find the frequency of transverse vibrations. [8+7]

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