Code: 13A03503

R13

B.Tech III Year I Semester (R13) Regular & Supplementary Examinations November/December 2016

DYNAMICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

- (a) What is a brake? What is the difference between a brake and a clutch?
- (b) Define the terms: (i) Coefficient of friction. (ii) Limiting angle of friction.
- (c) Relate the maximum fluctuation of energy in a flywheel to mean kinetic energy of the flywheel and coefficient of fluctuation of speed.
- (d) Write any one special characteristic exhibited by gyroscope when it is in motion.
- (e) Define and explain the following terms relating to governors: (i) Stability. (ii) Sensitiveness.
- (f) Find the height of a Watt governor when it rotates at 50 rpm.
- (g) Why is balancing of rotating parts necessary for high speed engines?
- (h) Write the magnitude of maximum secondary unbalanced force due to reciprocating parts in terms of its maximum primary unbalanced force.
- (i) What is whirling speed of shaft?
- (j) Write an equation for finding the length of a torsionally equivalent shaft to a stepped shaft.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 A cone clutch with a semi-cone angle of 15° transmits 10 kW at 600 rpm. The normal pressure intensity between the surfaces in contact is not to exceed 100 kN/m^2. The width of the friction surfaces is half of the mean diameter. Assume $\mu = 0.25$. Determine: (i) The outer and inner diameters of the plate. (ii) Width of the cone face. (iii) The axial force to engage the clutch.

OR

3 A band and block brake, having 14 blocks each of which subtends an angle of 15° at the centre, is applied to a drum of 1 m effective diameter. The drum and flywheel mounted on the same shaft has a 2000 kg and a combined radius of gyration of 500 mm. The two ends of the band are attached to pins on opposite sides of the brake lever at distances of 30 mm and 120 mm from the fulcrum. If a force of 200 N is applied at a distance of 750 mm from the fulcrum, find: (i) Maximum braking torque. (ii) Angular retardation of the drum. (iii) Time taken by the system to come to rest from the rated speed of 360 rpm. The coefficient of friction between blocks and drum may be taken as 0.25.

UNIT – II

4 Each wheel of a motor cycle is of 600 mm diameter and has a moment of inertia of 1.2 kgm^2. The total mass of the motor cycle and rider is 180 kg and t he combined centre of mass is 580 mm above the ground level when the motor cycle in upright. The moment of inertia of the rotating parts of the engine is 0.2 kgm^2. The engine speed is 5 times the speed of the wheels and is in the same sense. Determine the angle of heel necessary when the motor cycle takes a turn of 35 m radius at a speed of 54 kmph.

OR

5 In a machine, the intermittent operations demand the torque to be applied as follows:

(i) During the first half revolution, the torque increases uniformly from 800 Nm to 3000 Nm.
(ii) During next one revolution, the torque remains constant.
(iii) During the next one revolution, the torque decreases uniformly from 3000 Nm to 800 Nm.

During last 1 ½ revolution, the torque remains constant. Thus a cycle is completed in 4 revolutions. The motor to which the machine is coupled exerts a constant torque at a mean speed of 250 rpm. The flywheel of mass 1800 kg and radius of gyration of 500 mm is fitted to the shaft. Determine:

- (a) The power of the motor.
- (b) The total fluctuation of speed of the machine shaft.

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UNIT – III

6 Sketch a Hartnell Governor. Describe its function and deduce a relation to find the stiffness of the spring.

OR

7 Each arm of Porter governor is 200 mm long is hinged at a distance of 40 mm from the axis of rotation. The mass of each ball is 1.5 kg and of the sleeve 25 kg. When the links are at 30° to the vertical, the sleeve begins to rise at 260 rpm. Assuming that the friction force is constant, find the maximum and minimum speeds of rotation when the inclination of the arms to the vertical is 45°.

UNIT – IV

8 (a) Explain why only a part of unbalanced force due to reciprocating masses is balanced by revolving mass.

(b) Four masses A, B, C and D are attached to a shaft and revolve in the same plane. The masses are 12 kg, 10 kg, 18 kg and 15 kg respectively and their radii of rotation are 40 mm, 50 mm, 60 mm and 30 mm. The angular position of the asses B, C and D are 60°, 135° and 270° from mass A. Find the magnitudes and position of the balancing mass at a radius of 100 mm.

OR

9 The following data apply to an outside cylinder uncoupled locomotive:

Mass of rotating parts per cylinder = 360 kg
Mass of reciprocating parts per cylinder = 300 kg
Angle between cranks = 90°
Crank radius = 0.3 m
Cylinder centers = 1.75 m
Radius of balance masses = 0.75 m
Wheel centers = 1.45 m

If whole of the rotating and two-thirds of reciprocating parts are to be balanced in planes of the driving wheel, find: (i) Magnitude and angular positions of balance masses. (ii) Speed in kilometers per hour at which the wheel lift off the rails when the load on each driving wheel is 30 kN and the diameter of tread of driving wheels is 1.8 m. (iii) Swaying couple at speed arrived at in (ii) above.

UNIT – V

10 Derive an expression for the natural frequency of free longitudinal vibrations by equilibrium method.

OR

11 A reciprocating IC engine is coupled to a centrifugal pump through a pair of gears. The shaft from the flywheel of the engine to the gear wheel has a 48 mm diameter and is 800 mm long. The shaft from the pinion to the pump has 32 mm diameter and is 280 mm long. Pump speed is four times the engine speed. Moments of inertia of flywheel, gear-wheel, pinion and pump impeller are 1000 kgm^2, 14 kg.m^2, 5 kg.m^2 and 18 kg.m^2 respectively. Find the natural frequency of the torsional oscillations of the system. Take G = 80 GN/m^2.

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