Code: 13A03503 **R13**

B.Tech III Year I Semester (R13) Regular Examinations December 2015

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) State the laws of static friction.
(b) Write short notes on Friction clutch.
(c) What is the function of a flywheel?
(d) Define 'inertia force' and 'inertia torque'.
(e) What are the various classifications of governors?
(f) Define centrifugal governors.
(g) Define the static and dynamic balancing of rotating masses.
(h) Why is balancing of rotating parts necessary for high speed engines?
(i) Define in short, free vibrations and forced vibrations.
(j) Write the equation of Natural Frequency for Free Transverse Vibrations.

PART – B

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

UNIT – I

2 A dry single plate clutch is to be designed for an automotive vehicle whose engine is rated to give 100 kW at 2400 r.p.m. and maximum torque 500 N-m. The outer radius of friction plate is 25% more than the inner radius. The intensity of pressure between the plate is not to exceed 0.07 N/mm^2. The coefficient of friction may be assumed equal to 0.3. The helical springs required by this clutch to provide axial force necessary to engage the clutch are eight. If each spring has stiffness equal to 40 N /mm, determine the initial compression in the springs and dimensions of the friction plate.

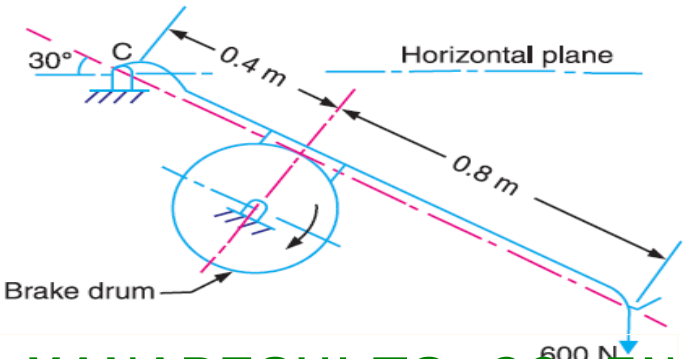
OR

3 A braking system has its braking lever inclined at an angle of 30° to the horizontal plane, as shown in figure below. The mass and diameter of the brake drum are 218 kg and 0.54 m respectively. At the instant the lever is pressed on the brake drum with a vertical force of 600 N, the drum is found to rotate at 2400 r.p.m. clockwise. The coefficient of friction between the brake shoe and the brake drum is 0.4. Assume that the lever and brake shoe are perfectly rigid and possess negligible weight.

Find: (i) Braking torque.

(ii) Number of revolutions the drum will make before coming to rest from the instant of pressing the lever.

(iii) Time taken for the drum to come to rest from the instant of pressing the lever.



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UNIT – II

4 A multi-cylinder engine is to run at a speed of 600 r.p.m. On drawing the turning moment diagram to a scale of 1 mm = 250 N-m and 1 mm = 3°, the areas above and below the mean torque line in mm^2 are: +160, –172, +168, –191, +197 and –162. The speed is to be kept within ± 1% of the mean speed of the engine. Calculate the necessary moment of inertia of the flywheel. Determine the suitable dimensions of a rectangular flywheel rim if the breadth is twice its thickness. The density of the cast iron is 7250 kg/m^3 and its hoop stress is 6 MPa. Assume that the rim contributes 92% of the flywheel effect.

OR

5 The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 r.p.m. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship: (i) When the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h?

(ii) When the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity? The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees.

UNIT – III

6 A Porter governor has all four arms 250 mm long. The upper arms are attached on the axis of rotation and the lower arms are attached to the sleeve at a distance of 30 mm from the axis. The mass of each ball is 5 kg and the sleeve has a mass of 50 kg. The extreme radii of rotation are 150 mm and 200 mm. Determine the range of speed of the governor.

OR

7 In a spring loaded Hartnell type governor, the extreme radii of rotation of the balls are 80 mm and 120 mm. The ball arm and the sleeve arm of the bell crank lever are equal in length. The mass of each ball is 2 kg. If the speeds at the two extreme positions are 400 and 420 r.p.m, find: (i) The initial compression of the central spring. (ii) The spring constant.

UNIT – IV

8 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.

OR

9 A shaft is supported in bearings 1.8 m apart and projects 0.45 m beyond bearings at each end. The shaft carries three pulleys one at each end and one at the middle of its length. The mass of end pulleys is 48 kg and 20 kg and their centre of gravity are 15 mm and 12.5 mm respectively from the shaft axis. The centre pulley has a mass of 56 kg and its centre of gravity is 15 mm from the shaft axis. If the pulleys are arranged so as to give static balance. Determine: (i) Relative angular positions of the pulleys. (ii) Dynamic forces produced on the bearings when the shaft rotates at 300 r.p.m.

UNIT – V

10 A machine of mass 75 kg is mounted on springs and is fitted with a dashpot to damp out vibrations. There are three springs each of stiffness 10 N/mm and it is found that the amplitude of vibration diminishes from 38.4 mm to 6.4 mm in two complete oscillations. Assuming that the damping force varies as the velocity, determine: (i) The resistance of the dashpot at unit velocity. (ii) The ratio of the frequency of the damped vibration to the frequency of the undamped vibration. (iii) The periodic time of the damped vibration.

OR

11 The mass of an electric motor is 120 kg and it runs at 1500 r.p.m. The armature mass is 35 kg and its C.G. lies 0.5 mm from the axis of rotation. The motor is mounted on five springs of negligible damping so that the force transmitted is one-eleventh of the impressed force. Assume that the mass of the motor is equally distributed among the five springs. Determine: (i) Stiffness of each spring. (ii) Dynamic force transmitted to the base at the operating speed. (iii) Natural frequency of the system.

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