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BIMEE-007

B.Tech. – VIEP – MECHANICAL ENGINEERING (BTMEVI)

Term-End Examination

00283

December, 2016

BIMEE-007 : ADVANCED DYNAMICS OF MACHINES

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any **five** questions. All questions carry equal marks. Use of scientific calculator is permitted. Assume missing data suitably, if any.*

1. A disturbing mass 600 kg is attached to a shaft. The shaft is rotating at a uniform angular velocity ω rad/sec. and the distance of the C.G. of the disturbing mass from the axis of rotation is 270 mm. The disturbing mass is to be balanced by two masses in two different planes. The distance of the C.G. of the balancing mass from the axis of rotation is 450 mm each. The distance between the two planes of the balancing masses is 1·5 m and the distance between the plane of the disturbing mass and one of the planes of the balancing masses is 300 mm. Determine

(a) the distance between the plane of the disturbing mass and the plane of the other balancing mass.

(b) the magnitude of the balancing masses when

(i) the planes of the balancing masses are on the same side of the plane of the disturbing mass.

(ii) the planes of the balancing masses are on either side of the plane of the disturbing mass. *14*

2. A shaft, 1·5 m long, supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375 mm from the centre towards left. The shaft is hollow with external diameter 75 mm and internal diameter 40 mm. The density of the shaft material is 7700 kg/m^3 and its modulus of elasticity is 200 GN/m^2. Find the lowest whirling speed of the shaft, taking into account the mass of the shaft. *14*

3. A four-wheeled trolley car of total mass 2000 kg running on rails of 1·6 m gauge, rounds a curve of 30 m radius at 54 km/hour. The track is banked at 8°. The wheels have an external diameter of 0·7 m and each pair with axle has a mass of 200 kg. The radius of gyration for each pair is 0·3 m. The height of centre of gravity of the car above the wheel base is 1 m. Determine the pressure on each rail, allowing gyroscopic couple actions. *14*

4. Draw and describe the Turning Moment Diagram for a 4-stroke I.C. Engine A punching press is required to punch 30 mm diameter holes in a plate of 20 mm thickness at the rate of 20 holes per minute. It requires 6 Nm of energy per mm^2 of sheared area. If punching takes place in $\frac{1}{10}$ of a second and the r.p.m. of the flywheel varies from 160 to 140, determine the mass of the flywheel having radius of gyration of 1 m. *14*

5. The lengths of crank and connecting rod of a horizontal reciprocating engine are 300 mm and 1·5 m respectively. The crank is rotating at 120 r.p.m. clockwise. The mass of the reciprocating parts of the engine is 290 kg whereas the mass of the connecting rod is 250 kg. The C.G. of the connecting rod is 475 mm from the crank-pin centre and radius of gyration of the connecting rod about an axis passing through the C.G. is 625 mm. Find the inertia torque on the crank-shaft. *14*

6. The cranks of a two-cylinder, uncoupled, inline, inside cylinder locomotive are at right angles and are 300 mm long. The distance between the centre lines of the cylinder is 650 mm. The wheel centre lines are 1·6 m apart. The reciprocating mass per cylinder is 300 kg. The driving wheel diameter is 1·8 m. If the hammer blow is not to exceed 45 kN at 100 km/hour, determine

(a) the fraction of the reciprocating masses to be balanced,

(b) the variation in tractive effort, and

(c) the maximum swaying couple. *14*

7. Write short notes on any ***two*** of the following : *7+7*

(a) Lagrange's Equation of Motion

(b) Gyroscopic Effect on Critical Speed

(c) Dynamic Force Analysis of the Link

(d) Dynamically Equivalent System of the Link