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BIMEE-007

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

00236

Term-End Examination

June, 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 any missing data suitably.*

1. A uniform shaft is simply supported at its ends and has 20 mm diameter and 600 mm length. The shaft carries a load of 19·62 N at its centre. The weight of shaft per metre length is 248·2 N. Find the critical speed of the shaft. Take Young's modulus of shaft material as 200 GN/m^2. *14*

2. A pair of locomotive driving wheels with the axle, have a moment of inertia of 180 kg-m^2. The diameter of the wheel treads is 1·8 m and the distance between the wheel centres is 1·5 m. When the locomotive is travelling on a level track at 95 km/h, defective ballasting causes one wheel

to fall 6 mm and to rise again in a total time of 0·1 second. If the displacement of the wheel takes place with simple harmonic motion, find

(a) the gyroscopic couple set up, and

(b) the reaction between the wheel and rail due to this couple. *14*

3. The crank-pin circle radius of a horizontal engine is 300 mm. The mass of the reciprocating parts is 250 kg. When the crank has travelled 60° from I.D.C., the difference between the driving and the back pressure is 0·35 N/mm^2. The connecting rod length between the centres is 1·2 m and the cylinder bore is 0·5 m. If the engine runs at 250 r.p.m. and if the effect of piston rod diameter is neglected, calculate the

(a) pressure on slide bars,

(b) thrust in the connecting rod,

(c) tangential force on the crank-pin, and

(d) turning moment on the crank-shaft. *14*

4. Why is balancing of rotating parts necessary for high speed engines ? 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 the successive masses with respect to m_1 are 45°, 75° and 135°. Find the position and magnitude of the balance mass required, if the radius of rotation is 0·2 m. *14*

5. A machine punching 38 mm holes in 32 mm thick plate requires 7 N-m of energy per sq.mm of sheared area, and punches one hole in every 10 seconds. Calculate the power of the motor required. The mean speed of the flywheel is 25 metres per second. The punch has a stroke of 100 mm. Also find the mass of the flywheel required, if the total fluctuation of speed is not to exceed 3% of the mean speed. Assume that the motor supplies energy to the machine at uniform rate. *14*

6. The cranks of a two-cylinder, uncoupled inside cylinder, in line locomotive, are at right angles and are 325 mm long. The cylinders are 675 mm apart. The rotating mass per cylinder is 200 kg at the crank-pin and the mass of the reciprocating parts per cylinder is 240 kg. The wheel centre lines are 1·5 m apart. The whole of the rotating and two-third of the reciprocating masses are to be balanced and the balance masses are to be placed in the planes of the rotation of the driving wheels at a radius of 800 mm. Find

   (a) the magnitude and direction of the balancing masses, and

   (b) the maximum swaying couple at a crank speed of 240 r.p.m. *14*

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

(a) D'Alembert's Principle

(b) Euler's Equation of Motion

(c) Gyroscopic Stabilization of Naval Ship

(d) Principle of Virtual Work