

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

00046

Term-End Examination

June, 2015

BIMEE-007 : ADVANCED DYNAMICS OF MACHINE

Time : 3 hours

Maximum Marks : 70

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

1. 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 of 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

2. A ship is propelled by a turbine rotor which has a mass of 5 tonnes and a speed of 2100 rpm. The rotor has a radius of gyration of 0.5 m and rotates in a clockwise direction when viewed from the stern. Find the gyroscopic effects in the following conditions :

- (a) The ship sails at a speed of 30 km/hr and steers to the left in a curve having 60 m radius.
- (b) The ship pitches 6 degree above and 6 degree below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic and the periodic time is 20 seconds.
- (c) The ship rolls and at a certain instant it has an angular velocity of 0.03 rad/s clockwise when viewed from stern.

Also determine the maximum angular acceleration during pitching.

14

3. A horizontal steam engine has a piston of diameter 225 mm and a stroke of 600 mm. When the crank has turned through 40° from the I.D.C., the steam pressure on the cover and crank sides are 1.1 N/mm^2 and 0.220 N/mm^2 absolute respectively. The length of connecting rod is 1.5 m and diameter of piston rod is 50 mm. The r.p.m. of the crank is 240. Neglecting the friction of moving parts, find the torque exerted on the crank shaft.

14

4. 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 metre.

14

5. A shaft is rotating at a uniform angular speed. Four masses m_1 , m_2 , m_3 and m_4 of magnitudes 300 kg, 450 kg, 360 kg and 390 kg respectively are attached rigidly to the shaft. The masses are rotating in the same plane. The corresponding radii of rotation are 200 mm, 150 mm, 250 mm and 300 mm respectively. The angles made by these masses with the horizontal are 0° , 45° , 120° and 225° respectively. Determine

- (i) the magnitude of the balancing mass, and
- (ii) the position of the balancing mass, if its radius of rotation is 200 mm.

14

6. A connecting rod is suspended from a point 25 mm above the centre of small end, and 650 mm above its centre of gravity. Its mass is 37.5 kg. When permitted to oscillate, the time period is found to be 1.87 seconds. Find the dynamically equivalent system constituted of two masses, one of which is located at the small end centre. 14
7. Write short notes on any *two* of the following : 7+7
- (a) Principle of virtual work
 - (b) Turning Moment diagram for a single cylinder double acting steam engine
 - (c) Gyroscopic effects in machines
 - (d) Lagrange's equation of motion
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