

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

Term-End Examination

December, 2015

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 required.*

1. A vertical shaft of 5 mm diameter is 200 mm long and is supported in long bearings at its ends. A disc of mass 50 kg is attached to the centre of the shaft. Neglecting any increase in stiffness due to the attachment of the disc to the shaft, find the critical speed of rotation and the maximum bending stress, when the shaft is rotating at 75% of the critical speed. The centre of the disc is 0.25 mm from the geometric axis of the shaft. $E = 200 \text{ GN/m}^2$.

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2. 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 rpm clockwise, when looking from stern. Determine the gyroscopic couple and its effect upon the ship :

(a) when the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/hr.

(b) 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.

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3. A vertical petrol engine, 150 mm diameter and 200 mm stroke has a connecting rod 350 mm long. The mass of the piston is 1.6 kg and the engine speed is 1800 rpm on the expansion stroke with crank angle 30° from the top dead centre, the gas pressure is 750 kN/m^2 . Determine the net thrust on the engine.

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4. A punching machine operates at the rate of 600 holes/hr. It does 45 N-m of work per sq.mm of sheared area in cutting 25 mm diameter hole in a 3 mm thick plate. The machine is operated by a constant torque motor. The speed of the machine fluctuates between 250 rpm and 230 rpm. The frictional losses are 20% of the work done during punching and actual punching time of per hole is 2 seconds. Find :

- (i) The power required to drive punching machine
- (ii) The maximum fluctuation of energy
- (iii) The mass of the flywheel required to keep the speed fluctuation in the given range.
Radius of gyration of flywheel is 500 mm.

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5. A shaft carries four rotating masses A, B, C and D in the same order along its axis. The mass A may be assumed to be concentrated at a radius of 18 cm, B of 24 cm, C of 12 cm and D of 15 cm. The masses of B, C and D are 30 kg, 50 kg and 40 kg respectively. The planes containing B and C are 30 cm apart. The angular spacing of the planes containing C and D are 90° and 210° respectively relative to B measured in the same plane. If the shaft and masses are to be in complete dynamic balance, calculate :

- (i) the mass and the angular position of A
- (ii) the position of planes A and D from plane B

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6. The length of a connecting rod of an engine is 500 mm measured between the centres and its mass is 18 kg. The centre of gravity is 125 mm from the crank-pin centre and crank radius is 100 mm. Determine the dynamically equivalent system keeping one mass at the small end. The frequency of oscillations of the rod, when suspended from the centre of the small end is 43 cycles per minute. 14
7. Write short notes on any *two* of the following : 7+7
- (a) D'Alembert's Principle
 - (b) Dynamic Force Analysis
 - (c) Balancing of Internal Combustion Engine
 - (d) Gyroscopic Stabilization
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