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

Term-End Examination

December, 2018

00025

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.*

1. A ship is propelled by a turbine rotor which has 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 degrees above and 6 degrees below the horizontal position. The bow is descending with its maximum velocity. The motion due to pitching is simple harmonic motion and periodic time is 20 seconds.   *14*

2. A vertical shaft of 6 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. $E = 200 \text{ GN/m}^2$. **14**

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. **14**

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

   (a) the mass and the angular position of A, and

   (b) the position of P and S from Q. **14**

5. (a) Explain clearly how the function of flywheel and governor differ from each other in a steam engine.

(b) Find the maximum and minimum speeds of flywheel of mass 5200 kg and radius of gyration 1·8 m when the fluctuation of energy is 100800 Nm. The mean speed of the engine is 180 rpm. 7+7

6. During forward stroke of the piston of the double acting steam engine, the turning moment has the maximum value of 2000 Nm when the crank makes an angle of 80° with the inner dead centre. During the backward stroke, the maximum turning moment is 1500 Nm when the crank makes an angle of 80° with the outer dead centre. The turning moment diagram for the engine may be assumed for simplicity to be represented by two triangles. If the crank makes 100 rpm and the radius of gyration of the flywheel is 1·75 m, find the coefficient of fluctuation of energy and the mass of the flywheel to keep the speed within ± 0·75% of the mean speed. Also determine the crank angle at which the speed has its maximum and minimum values. 14

7. Write short notes on the following : 7+7

    (a) Principle of Virtual Work

    (b) Gyroscopic Stabilization

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