Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 42849

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018

Fifth Semester

Mechanical Engineering

ME 2302 – DYNAMICS OF MACHINERY

(Common to PTME 2302-Dynamics of Machinery for B.E. (Part-Time) Fourth Semester-Mechanical Engineering-Regulations 2009)

(Regulations 2008)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. What is the static force analysis ?
2. What is the function of a flywheel ?
3. What is an in-line engine ?
4. Give the conditions of static balancing.
5. What is whirling speed of shaft ?
6. What is damping factor ? State its significance.
7. What is a steady state vibration ?
8. List some vibration isolating materials.
9. Define height of the governor.
10. What do you mean by processional angular motion ?

PART – B **(5×16=80 Marks)**

11. a) i) The crank and connecting rod of a steam engine are 0.35 m and 1.55 m in length. The crank rotates at 180 rpm clockwise. Determine the velocity and acceleration of the piston, when the crank is at 40° from the inner dead centre position. Also determine the position of the crank for zero acceleration of the piston. **(7)**

ii) A steam engine 200 mm bore and 300 mm stroke has a connecting rod 625 mm long. The mass of the reciprocating parts is 15 kg and the speed is 250 rpm when the crank is at 30° to the inner dead centre and moving outwards, the difference in steam pressure is 840 kN/mm^2, If the crank pin radius is 30 mm, determine the force on the crank shaft and the torque acing on the frame. **(9)**

(OR)

b) A steam engine runs at 150 rpm. Its turning moment diagram gave the following area measurements in mm^2 taken in order above and below the mean torque line : 500, –250, 270, –390, 190, –340, 270, and –250. The scale for the turning moment is 1 mm = 500 Nm and crank angle is 1 mm = 5°. If the fluctuation of speed is not to exceed ± 1.5% of the mean, determine a suitable diameter and cross-section of the rim of the flywheel assumed with axial dimensions is equal to 1.5 times the radial dimension. The hoop stress is limited to 3 MPa and the density of the material of the flywheel is 7500 kg/m^3. **(16)**

12. a) A rotating shaft carries four masses A, B, C and D which are radially attached to it. The mass centres are 30 mm, 38 mm, 40 mm ,and 35 mm respectively from the axis of rotation. The masses A, C and D are 7.5 kg, 5kg and 4kg respectively. The axial distances between the planes of rotation of A and B is 400 mm and between B and C is 500 mm. The masses A and C are at right angles to each other. Find for a complete balance, the angle between the masses B and D from mass A, the axial distance between the planes of rotation of C and D and the magnitude of mass B. **(16)**

(OR)

b) The cranks and connecting rods of a 4-cylinder in-line engine running at 1800 rpm are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine the unbalanced primary and secondary forces, if any, and the unbalanced primary and secondary couples with reference to central plane of the engine. **(16)**

13. a) A body of mass of 50 kg is supported be an elastic structure of stiffness of 10 kN/m. The motion of the body is controlled by a dashpot such that the amplitude of vibration decreases to one-tenth of its original value after two complete vibrations. Determine the damping ratio, the damping force at 1 m/s and the natural frequency of vibration. **(16)**

(OR)

b) The flywheel of an engine driving a dynamo has a mass of 200 kg and has a radius of gyration of 30 cm. The shaft at the flywheel end has an effective length of 25 cm and is 5 cm in diameter. The armature mass is 225 kg and has a radius of gyration of 25.5 cm. The dynamo shaft has a diameter of 4.375 cm and an equivalent length of 20 cm. Neglecting the inertia of the shaft and coupling, calculate the frequency of the torsional vibrations and the position of node. The modulus of rigidity for the shaft material is 80 GN/m^2. **(16)**

14. a) A computer monitor set of 18 kg mass must be isolated from a machine vibrating with an amplitude 0.06 mm at 520 cycles per minute. The set is mounted on four isolators, each having a spring scale of 31000 N/m and damping coefficient of 400 Ns/m. What is the amplitude of vibration of the computer monitor ? What is the dynamic load on each isolator due to vibration ? **(16)**

(OR)

b) A single-Cylinder engine has an out-of-balance force of 500 N at an engine speed of 300 rpm. The total mass of the engine is 150 kg and it is carried on a set of springs of total stiffness 300 N/cm. Find the amplitude of the steady state motion of the mass and the maximum oscillating force transmitted to the foundation. If a viscous damping is interposed between the mass and the foundation, the damping force being 1000 N at 1 m/s of velocity, find the amplitude of the forced damped oscillation of the mass and its angle of lag with disturbing force. **(16)**

15. a) A Proell governor has equal arms of length 300 mm. The upper and lower ends of the arms are pivoted on the axis of the governor. The extension arms of the lower links are each 80 mm long and parallel to the axis when the radii of rotation of the balls are 150 mm and 200 mm. The mass of each ball is 10 kg and the mass of the central load is 100 kg. Determine the range of speed of the governor. **(16)**

(OR)

b) The turbine rotor of a ship has a mass of 2000 kg and rotates at a speed of 3000 r.p.m. clockwise when looking from a stern. The radius of gyration of the rotor is 0.5m. Determine the gyroscopic couple and its effects upon the ship when the ship is steering to the right in a curve of 100 m radius at a speed of 16.1 knots (1 knot = 1855 m/hr). Calculate also the torque and its effects when the ship is pitching in simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 50 seconds and the total angular displacement between the two extreme positions of pitching is 12°. Find the maximum acceleration during pitching motion. **(16)**
