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

Question Paper Code : 51855

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Fifth Semester

Mechanical Engineering

ME 2302/ME 52/ME 1301/10122 ME 503 – DYNAMICS OF MACHINERY

(Regulations 2008/2010)

(Common to PTME 2302/10122 ME 503 – Dynamic of Machinery for B.E. (Part-Time) Fourth Semester Mechanical Engineering – Regulations 2009/2010)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. With suitable example, explain the concept of Inertia torque.
2. Define Coefficient of Fluctuation of Energy in Flywheels.
3. Why balancing is necessary of rotating parts necessary for high speed engines ?
4. What do you mean by primary and second balancing in balancing of reciprocating masses ?
5. What is the meaning of critical speed of shaft ?
6. Define degree of freedom in vibrations.
7. Explain the concept of Vibration Isolation and Transmissibility.
8. Explain the term Logarithmic Decrement as applied to damped vibrations.
9. Differentiate between gravity controlled governors and spring controlled governors.
10. Explain the terms spin and precession. How do they differ from each other ?

PART – B (5 × 16 = 80 marks)

11. (a) The turning moment diagram for a multi-cylinder engine has been drawn to a scale of 1 mm = 325 N-m vertically and 1 mm = 3° horizontally. The areas above and below the mean torque line are –26, + 378, – 256, +306, +244, –380, + 261 and –225 mm^2 . The engine is running at a mean speed of 600 r.p.m. The total fluctuation of speed is not to exceed ± 1.8% of the mean speed. If the radius of the flywheel is 0.7 m, find the mass of the flywheel. **(16)**

OR

(b) The lengths of the crank and connecting rod of a reciprocating engine are 300 mm and 1.5m respectively. The crank is rotating clockwise at a speed of 120 r.p.m. The mass of connecting rod is 250 kg and the distance of centre of gravity of the rod from the crank pin centre is 475 mm .The radius of gyration of the rod about centre of gravity is 625 mm, When the crank position is 40° from the inner dead centre then find by graphical method and analytical method (i) Magnitude, position and direction of inertia force due to the mass of the connecting rod (ii) Torque exerted on the crank-shaft in magnitude and direction. Take the mass of reciprocating parts = 290 kg. **(16)**

12. (a) A rotating shaft carries four unbalanced masses 18kg, 14kg, 16 kg and 12 kg at radii 50 mm , 60 mm , 70 mm and 60 mm respectively. The 2nd, 3rd and 4th masses revolve in planes 80 mm, 160 mm and 280 mm respectively from the plane of first mass and are angularly located at 60°, 135° and 270° respectively measured clockwise from the first mass looking from the end of the shaft. The shaft is dynamically balanced by two masses, both located at 50 mm radii and revolving in planes mid-way between those of 1st and 2nd masses and midway between those of 3rd and 4th masses. Determine the magnitudes of their masses and their respective angular positions. **(16)**

OR

(b) The following data apply to an outside cylinder uncoupled locomotive;

Mass of reciprocating parts per cylinder = 300 kg,

Mass of reciprocating parts per cylinder = 360 kg.

Angle between cranks = 90°. Crank radius = 0.3 m;

Cylinder lines = 1.75 m;

Radius of Balanced Mass = 0.75 m ;

Wheel centers = 1.45 m.

If the whole of the rotating and two thirds of reciprocating parts are to be balanced in planes of driving wheels, find their magnitude and angular positions of balanced masses.

13. (a) (i) In a single -degree damped vibrating system; a suspended mass of 3.75 kg makes 12 oscillations in 7 seconds when disturbed from its equilibrium position. The amplitude of vibration reduces to 0.33 of its initial value after four oscillations. Determine: (i) stiffness of the spring (ii) logarithmic decrement (iii) damping factor and (iv) the damping co-efficient. **(10)**

(ii) A shaft of 100 mm diameter and 1 metre long has one of its end fixed and the other end carries a disc of mass 500-kg. The modulus of elasticity for the shaft material is 200 GN/m^2. Determine the frequency of longitudinal vibrations. **(6)**

OR

(b) A steel shaft ABCD 1.5 m long has flywheel at its ends A and D. The mass of the flywheel A is 600 kg and has a radius of gyration of 0.6 m. The mass of the flywheel D is 800 kg and has a radius of gyration of 0.9 m. The connecting shaft has a diameter of 50 mm for the portion AB which is 0.4 m long; and has a diameter of 60 mm for the portion of BC which is 0.5 m long: and has a diameter of D mm for the portion CD which is 0.6 m long. Determine :

(i) the diameter D of the portion CD so that the node of the torsional vibration of the system will be at the centre of the length BC; and

(ii) The natural frequency of the torsional vibrations.

The modulus of rigidity for the shaft material is 80 GN/ m^2.

14. (a) A single cylinder vertical petrol engine of total mass 300 kg is mounted upon a steel chassis frame and causes a vertical static deflection of 2 mm. The reciprocating parts of the engine have a mass of 20 kg and move through a vertical stroke of 150 mm with simple harmonic motion. A dashpot is provided whose damping resistance is directly proportional to the velocity and amounts to 1.5 kN per metre second. Considering that the steady state of vibration is reached; determine: 1) The amplitude of forced vibrations, when the driving shaft of the engine rotates at 480 rpm 2), The speed of the driving shaft at which resonance will occur. **(16)**

OR

(b) A machine of mass 75 kg is mounted on springs of stiffness 1200 kN/mm and with an assumed damping factor of 0.2. A piston within the machine of mass 2 kg has a reciprocating motion with a stroke of 80 mm and a speed of 3000 cycles/ min. Assuming the motion to be simple harmonic, Find 1 (The amplitude of motion of the machine 2) Its phase angle with respect to the exciting force, 3) The force transmitted to the foundation and 4) The phase angle of transmitted force with respect to the exciting force. **(16)**

15. (a) A loaded porter governor has four links each 300 mm long, two revolving masses each of 7 kg and a central dead weight of mass 54 kg. The upper arms are pivoted on the axis of rotation and the lower arms are attached to the sleeve at radial distances of 3.5 mm from the axis of rotation. The masses revolve at a radius of 200 mm at minimum speed and at a radius of 250 mm at maximum speed. Determine the range of speed. **(16)**

OR

(b) (i) A ship has a propeller of mass moment of inertia 2000 kgm^2. The propeller rotates at a speed of 360 rpm in clockwise sense looking from the stern. Determine gyroscopic couple and its effect when ship moves at 30km/ hr. and steers to the left at a radius of 200 m. **(8)**

(ii) An air craft consists of a propeller. It also consists of engine and propeller of mass moment of inertia 150 kgm^2. The engine rotates at 3600 r.p.m in a sense clockwise looking from rear. The aircraft completes half circle of radius 100 m towards left flying at 360 km per hour. Determine the gyroscopic couple on the aircraft and state its effect. **(8)**