09/06/2025 TE MECHANICAL SEM-V C-SCHEME DOM QP CODE: 10087505

Time: 3 Hours **Total Marks: 80**

N.B.
1. Question No. 1 is compulsory
2. Answer any three questions from reaming questions
3. Assume suitable data if required
4. Figure to the right indicates full marks.

Q 1 Solve **any four** **[20]**

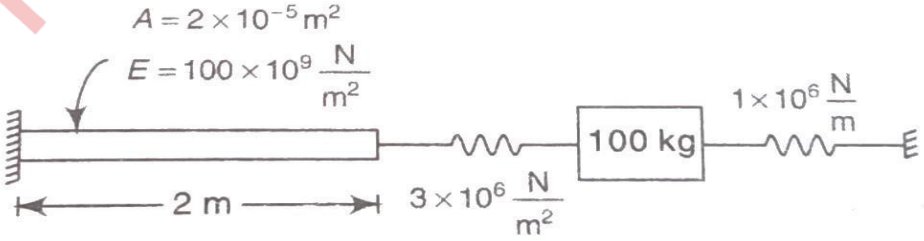
1. State the different type of governors. Explain construction and working of centrifugal Governor.
2. Explain two mass dynamical equivalent systems.
3. Explain Static and Dynamic Balancing
4. Compare Viscous and Coulomb damping.
5. Classify vibration measuring instruments? Explain anyone.

Q 2 A) A porter governor has equal mass each 250 mm long and pivoted on the axis of rotation. Each ball has a mass of 5 kg and the mass of the central load on the sleeve is 25 kg. The radius of rotation of the ball is 150 mm when the governor begins to lift and 200 mm when the governor is at maximum speed. Find the range of speed, sleeve lift, governor effort and power of the governor in the following cases: **[10]**

(i)When friction at sleeve is neglected?
(ii)When friction at sleeve is equal to 10 N?

Q2 B) The connecting rod of a gasoline engine is 300 mm long between its centres. It has a mass of 15 kg and mass of inertia of 7000 kg-mm^2. Its centre of gravity is at 200 mm from its small end centre. Determine the dynamical equivalent two-mass system of the connecting rod if one of the masses is located at the small end centre **[10]**

Q 3 A) Determine the natural frequency for the given system as shown in Fig below **[10]**



Q3 B) Derive the equation for critical speed of a light shaft with a single disk without damping **[10]**

Q 4 A) A Vibrometer has a period of free vibration of 2 sec. It is attached to a machine with a vertical harmonic frequency of 1 Hz. If the Vibrometer mass has an amplitude of 3 mm relative to the vibrometer frame, what is the amplitude of vibration of machine? **[10]**

Q 4 B) A seismic instrument with natural frequency of 6Hz is used to measure vibration of machine running at 125 rpm. The instrument gives reading for relative displacement of mass as 0.05mm. Determine amplitude of displacement, velocity and acceleration of vibrating machine. Neglected damping. **[10]**

Q 5 A) A,B,C,D are four masses carried by a rotating shaft at radii 100mm,125mm, 200mm, and 150mm respectively. The planes in which masses revolve are spaced 600 mm apart and mass of B,C,D are 10kg, 5kg, 4kg respectively. Find the required mass and angular position of mass A in order to have complete balance. **[10]**

Q 5 B) 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 r.p.m. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship: **[10]**

1. When the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h.
2. 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.

Q 6 A) In Hartnell governor, the lengths of ball and sleeve arms of bell crank lever are 120 mm and 100 mm respectively. The distance of the fulcrum of the bell crank lever from the governor axis is 140 mm. Each governor ball has a mass of 4 kg. The governor runs at a mean speed of 300 rpm with the ball arms vertical and sleeve arms horizontal. For an increase of speed of 4%, the sleeve moves 10 mm upwards. Neglecting friction, Find **[10]**

(i)The minimum equilibrium speed if the total sleeve movement is limited to 20 mm.
(ii) Spring stiffness.
(iii)The sensitiveness of the governor

Q 6 B) A vertical double acting steam engine has a cylinder 300 mm diameter and 450 mm stroke and runs at 200 r.p.m. The reciprocating parts have a mass of 225 kg and the piston rod is 50 mm diameter. The connecting rod is 1.2 m long. When the crank has turned through 125° from the top dead centre, the steam pressure above the piston is 30 kN/m^2 and below the piston is 1.5 kN/m^2. Calculate the effective turning moment on the crank shaft. **[10]**
