TIME: 3 Hrs **Total Marks: 80**

Instructions:

i. Question No.1 is compulsory
ii. Attempt any 3 out of the remaining questions
iii. Use your judgement for unspecified data, if any but justify the assumption.
iv. Numbers to the right indicate marks.

Q1. Attempt any four of the following sub questions:

a. Compare vibrometer and accelerometer on the basis of the following parameters: mass, natural frequency, practical applicability and error estimation. (5)

b. Why does gyroscopic couple occurs. Derrive an expression for Gyroscopic couple. (5)

c. Compare under damped, critical damp and over damped in details (5)

d. What do you mean by Dynamically Equivalent systems? State the conditions for systems to be dynamically equivalent. (5)

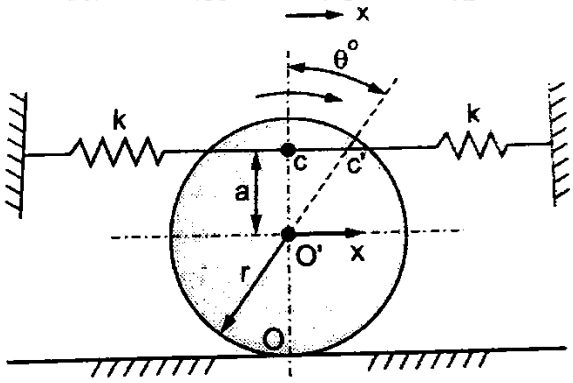
e. Explain the meaning of vibration isolation and transmissibility. List at least four vibration isolation materials. (5)

Q2.a A gun barrel having mass 560kg is designed for following data: Initial recoil velocity 36m/sec. Recoil distance on firing 1.5m Determine i) Spring constant ii)Damping coefficient iii.) Time required by barrel to return to a position of 0.12m from its initial position. (10)

Q2.b The rotor of a turbine installed in a boat with its axis along the longitudinal axis of the boat makes 1500 r.p.m. clockwise when viewed from the stern. The rotor has a mass of 750 kg and a radius of gyration of 300 mm. If at an instant, the boat pitches in the longitudinal vertical plane so that the bow rises from the horizontal plane with an angular velocity of 1 rad /s, determine the torque acting on the boat and the direction in which it tends to turn the boat at the instant. (10)

Q3.a 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 r.p.m.When the crank is at 30° to the inner dead centre and moving outwards, the difference in steam pressures is 840 kN/m^2. If the crank pin radius is 30 mm determine: 1. the force on the crankshaft bearing; and 2. the torque acting on the crank shaft. (10)

Q3.b Determine the natural frequency of the system shown in Fig below. Assume the Cylinder rolls on the surface without slipping. Consider the mass of cylinder as M. (10)



Q4.a A loaded governor of the Porter type has equal arms and links each 250 mm long. The mass of each ball is 2 kg and the central mass is 12 kg. When the ball radius is 150 mm, the valve is fully open and when the radius is 185 mm, the valve is closed. Find the maximum speed and the range of speed. If the maximum speed is to be increased 20% by an addition of mass to the central load, find what additional mass is required. (10)

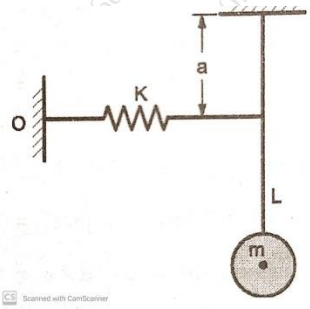
Q4.b The springs of an automobile trailer are compressed 0.1 m under its own weight. Find the critical speed when the trailer is passing over a road with a profile of sinewave whose amplitude is 80 mm and the wavelength is 14 m. Find the amplitude of vibration at a speed of 60 km/kr. (10)

Q5.a. A five cylinder in-line engine running at 750 r.p.m. has successive cranks 144° apart, the distance between the cylinder centre lines being 375 mm. The piston stroke is 225 mm and the ratio of the connecting rod to the crank is 4. Examine the engine for balance of primary and secondary forces and couples. Find the maximum values of these and the position of the central crank at which these maximum values occur. The reciprocating mass for each cylinder is 15 kg. (10)

Q5.b A machine of mass 1000 kg is acted upon by an external force of 3000 N at 1800 rpm. To reduce the effect of vibrations, isolators having static deflection of 2 mm under the machine weight and damping factor of 0.2 are used. Determine : (10)

(i) Amplitude of vibration of machine
(ii) Force transmitted to the foundation
(iii) Phase lag and
(iv) Phase angle between transmitted force and exciting force.

Q6.a Find the differential equation of motion and the natural frequency of vibration for a system shown in Fig. (7)



Q6.b Explain vibration based condition monitoring and fault diagnosis in rotating machine. (5)

Q6.c The natural frequency and the damping ratio of a vibrometer are 6 Hz and 0.22 respectively. What is the range of frequencies for the measurement error to be below 3%. (8)

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