(3 Hours) **Total Marks : 80**

Instructions. : (1) **Question No.1 is compulsory**
(2) **Solve any three questions from the remaining**
(3) **Assume suitable data wherever necessary**
(4) **Figure to the right indicates marks**

Q.1) Solve **any four** questions from following

(a) Differentiate between coulomb and viscous damping. (5)

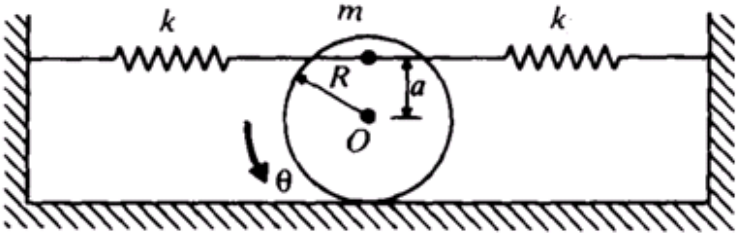
(b) What is stability of governor? Sketch controlling force versus radius diagrams for stable, unstable and isochronous spring-controlled governors (5)

(c) Briefly explain steps involved in vibration analysis. (5)

(d) Explain with a neat sketch, the principle of vibration measuring instruments (5)

(e) Discuss the balancing of V engine (5)

Q.2) (a) Find the natural frequency of oscillation of homogeneous cylinder which rolls on ground without slipping. (10)



(b) A motor car moving with a speed of 100 kmph has a gross mass of 1500 kg. It passes over a rough road which has a sinusiodal surface with amplitude of 75 mm and a wavelength of 5 m. The suspension system has a spring constant of 500 N/mm and damping ratio of 0.5. Determine the displacement amplitude of the car and the time lag. (10)

Q.3) (a) The arms of a Porter governor are each 250 mm long and pivoted on the governor axis. The mass of each ball is 5 kg and the mass of the central sleeve is 30 kg. The radius of rotation of the balls is 150 mm when the sleeve begins to rise and reaches a value of 200 mm for maximum speed. Determine the speed range of the governor. If the friction at the sleeve is equivalent of 20 N of load at the sleeve, determine how the speed range is modified. (10)

(b) A shaft carries five masses A,B,C,D and E which revolve at the same radius in plane which are equidistant from one another. The magnitude of masses in planes A,C and D are 50 kg, 40 kg and 80 kg respectively. The angle between A and C is 90^0 and that between C and D is 135^0 Determine the magnitude of masses in plane B and E and their position to put in complete rotating unbalance. (10)

Q.4) (a) A ship is propelled by a turbine having a mass of 6000 kg and a speed of 2400 rpm. The direction of the motion of the rotor is anticlockwise when viewed from the bow end. The radius of gyration of rotor is 450 mm. Determine gyroscopic effect when (1) Ship is steering to left in a curve of 60 m radius at a speed of 1860 m/hr (2) Ship is pitching in SHM with bow decending with maximum velocity. The time period of pitching is 18 seconds and the ship pitches 7.5^0 above and 7.5^0 below the norma; position. (3) Ship is rolling and at the instant, its angular velocity is 0.035 rad/sec counterclockwise when viewed from stern (4) Also find the maximum angular acceleration during pitching. (10)

(b) A door 250 cm high, 80 cm wide and 4.5 cm thick and weighing 40 kg is fitted with an automatic door closure. The door opens against a spring with a modulus of 1 kg cm/rad. If the door is opened 90^0 and released. How long will it take the door to be within 1^0 of closing ? A ssume the return spring of the door to be critically damped. (10)

Q.5) (a) A machine 90 kg mass has a 20 kg rotor with 0.5 mm eccentricity. The mounting springs have stiffness 85000 N/m and damping 0.02. The operating speed of machine is 600 rpm and the unit is constrained to move vertically. Find (i) The dynamic amplitude of machine (ii) The force transmitted to the supports. (10)

(b) A disc of mass 5 kg is mounted midway between two short bearings, 500 mm apart. The diameter of the shaft is 10 mm. The C.G. of the disc is 5 mm away from the geometric center. The equivalent viscous damping at the center of the disc may be taken as 40 N sec/m. If the shaft rotates at 740 rpm, find critical speed of shaft and amplitude of vibration. Assume E = 200 GPa. (10)

Q.6) (a) An accelerometer has a suspended mass of 0.01 kg with a damped natural frequency of vibration of 150 Hz. When mounted on an engine undergoing as acceleration of 9.81 m/sec^2 at an operating speed of 6000 rpm the acceleration is recorded as 9.5 m/sec^2 by the instrument. Find damping constant (C) and spring constant (K) of the accelerometer. (10)

(b) A connecting rod is suspended from the small end center, which is 65 cm from its center of gravity. The mass of the connecting rod is 50 kg. When set to oscillate, it makes 30 oscillation per minute. Find a dynamically equivalent system for the connecting rod constituted by two joint masses one of which is located at small end centre. Also find moment of inertia of rod. (10)
