Time: 3 hrs **Total Marks: 80**

Note:

1. **Question No. 1 is compulsory.**
2. **Attempt any three from the reaming five questions.**
3. **Assume suitable data wherever required with proper justification.**

Q1 Attempt any four of the following. All sub-question carries equal marks

A	Differentiate between Porter and Hartnell governor.	5
B	Derive the relation for Gyroscopic couple during pitching of ship and discuss its effect.	5
C	Discuss different types of damping.	5
D	Explain dynamically equivalent system with correction couple.	5
E	Plot variation between frequency ratio vs magnification factor and conclude graph.	5

Q2

2A. Find the natural frequency of a half solid cylinder of mass m and radius r when it is slightly displaced from the equilibrium position and released. 10

2B A Porter governor has rotating mass of each ball 5 kg and mass on the sleeve is 30 kg. Upper links are 250 mm long and lower links are 350 mm long.The upper ends of upper links and lower ends of lower links are hinged at 40 mm from the governor axis. Find equilibrium speed of the governor in rpm when the governor rotates at 130 mm radius. 10

Q3

3A. The turbine rotor of a ship has a mass of 2000 kg and it rotates at a speed of 3000 rpm clockwise when seen from stern .The radius of gyration of the rotor is 0.5 m . 10
1.Determine the gyroscopic couple and its effect, if the ship is steering to the right in a curve of 100 m radius at a speed of 16.1 knots. Assume 1 knot = 1855 m/hr.
2.Calculate the gyroscopic couple and its effect when the ship is pitching in SHM, with the bow falling with its maximum velocity. The period of pitching is 50 sec and the total angular displacement between the two extreme positions is 12^0. Find maximum acceleration during the pitching motion.

3B. An underdamped shock absorber is to be designed for a motorcycle of mass 200 kg, such that during a road bump, the damped period of vibration is limited to 2 sec and the amplitude of vibration shoud reduce to one-sixteen in one cycle. 10
Find spring stiffness and damping coefficient of the shock absorber.

Q4.

4A. In a vertical double acting steam engine ,the connecting rod is 4.5 times the crank .The mass of reciprocating parts is 120 kg and the stroke of the piston is 440 mm.The engine runs at 250 rpm.If the net load on the piston due to steam pressure is 25 KN when the crank has turned through an angle of 120^0 from the TDC , Determine 10

1.thrust in connecting rod 2.thrust on cylinder 3.tangential force on crank pin

4.thrust on bearing 5.turning moment on crankshaft

4B. A 30 Kg block is connected to a spring of stiffness 1.5 x 10^5 N/m. The coefficient of friction between block and surface on which its slides is 0.15. The block is displaced 12 mm from equilibrium and released. Calculate amplitude of motion at the end of the first cycle. How many cycles of motion occur? 10

Q5.

5A. If the peak amplitude of a single degree of freedom system under harmonic excitation is observed to be 0.6 cm. If the undamped natural frequency of the system is 6 Hz. And the static defection of the mass under the maximum force is 0.3 cm, estimate the damping ratio of the system and peak frequency. 12

5B.A seismic instrument with natural frequency of 7 Hz is used to measure vibration of machine running at 100 rpm. The instrument gives reading for relative displacement of mass as 0.07mm. Determine amplitude of displacement, velocity and acceleration of vibrating machine, by Neglecting damping. 08

Q6.

6A. The four masses m1, m2, m3 and m4 having their radii of rotation as 250 mm, 150 mm, 200 mm and 350 mm are 250 kg, 350 kg, 240 kg and 200 kg in magnitude respectively. The angles between the successive masses are 40-degree, 70 degree and 130 degree respectively. Find the position and magnitude of the balance mass required, if its radius of rotation is 150 mm. 08

6B. i) Write short note on partial balancing in reciprocating masses. 07

ii) Discuss fault diagnosis. 05

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