BACHELOR OF ENGINEERING (MECHANICAL ENGINEERING) THIRD YEAR FIRST SEMESTER EXAM 2024

Subject: **DYNAMICS OF MACHINES**

Time : Three hours **Full Marks: 100**

*Answer any **5 (five)** questions*

1. From the equation of motion of viscously damped forced vibration, show the vector relationship and with the help of the same, solve the equation and show the curves of 'amplitude' and 'phase angle' with 'frequency ratio' for different 'damping ratios'. Explain the occurrence of resonance from the same. 15+5

2a. Explain what is 'Damping Ratio'.
b. From the equation of motion of free vibration, derive expressions of overdamped, underdamped and critically-damped motions and explain those with suitable plots. 5+15

3a. What do you mean by 'Logarithmic Decrement'.
b. What is 'Support Motion'. Find the expression for support motion and show appropriate plot. 5+15

4. Four rotating eccentric masses m_1, m_2, m_3, $m_4$are attached to a shaft at radius of r_1, r_2, r_3, r_4. Balance the system with the use of additional masses at appropriate radius and positions.
Given: m_1= 8 kg, m_2=5 kg, m_3= 5 kg, m_4=10 kg.
r_1= 1 cm r_2= 4 mm, r_3= 6mm, r_4= 5 mm.
Initial configuration: m_1 is horizontal towards right, m_2 is 60° apart from the same, m_3 is directed vertically upward, m_4 is further 30° apart from m_3.
Distance between m_1& m_2 is 1.5 m, that between m_2 & m_3 is 2 m and that between m_3 & m_4 is 2.5 m. 20

5a. Write short note on: Seismometer and Accelerometer
b. Three rotating eccentric masses m_1= m_2= m_3= 10 kg are attached to a shaft at radius of r_1, r_2, r_3, Balance the system using Graphical method with the use of additional masses at appropriate radius and positions.
Given: r_1= r_2= 4 mm, r_3= 6mm.
Initial configuration: m_1 is horizontal towards left, m_2 is is directed vertically downward, m_4 is further 60° apart from m_3.
Distance between m_1& m_2 is 1 m, that between m_2 & m_3 is 2 m. 8+12

6a. Find the expression for suitable cross sectional area of a flywheel used for an IC engine. Mention requisite assumption.
b. Write short notes on: co-efficient of fluctuation of energy and the co-efficient of fluctuation of speed 12+8

7. A machine shaft running at a mean speed of 250 rpm requires a torque which increases uniformly from 7 kgm to 280 kgm during the first half revolution, remains constant for the following one revolution. It then decreases uniformly to 70 kgm during the next half revolution and remains constant for one revolution. The cycle is then repeated. If the torque applied to the shaft is constant and the flywheel has a mass of 450 kg with a radius of gyration of 600 mm, find,
a. the horse power necessary to drive the machine
b. percentage fluctuation of speed. 20

8. The turning moment diagram for one revolution of multicylinder engine shows the following intercepted areas below and above the line of resisting torque:
-3.50,+7.20,-6.11,+8.18,-5.31,+5.04,-5.50sqcm.
The vertical and horizontal scales are 1cm=325kgm torque and 1cm=25degree respectively. The engine has a mean speed of 240rpm. The fluctuation of speed is not to exceed 1.5% of mean speed. Determine a suitable diameter and cross section of the flywheel rim if the centrifugal stress is not to exceed 60kg/sqcm. The density of the material is 0.008kg/cu.m. The width of the rim is three times the thickness. 20