B.E./B.Tech. (Full Time) DEGREE END SEMESTER EXAMINATIONS NOV/DEC 2012
MECHANICAL ENGINEERING BRANCH
VIII SEMESTER-(REGULATIONS 2008)

ME-9024 MECHANICAL VIBRATIONS

29

Time: 3 hr Max Mark: 100

Answer ALL Questions
Part-A (10 x 2 =20 mark)

1. Define the following : i. Natural frequency of vibration ii. Logarithimic decrement
2. Write down the differential equation for the single degree free torsional vibration '$\theta(t)$' of a simple shaft rotor system having rotor inertia J_o, shaft torsional stiffness q. What is the nature of the solution of '$\theta(t)$'?
3. Write down the general response equations of a two degree freedom free vibration.
4. Define mass ratio of undamped dynamic absorber systems. What is the main advantage of having higher mass ratio.
5. Define modal matrix and normalized modal matrix.
6. Distinguish static and dynamic coupling
7. How many natural frequencies does a continuous system have?
8. State Rayleighs energy method to determine fundamental natural frequency?
9. Explain why field balancing is necessary?
10. Compare and differentiate vibrometer and accelerometer?

Part – B (5 x 16 = 80 Mark)

11) Using Holzer's method compute the fundamental torsional critical speed of a shaft having four discs of mass moments of inertia 2500, 2750, 3000 and 3250 $Nmmsec^2$ connected by three shaft stiffness of $16x10^9$, $12x10^9$ and $8x10^9$ Nmm/rad respectively.

12) a) Four cylinder in line IC engine weighing 5000 N, with a vertical line of stroke, running at a constant speed of 3000 rpm uses four cushy mounts with stiffness in three orthogonal directions in the ratio 1:3:20. What is the worst exciting frequency of this engine? If the lowest transmissibility for the worst exciting frequency is to be 1/20, what would be the transmissibility in the other two

orthogonal directions? What would be the stiffness required of each mount in the most favorable direction? OR

12) (b) A single cylinder vertical engine weighing half a tonne with a vertical line of stroke has a predominant exciting frequency of 6000 rpm. It is supported by four helical springs. Transmissibility of the isolator is 1/10. What should be the natural frequency of the system? What is the required stiffness of each helical spring? Each helical spring has a number of active coils n=10. What is the mean diameter D of the coils? G for spring steel 80,000 MPa. Stiffness of spring = $Gd^4/8D^3n$ (D/d=1/2)

13) (a) A piping system experiences resonance when the pump supplying the power to the system operates at 500 rpm. When a 5kg absorber tuned to 500 rpm is added to the pipe, the system new natural frequencies are measured as 380 & 624 rpm. Determine the natural frequency of the piping system and its equivalent mass. (OR)

13) (b) In a longitudinal 2 degree freedom system, the mass m_1 is acted upon by a harmonic force of amplitude F_0 and frequency ω. The amplitude of mass m_1 reaches zero under what condition? Find the amplitude of vibration of the mass m_2 under this condition.

14) (a) A commercial vibration pick up has a damped natural frequency of 5 cps and a damping ratio of 0.45. What is the lowest natural frequency in the range upto infinity at which the amplitude can be read from the pick up not exceeding 3% of the actual amplitude? (OR)

14 (b) Write short notes on

(1) Band pass filter (2) Mechanical Exciter (3) Carrier frequency amplifier

15(a) Determine the natural frequencies of a uniform beam of length l clamped at both ends.

(OR)

15) (b) A steel wire of 2mm diameter fixed between two points located 2m apart. The tensile force in the wire is 250N. Determine (a) fundamental natural frequency of vibration (b) the velocity of wave propagation in the wire.