



P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Sixth Semester, B.E., - Mechanical Engineering

Semester End Examination; June - 2017

Mechanical Vibrations

Time: 3 hrs

Max. Marks: 100

Note: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.
ii) Missing data may suitably be assumed.

UNIT - I

- 1 a. Obtain the natural frequency for the system shown in Fig.1 (b) by Newton's method and energy method. 12
- b. What is logarithmic decrement? Derive an expression for the same. 8
- 2 a. Obtain the response curve for the 2nd order mechanical system for under damping case. 12
- b. A thin plate of surface area 'A' weighing 'w' kg is attached by a spring of stiffness 'k'. This system has a periodic time (τ_1) when it is vibrating in a free air and this can be considered as free vibration. The periodic time will change to (τ_2) when this plate is made to vibrate in oil. 8
- Show that $\mu = \frac{2\pi w \sqrt{\tau_2^2 - \tau_1^2}}{gA\tau_1\tau_2}$ where μ is given by $F_d = \mu 2AV$, ie. viscosity of oil (coefficient).

UNIT - II

- 3 a. Derive an expression for forced vibration due to constant harmonic excitation. 12
- b. A mass of 10 kg from a spring of stiffness 20 N/mm damping which may be assumed to be proportional to velocity causes the amplitude to decrease to $\frac{1}{10}$ th of the initial value is 4 oscillations. If periodic force of $30 \sin 50t$ is applied to mass. Find the amplitude of force vibration. What would be amplitude if the frequency of force coincides with the natural period of vibration of the system? 8
- 4 a. Derive an expression for motion isolation. 12
- b. A weight of 50 N is suspended by a spring of stiffness 1200 N/m and is forced to vibrate by a harmonic force of 9 N. If viscous damping coefficient is given by 100 N-s/m. Find, 8
- (i) Amplitude at resonance (ii) Phase angle at resonance
- (iii) Frequency corresponding to peak amplitude (iv) Peak amplitude.

UNIT - III

- 5 a. Write a note on: 10
- (i) Vibrometer (ii) Accelerometer

- b. A disc of mass 5 kg is mounted midway between bearings of span 50 cm on a shaft. The mild steel shaft of 1 cm in diameter is horizontal and its CG is 5 mm from its geometric centre. The equivalent viscous damping is 60 N-s/m. The speed of the shaft is 600 rpm. Find the resulting deflection and the dynamic force caused $E = 200 \text{ GPa}$. 10
- 6 a. Derive an expression for whirling of shaft without damping with suitable sketch and assumptions. 12
- b. A vibration instrument is used with a machine running at 120 rpm. The natural frequency of the instrument is 5 Hz and it records its relative amplitude of 0.004 cm. Calculate the displacement, velocity and acceleration of the machine $\xi = 0$ 8

UNIT - IV

- 7. For the system shown in the Fig. 2 Q7 determine the natural frequency and mode shapes if $I_1 = I_2 = I$, $K_1 = K_3 = K$ and $K_2 = 2K$. 20
- 8 a. State and prove the Maxwell's reciprocal theorem. 10
- b. Determine the flexibility influence coefficients of the system shown in Fig. 3 Q8. 10

UNIT - V

- 9. Find the natural frequency and mode shape for the system shown in Fig. 4 Q9 by Holzer's method. 20
- 10. Find the natural frequency and mode shape for the system shown in Fig. 5 Q10 by Stodola's method. 20

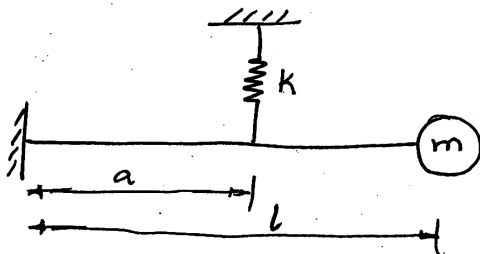


Fig 1 Q.1b

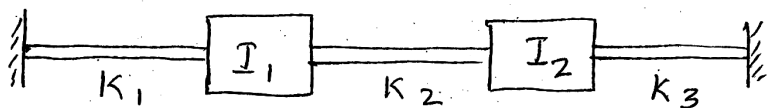


Fig 2 , Q.7

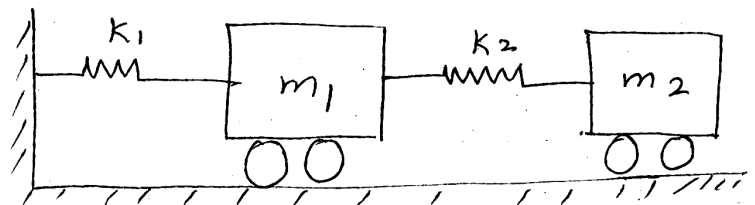


Fig 3 , Q.8

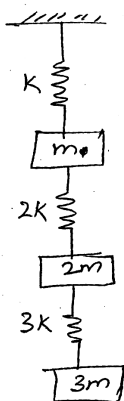


Fig 5. Q.10.

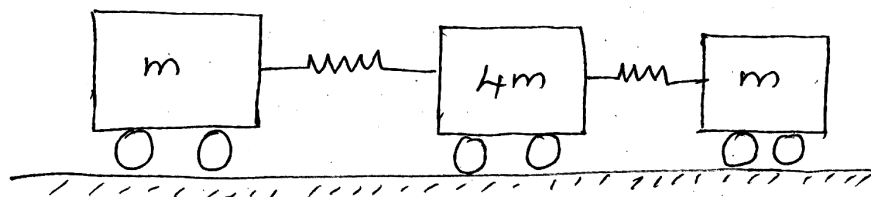


Fig 4. Q.9