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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 $\mu = \dfrac{2\pi w\sqrt{\tau_2^2 - \tau_1^2}}{gA\tau_1\tau_2}$ 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

Contd….2

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 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 is 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

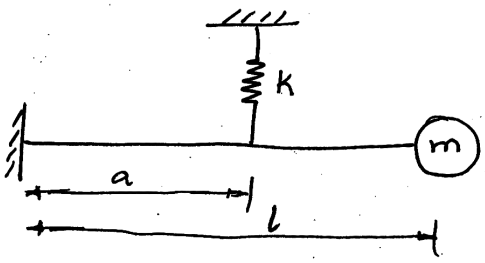

Fig 1 Q.1b

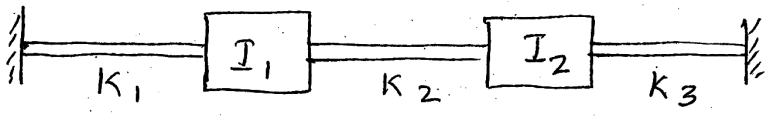

Fig 2 , Q.7

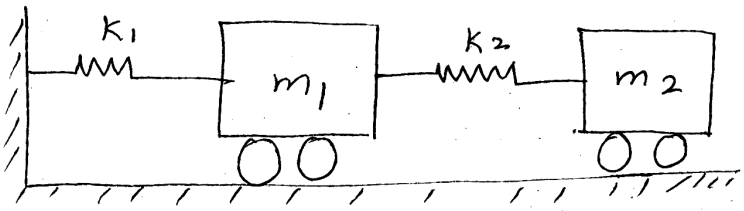

Fig 3, Q.8

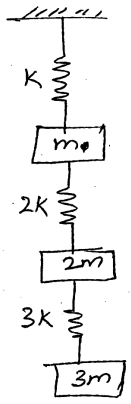

Fig 5. Q 10.

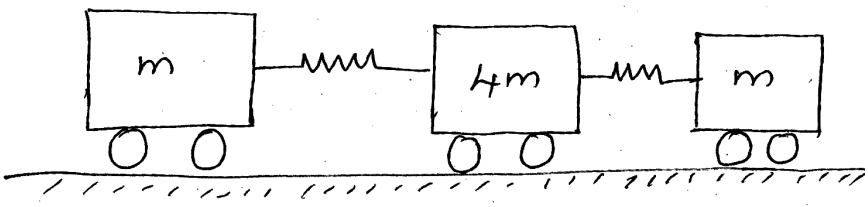

Fig 4. Q.9

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