CBCS SCHEME

USN | | | | | | | | | | | 15AE553

Fifth Semester B.E. Degree Examination, June/July 2018
Theory of Vibrations

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define vibration and explain types of vibrations. **(08 Marks)**

b. A periodic motion is as shown in Fig.Q1(b). Determine the harmonic services of this motion.

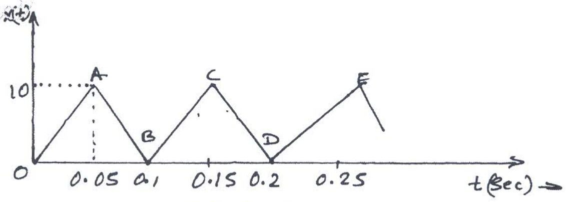

Fig.Q1(b) **(08 Marks)**

OR

2 a. A body is subjected to harmonic motions $x_1 = 10\sin(\omega t + 30^\circ)$ and $x_2 = 5\cos(\omega t + 60^\circ)$, what harmonic motion should be given to the body to bring it to equilibrium. **(08 Marks)**

b. Represent the periodic motion given in Fig.Q2(b) by harmonic series.

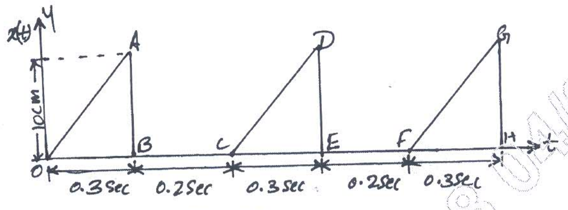

Fig.Q2(b) **(08 Marks)**

Module-2

3 a. Determine the natural frequency of a spring mass system where the mass of the spring is also to be taken into account. **(08 Marks)**

b. Obtain the differential equation of motion for the system shown in Fig.Q3(b) and hence find:

i) Critical damping coefficient and

ii) Natural frequency of damped oscillation.

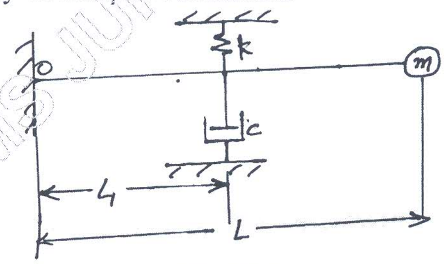

Fig.Q3(b) **(08 Marks)**

OR

4 a. Determine the natural frequency of the system shown in Fig.Q4(a). Neglecting the mass of rod.

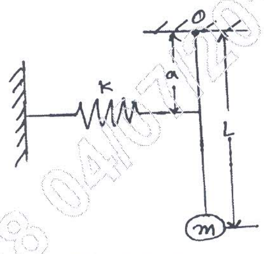

Fig.Q4(a) **(08 Marks)**

b. Define Logarithmic decrement and show that it can be expressed as $\delta = \frac{1}{n}\log\left(\frac{x_0}{x_1}\right)$, where 'n' cycles, x_0 is the initial amplitude and x_0 is the amplitude after 'n' cycles. **(08 Marks)**

Module-3

5 a. A mass of 100 kg been mounted on a spring dashpot system having spring stiffness of 19600 N/m and damping coefficient of 100 N-sec/m. The mass is acted upon by a harmonic force of 39 N at the undamped natural frequency of the system. Determine,
i) Amplitude of vibration of the mass
ii) Phase difference between force and displacement
iii) Force transmissibility ratio **(08 Marks)**

b. A vibration pick up has a natural frequency of 7.5 Hz and a damping factor of 0.5. Determine the lowest frequency beyond which the amplitude can be measured within (i) 1% error or (ii) 2% error. **(08 Marks)**

OR

6 a. A mass of 6 kg suspended by a spring of stiffness 1180 N/m is forced to vibrate by the harmonic force 10 N. Assuming viscous damping coefficient of 85 Ns/m, determine the resonant frequency, amplitude at resonance, phase angle at resonance, frequency corresponding to the peak amplitude. **(08 Marks)**

b. A shaft carrying a rotor of weight 450 N and eccentricity 2.54 mm rotates at 1200 rpm. Determine: (i) Steady state whirl amplitude, (ii) Maximum whirl amplitude during start up conditions of the system. Assume the stiffness of the shift as 36000 N/m and the external damping ratio as 0.1. **(08 Marks)**

Module-4

7 a. Fig.Q7(a) shows a system subjected to vibration. Find an expression for the natural frequency.

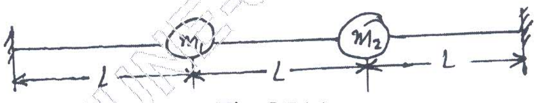

Fig.Q7(a) **(08 Marks)**

b. Determine the frequency equation and the general solution of the two degrees of freedom torsional system shown in Fig.Q7(b).

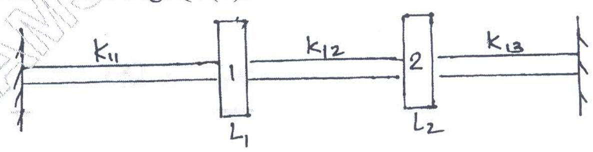

Fig.Q7(b) **(08 Marks)**

OR

8 a. With respect to Fig.Q8(a). Assume $\ell_1 = \ell$ and $\ell_2 = 2\ell$, $m_1 = m_2 = m$. Obtain the natural frequencies of the double pendulum and sketch its mode shapes.

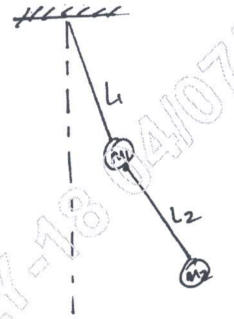

Fig.Q8(a) **(08 Marks)**

b. Determine the natural frequency of the system shown in Fig.Q8(b).

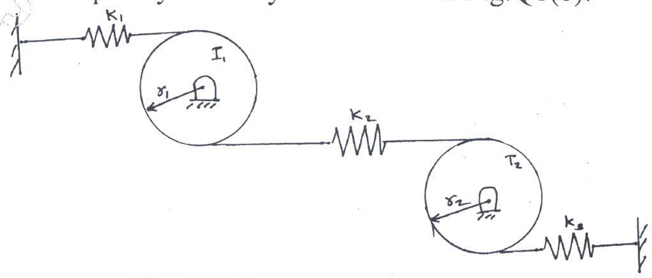

Fig.Q8(b) **(08 Marks)**

Module-5

9 a. Explain Stodola's method for a spring mass system (steps). **(08 Marks)**

b. A torsional vibrating system is shown in Fig.Q9(b). Determine the first two natural frequencies using Holzer's method.

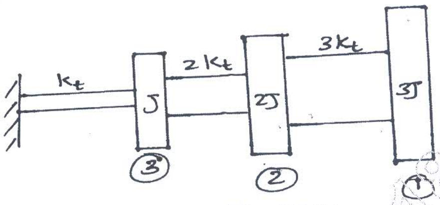

Fig.Q9(b) **(08 Marks)**

OR

10 a. Explain the following:
i) Coordinate coupling
ii) Orthogonality principle
iii) Influence coefficients
iv) Dunkerley's method. **(08 Marks)**

b. Determine the influence coefficients of the triple pendulum shown in Fig.Q10(b).

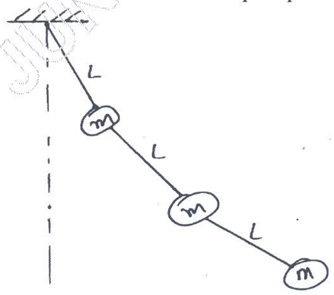

Fig.Q10(b) **(08 Marks)**

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