CBCS SCHEME

USN | | | | | | | | | | |

15AE553

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
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 and explain following terms : **(08 Marks)**
i) Natural frequency ii) Degree of freedom iii) Beats iv) Resonance.

b. Represent the periodic motion given in the following Fig Q1(b) by harmonic series

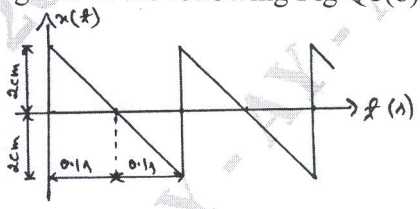

Fig Q1(b) **(08 Marks)**

OR

2 a. Define vibration and briefly explain different types of vibration. **(08 Marks)**

b. Split the harmonic motion $x = 10 \sin\left(wt + \frac{\pi}{6}\right)$ into two harmonic motions having phase angle of zero and the other of 45°. Verify answers by graphical method. **(08 Marks)**

Module-2

3 a. What are the types of damping? Explain any two types of damping. **(08 Marks)**

b. Find the natural frequency of vibration of the half solid cylinder shown in Fig Q3(b), when slightly displaced from the equilibrium position and released by using i) Newton's method ii) Energy method.

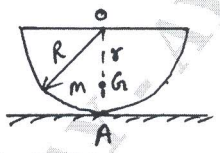

Fig Q3(b) **(08 Marks)**

OR

4 a. Determine the natural frequency of the simple pendulum i) Neglecting the mass of rod and ii) Considering the mass of rod. **(08 Marks)**

b. Determine the natural frequency of the system shown in Fig Q4(b), using Newton's method.

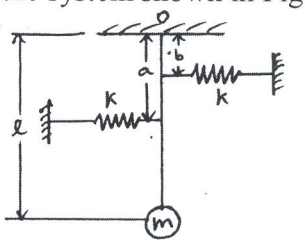

Fig Q4(b) **(08 Marks)**

Module-3

5 a. Briefly explain vibration isolation and transmissibility. **(08 Marks)**

b. A machine part of mass 4Kg vibrates in a viscous medium. A harmonic exciting force of 40N acts on the machine and causes resonant amplitude of 15mm with a period of 0.2s. Determine the damping coefficient. If the system is excited by a harmonic force of frequency 4Hz, what will be the percentage increase in the amplitude of forced vibration, when damper is removed? **(08 Marks)**

OR

6 a. Explain the working principle of i) Vibro meter ii) Fullarton Tachometer. **(08 Marks)**

b. Derive an expression for amplitude of a whirling shaft without air damping. **(04 Marks)**

c. A vibrometer gives a reading of relative displacement 0.5mm. The natural frequency of vibration is 600rpm and the machine runs at 200rpm. Determine the magnitude of displacement, velocity and acceleration of the vibrating machine part. **(04 Marks)**

Module-4

7 a. Derive one dimensional wave equation for lateral vibration of a string. **(08 Marks)**

b. Derive the differential equation for torsional vibration of a uniform shaft. **(08 Marks)**

OR

8 a. Write a short note on principal modes and normal modes of vibration. **(08 Marks)**

b. For the system shown in Fig Q8(b),

i) Derive the equation of motion

ii) Set up frequency equation and obtain natural frequencies of the system

iii) Obtain modal vectors

iv) Draw mode shapes

$m_1 = m_2 = m$; $k_1 = k_2 = k_3 = k$.

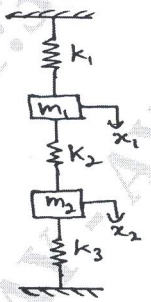

Fig Q8(b) **(08 Marks)**

Module-5

9 a. Using Stodola's method, determine the lowest natural frequency of the system shown in Fig Q9(a)

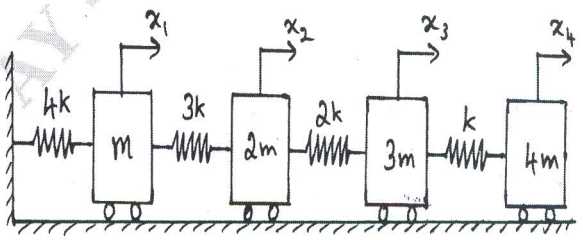

Fig Q9(a) **(08 Marks)**

b. Determine the natural frequency of the system shown Fig 9(b) by Holzer method. Given $J_1 = J_2 = J_3 = 1\text{Kg m}^2$, $K_{t_1} = K_{t_2} = 1\text{N.m/rad}$.

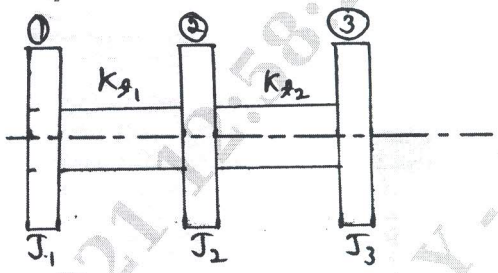

Fig Q9(b) **(08 Marks)**

OR

10 a. State and prove Maxwell reciprocal theorem. **(06 Marks)**

b. A shaft 100mm diameter is supported in short bearing 3m apart and carries 3 discs weighing 900N, 1400N, 700N situated in 1m, 2m and 2.5m from one of the bearings respectively. Assuming E = 200GPa and density of shaft material = 7800 Kg/m^3, calculate the frequency of transverse vibration, by Dunkerley's method. **(10 Marks)**

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