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MANIPAL INSTITUTE OF TECHNOLOGY

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I SEMESTER M.TECH. (STRUCTURAL ENGINEERING)

END SEMESTER EXAMINATIONS, November/December 2017

SUBJECT: **STRUCTURAL DYNAMICS (CIE – 5153)**

REVISED CREDIT SYSTEM
(/ 11 / 2017)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A.	The tower shown in Fig. Q1A is having a uniform mass of m per unit length and constant EI. Formulate the equation of motion if the tower is subjected to a base excitation $\ddot{V}_g(t)$. Use $\psi(x) = 1 - \cos\frac{\pi x}{2L}$	**5**
1B.	Determine the natural frequency for the system shown in Fig. Q1B. Assuming that the beam and springs supporting the weight W are massless. L = 0.3 m, EI = 20 kN-m^2, W = 2.0 kN, K = 70 kN/m. Determine the displacement and velocity after 2.0 sec, if Vo = 10 mm and $\dot{V}_0$ = 20 mm/sec and ξ = 0.10.	**5**
2A.	Derive the expression for response for the free vibration of an critically damped SDOF system with the following initial boundary conditions i) at t = 0 V(t) = V_o and $\dot{V}$ (t) = $\dot{V}_o$ ii) at t = 0 V(t) = 15 mm and $\dot{V}$ (t) = 30 mm/ sec	**5**
2B.	An electric motor weighing 1180 N is attached to a floor beam that deflects 0.75 mm under the weight. The armature of the motor weighs 380 N. As the motor is run up gradually to operating speed of 1600 rpm, it is observed that the maximum amplitude is 3.0 mm and decreases to 0.5 mm at the operating speed. Calculate the damping coefficient and eccentricity of the armature from its axis of rotation.	**5**
3A.	A sine wave impulse of duration t_1 seconds (Fig. Q3A) is acting on a SDOF system. Derive expressions for the response at t < t_1 and t > t_1. Use the initial condition as at t = 0 V(t) = V_o and $\dot{V}$ (t) = $\dot{V}_o$. Determine also the maximum response in the free vibration era.	**5**

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3B.	Using rectangular rule for numerical evaluations of Duhamel's integral determine the dynamic response of SDOF system subjected to a blast loading shown in Fig. Q3B. The physical properties are W = 30 kN and K = 3000 kN/m. Take $\Delta\tau$ = 0.12 sec	**5**
4A.	For the three storey shear building shown in Fig. Q4A, obtain the natural frequencies and the modes of vibration.	**7**
4B.	Write a note on orthogonality relationship	**3**
5A.	A cantilever beam supporting three equal lumped masses is shown in Fig.Q5A. Its undamped mode shapes ϕ and frequencies of vibration ω are shown below. Write an expression for the dynamic response of this system after a 40 kN step function load is applied at mass point 3. Include effect of all three modes and neglect damping. Take m = 300 kg. $\phi = \begin{pmatrix} 1 & 1 & 1 \\ 0.7 & -0.3 & -1.6 \\ 0.4 & -0.6 & 1.2 \end{pmatrix}$ $\omega = \begin{pmatrix} 3 \\ 20 \\ 30 \end{pmatrix}$ rad/sec	**5**
5B.	Treating the Fixed beam of uniform cross section as continuous systems obtain expression for vibration shape.	**5**

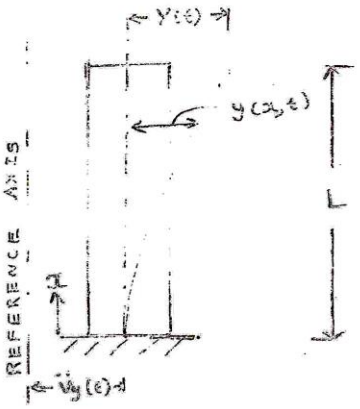

Fig. Q1A

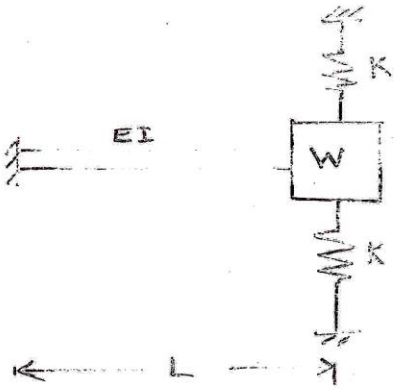

Fig. Q1B

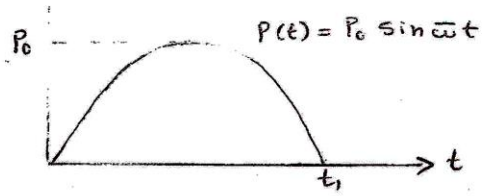

Fig. Q3A

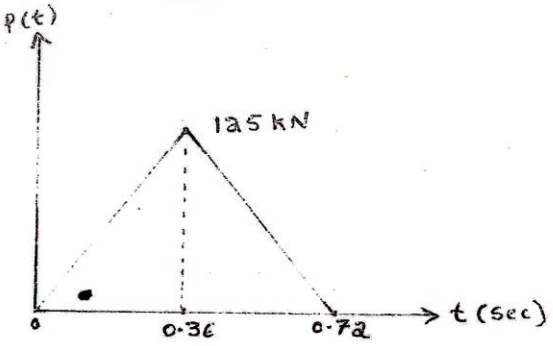

Fig Q3B

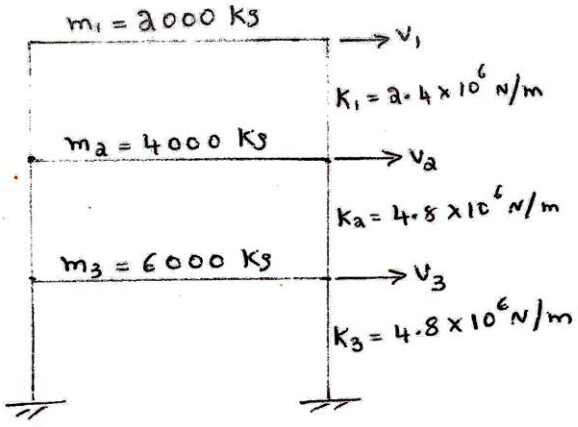

Fig. Q4A

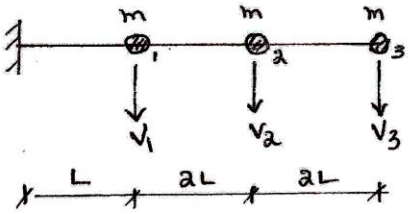

Fig. Q5A