Reg. No.										

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I SEMESTER M.TECH. (STRUCTURAL ENGINEERING)

END SEMESTER EXAMINATIONS, DECEMBER 2023

SUBJECT: STRUCTURAL DYNAMICS (CIE – 5129)

REVISED CREDIT SYSTEM
(7 / 12 / 2023)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

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

Q.No.	Question	M	CO	PO	BTL
1A.	The column of Fig. Q1A is to be treated as a SDOF system by defining its displaced shape $\psi(x) = \frac{V(x,t)}{Z(t)} = \frac{x}{L}\left(\frac{5}{2} - \frac{2x}{L}\right)$. Denoting the uniform distributed mass per length by $\overline{m}$, the uniform stiffness by EI and the uniform distributed load per unit length by $\overline{p}(t)$, evaluate the generalized physical properties m, k and the generalized loading p (t).	**5**	CO1	1,3,4,5	5
1B.	Formulate the expression for free vibration response of over damped SDOF system. Take the initial boundary condition as, at t = 0, V (t) = V_o and $\dot{v}$ (t) = $\dot{v}_o$	**5**	CO2	1,3,4,5	5
2A.	Define Dynamic magnification factor. Formulate an expression for β at which the maximum amplitude occurs in the case of under damped SDOF system subjected to harmonic loading. Also assess the maximum Dynamic magnification factor.	**5**	CO2	1,3,4,5	5
2B.	A machine weighing 900 N is supported on springs of total stiffness 850 N/mm. Imbalance results in a disturbing force of 400 N at a speed of 3400 rpm. Damping is estimated at 10% of critical value. Assess i) The amplitude of motion ii) Transmissibility iii) Transmitted force	**5**	CO2	1,3,4,5	5

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3A.	Using Trapezoidal's rule for numerical evaluations of Duhamel's integral Asses the dynamic response of SDOF system subjected to a blast loading shown in Fig. Q3A. The physical properties are W = 30 kN and K = 3000 kN/m. Take $\Delta\tau$ = 0.1 sec.	**5**	CO3	1,3,4,5	5
3B.	Using modified Rayleigh's method assess the fundamental frequency of the system shown in Fig. Q3B. Take K_1 = 1500 kN/m, K_2 = 1000 kN/m, K_3 = 500 kN/m, m_1 = 2500 kg, m_2 = 1500 kg and m_3 = 500 kg.	**5**	CO4		
4A.	For the three storey shear building shown in Fig. Q4A, Assess the natural frequencies and the modes of vibration. Use classical method. Take, K_1 = 1400 kN/m, K_2 = 2100 kN/m, K_3 = 2800 kN/m, m_1= 4000 kg, m_2= 4000 kg and m_3= 6000 kg	**7**	CO4	1,3,4,5	5
4B.	Explain orthogonality relationship	**3**	CO4	1,3,4,5	2
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. Formulate an expression for the dynamic response of this system after a 30 kN step function load is applied at mass point 2. Include effect of all three modes and neglect damping. Take m = 300 kg. $\phi = \begin{pmatrix} 1 & 1 & 1 \\ 0.7 & -0.3 & -1.6 \\ 0.4 & -0.6 & 1.2 \end{pmatrix}$ $\omega = \begin{pmatrix} 4 \\ 12 \\ 20 \end{pmatrix}$ rad/sec	**5**	CO4	1,3,4,5	
5B.	Treating the simply supported beam of uniform cross section as continuous systems Formulate the expression for the vibration frequency and mode shapes	**5**	CO5	1,3,4,5	5

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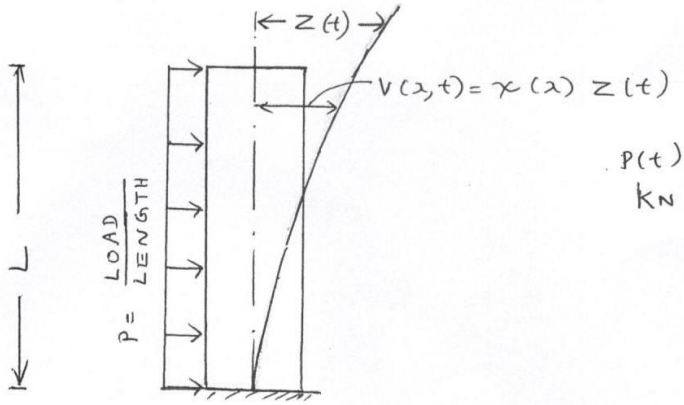

Fig. Q1A

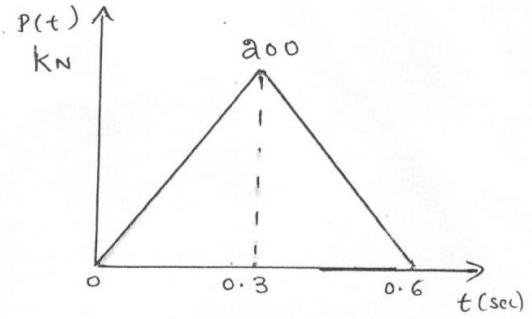

Fig. Q3A

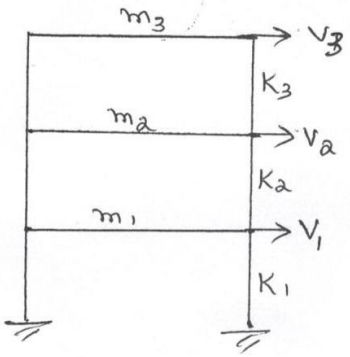

Fig. Q3B

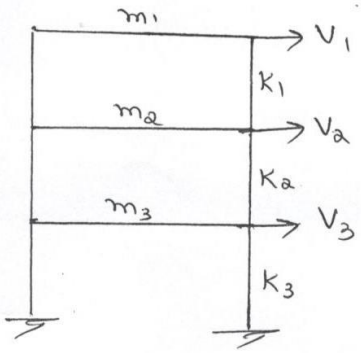

Fig Q4A

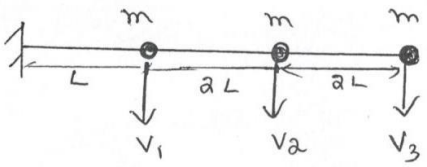

Fig Q5A