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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2018

Civil Engineering

Structural Engineering

01CE6105 STRUCTURAL DYNAMICS

Answer *any two full* questions from *each* part

Limit answers to the required points.

Assume any missing data suitably

Max. Marks: 60 Duration: 3 hours

PART A

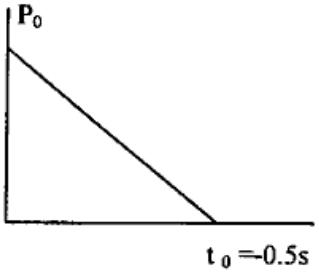
1. a. Develop the mathematical model and derive the equation of motion of a single degree of freedom system. (4)

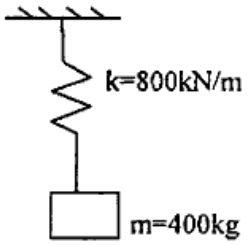
   b. A steel rigid frame of height 4m supports a rotating machine which exerts a horizontal force at the girder level of 50,000sin11t N. Assume 4% critical damping and mass of the girder as 5000kg. What is the steady state amplitude of vibration? Take I = 1500×10^{-7} m^4 and E = $2\times10^{10}N/m^2$. (5)

2. a. Show that for a damped system in free vibration , the logarithmic decrement is expressed as (3)

   $\delta = 1/m \ln [u_n/u_{n+1}]$, where m is the number of cycles separating two measured amplitudes u_n & u_{n+1}.

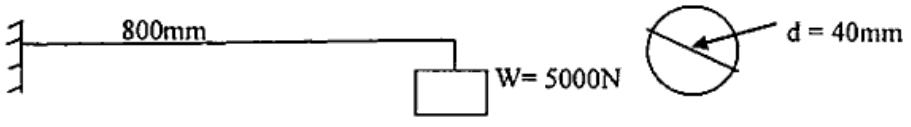
   b. For a dynamic system and loading shown in figure, compute the deflection at t = 0.15s. (6)





3. a. List the different methods for numerical evaluation of response of dynamic system. Explain the concept of average acceleration method. (5)

   b. Calculate the natural frequency of a transverse vibration of a cantilever beam of 40mm diameter circular section carrying a load of 5000N at the free end. Span of the beam is 800mm, E = 220kN/mm^2. If the spring of stiffness 52.75kN/m is introduced between the mass and the beam , calculate the change in natural frequency. (4)

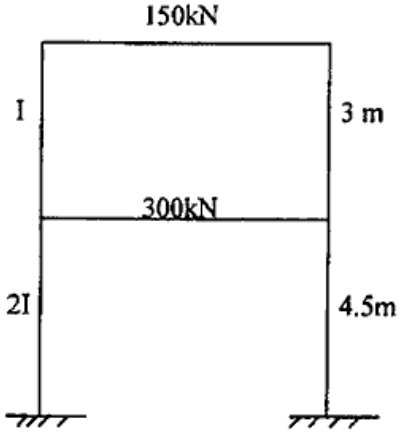


PART B

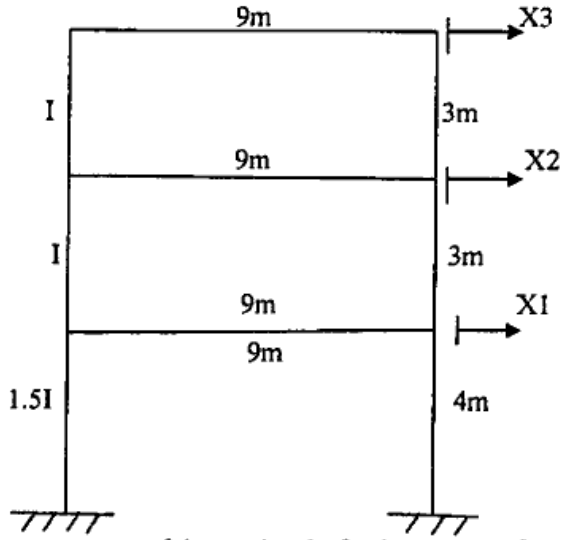
4. a. Explain the concept of a shear building model for the analysis of a multistoried building frame. (3)

   b. Develop the equation of motion of a multi degree of freedom system. (3)

   c. Using Raylegh's method determines the fundamental frequency of the following two storey frame. E= 2.1×10^5 N/mm^2 and I = 6000cm^4 . (3)



5. a. All the beams of the frame shown in figure are loaded with a uniformly distributed load of 25kN/m . Find the natural frequency and mode shapes of the frame . Beams are assumed to be rigid. Use Stodola method. Take E= 2×10^5 N/mm^2 and I = 5000cm^4 . (9)



6. a. Evaluate the steady state response of the top level of a three storey frame which is subjected to a harmonic load of 100 sin (0.5 $\omega_1 t$) kN at the top level. Considering the contribution from first two modes only. Take m1=m2=m3= 20000kg, k1=k2=160kN/m, k3= 240kN/m. Stories are numbered from top to bottom. (9)

$$\omega = \begin{pmatrix} 43.872 \\ 120.155 \\ 167.00 \end{pmatrix} \qquad \phi = \begin{pmatrix} 1.0 & 1.0 & 1.0 \\ 0.7594 & -0.8047 & -2.427 \\ 0.3361 & -1.1572 & 2.512 \end{pmatrix}$$

PART C

7.	a.	Derive the equation of motion for a two degree of freedom system using Lagrange's equation.	(4)
	b.	Derive the equation of motion and the solution for the axial vibration of prismatic bar.	(6)
	c.	Define vibration isolation in dynamic system.	(2)
8.	a.	Find the first three natural modes of a uniform simply supported beam with distributed mass.	(6)
	b.	Derive the differential equation of motion for the flexural vibration of bar including shear and rotary inertia.	(6)
9.	a.	Plot the first three possible mode shapes o a beam with distributed mass under the following support condition. i) One end fixed and other end free ii) Both ends hinged	(4)
	b.	Enumerate the different vibration measuring instruments. Explain any two in detail.	(6)
	c.	Explain the role of tuned mass damper in vibration control.	(2)