B.E. CIVIL ENGINEERING (PART TIME) FIFTH YEAR SECOND SEM. EXAM. -2017

Subject: STRUCTURAL DYNAMICS **Time: Three Hours** **Full Marks 100**

PART-I (50 marks for each part)

Use a separate Answer-Script for each part

No. of questions	Answer question no.1 and any 3 from the rest	Marks (5+15x3)=50
1.	What do you know about D'Alemberts Principle?	5
2.	Deduce the solution of equation of motion of a single degree of freedom system at under damped, over damped and critically damped situation at free vibration condition.	15
3.	Write short :	5x3=15
a)	Viscous damping.	
b)	Logarithmic decrement.	
c)	Resonant response.	
4.		7+8 =15
a)	A harmonic oscillation test gives the natural frequency of an overhead water tank to be 0.50 Hz. Given that the weight of the tank is 900 kN. What deflection will result if a 90 kN horizontal load is applied statically? The mass of the tank staging can be neglected.	
b)	A SDOF system is subjected to a sinusoidal force. At resonance, the displacement amplitude is 60 mm. At an exciting frequency of one fifth of the natural frequency of the system, the displacement amplitude was measured to be 10 mm. Determine Damping ratio.	

5. a)	Deduce the response of a SDOF system due to an impulse loading at un damped condition.	10+5=15
b)	A SDOF frame has a mass 4500 kg and having lateral stiffness $k = 4 \times 10^6$ N/m and damping ratio 4 percent. Determine its un damped and damped natural frequency.	

Form A : Paper-setting Blank

Ref. No. ...*EX/CE/5/T/505B/2017(old)*

.....*B. Civil Engineering (Part Time) 5th Year*... EXAMINATION, *2017*
(1st / 2nd Semester / ~~Repeat / Supplementary / Annual / Bi-Annual~~)

SUBJECT .....*Structural Dynamics*
(Name in full)

PAPER .....*XX*.....

Full Marks 100
(50 marks for part II)

Time: ~~Two hours~~/Three hours/~~Four hours/Six hours~~

Use a separate Answer-Script for each part

No. of Questions	PART II	Marks
	Assume reasonable data if not given	
	Answer Q.1 and any one from the rest	
1.	A three storeyed frame AB and the corresponding plan diagram are shown in Fig.1. The total gravity load (DL+LL) intensity is 11.5 kN/m^2. Formulate the mass matrix and stiffness matrix for this frame and evaluate the followings. Given, E=2×10^{5}N/mm^2, c/s of column 300mm×450mm. a) Natural frequencies and mode shapes for this shear building. b) Prove that these modes are orthogonal and also satisfy the normality condition. c) Find the displacement of the frame at ***t=4.5sec*** if the frame is subjected to a displacement of $\begin{Bmatrix} v_1 \\ v_2 \\ v_3 \end{Bmatrix} = \begin{Bmatrix} 25 \\ 14 \\ 9 \end{Bmatrix} mm \quad at\ t = 0.0\,\text{sec}$	35
2.	a) Starting from the dynamic equilibrium equation, find the uncoupled equation of motion for viscous damping. b) State and prove the orthogonality condition for mode shape.	8 7

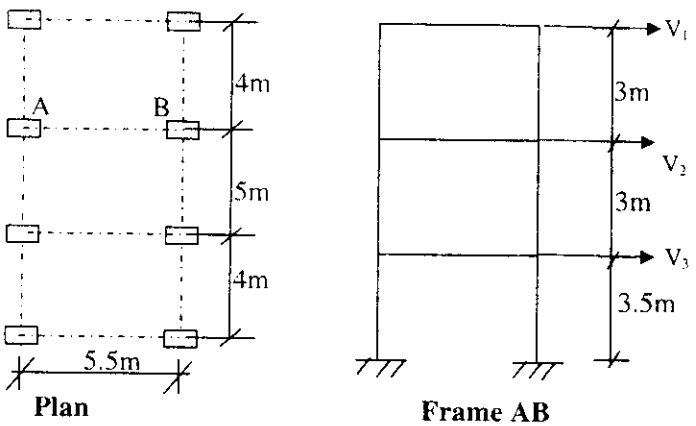

Fig.1

3.	If the responses of the frame (**Fig.1**) due to the force ($F=10\sin 8.9t$) at the tip off the frame at $t=10.25sec$ are $v=\begin{Bmatrix}0.0048\\0.0041\\0.0028\end{Bmatrix}m,\quad \dot{v}=\begin{Bmatrix}-0.006\\-0.0045\\-0.0033\end{Bmatrix}m/\text{sec},\quad and\quad \ddot{v}=\begin{Bmatrix}-1.243\\-1.087\\-0.743\end{Bmatrix}m/\text{sec}^2$ Find responses at $t=10.5sec$ *and* $t=10.75sec$. Use **Newmark's average integration method**. Mass and stiffness matrices are same as question no 1.	15