Use separate answer script for each Part

PART I (60 Marks)

1. Define

i) Stationary and Ergodic process

ii) Effective modal mass

iii) Modal participation factor　　　　　　　　　　　　　　　　　　　　　　(3 x 3)

2. Obtain the governing differential equation for the vibration of the beam shown in Figure 1 using the variational form of the KE, PE and non-conservative work done using the Hamiltonian principle. (20)

3. If the PSD of a function f(t) is expressed as $S_f(\omega)$ obtain the PSD of $\dot{f}(t)$ and $\ddot{f}(t)$.　　　(10)

4. Obtain the PSD of response of a system if the PSD of the disturbance is given as $S_f(\omega)$　　(11)

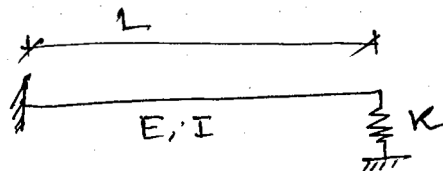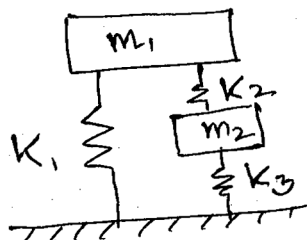5. Find the EMM and MPF of the system shown in Figure 2.　　　　　　　　　(10)

Figure 1.

Figure - 2.

$M_1 = 100 \, kg$

$m_2 = 50 \, kg$

$K_1 = 10000 \, kN/m$

$K_2 = 8000 \, kN/m$

$K_3 = 5000 \, kN/m$

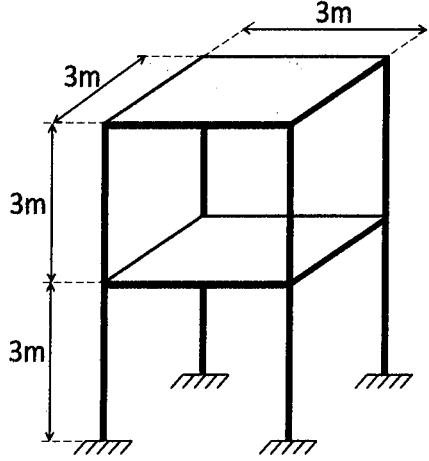**Name of the Examination: M.E. CIVIL ENGINEERING FIRST YEAR FIRST SEMESTER - 2024**

Subject : DYNAMICS OF STRUCTURES (SE)   **PART-II**

Full Marks: 40

Instructions:	
I	All notations represent their standard relevant meaning.
II	If you feel that any data or condition is/are missing in any question, please assume relevant inputs and mention the same.

Sl No	Question	Marks
1	Amplitude of a Single Degree of Freedom System under free vibration decreased from 10mm to 4mm in 10 cycles. If the mass of the system is 10kg and stiffness is 20 N/mm, find out damping ratio, damped natural frequency of the system, time period of undamped system.	10
2	A friction device of coefficient of friction 0.15 is attached with a Single Degree of Freedom system of mass 20kg and stiffness coefficient 12000 N/m and with no viscous damping. If the system is subjected to 50mm of initial displacement, after how many cycles the system will come to rest?	8
3	An instrument of weight 1.5 kN is installed on a floor. The instrument is vibrating in a harmonic manner with force amplitude = 300 kN and exciting frequency 60 rad/sec. If the instrument rests on a fixed pad that provides stiffness of 50 kN/m between the instrument and the floor, considering damping ratio as 0.1, find out amplitude of force transmitted to the floor.	8
4	A two storey PCC frame as shown in Figure: 1 made of M25 concrete (of density 2400kg/m³) is having identical features in both storey. Thickness of the Slabs are 120mm and the columns are each of 300mm x 300mm cross section. Draw mode shapes of the system with respect any of its primary lateral directions. Consider the structure without any beam and ignore the mass of the columns. Figure: 1 (Not to scale)	14