Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B. TECH CIVIL ENGINEERING END SEMESTER EXAMINATIONS

DECEMBER -2023

SUBJECT: ELEMENTS OF EARTHQUAKE ENGINEERING [CIE 4078]

Date of Exam: **07/12/2023** Time of Exam: **2.30PM to 5.30PM** Max. Marks: **50**

Instructions to Candidates:

- Answer ALL the questions & missing data may be suitably assumed.
- Usage of IS 1893:2016 and IS 13920:2016 is allowed.

No.	Question	Marks	CO	BL
1A.	Write a short note on seismic bands.	**(3)**	**CO1**	**2**
1B.	Write a short note on Mohorvic discontinuity.	**(2)**	**CO1**	**2**
1C.	Derive the expression for free vibration response of an under damped SDOF system with the following initial boundary condition, at t = 0 displacement is initial displacement and velocity is initial velocity.	**(5)**	**CO2**	**2**
2A.	Determine the displacement after 2.0 sec for the system shown in **Fig.1**, if initial displacement is 20 mm, initial velocity is 75 mm/sec and damping of 10%. Take E = 180 GPa, I = 1×10^{-6} m^4, k = 20 N/m and w = 100 N.	**(5)**	**CO2**	**4**
2B.	A one storey building is idealized has a rigid girder supported by weightless column, in order to evaluate the dynamic properties of this structure, a free vibration test is made in which the rigid girder is displaced laterally by a hydraulic jack. During jacking operation, it was observed that 60kN force is required to displace the girder by 12mm after the immediate release at this initial displacement, the maximum displacement on the return swing is 6mm and the period of this cycle is 2.0 sec. Determine a) Weight of the girder b) Natural frequency c) Damping ratio d) Damping coefficient e) Amplitude after 6 cycles	**(5)**	**CO2**	**4**
3A.	Define dynamic magnification factor and derive the expression of maximum dynamic magnification factor.	**(5)**	**CO3**	**2**
3B.	An electric motor weighing 1500 N and operating at 500 rpm is mounted on 4 parallel springs of stiffness 5000 N/m each. Determine the maximum permissible unbalance in order to limit the steady state amplitude of 5mm and assume damping as 10% of critical damping.	**(3)**	**CO3**	**4**
3C.	Explain dynamic load factor.	**(2)**	**CO3**	**2**
4A.	A frame shown in **Fig.2** supports a rotating machine, which exerts a horizontal force at the girder level is F(t) = 250 N sin 20 Hz t. Assuming 5% of critical damping, determine steady-state amplitude of vibration and the maximum dynamic bending stress in the column Take E = 200 kN/mm^2, I = $4x10^6$ mm^4 and Z = 2000 mm^3 for each leg.	**(5)**	**CO3**	**4**
4B.	The static deflection of a washing machine of mass 700 kg supported by a system of four parallel springs is found to be 35 mm. If the washing machine has a rotating unbalance of 0.4 kg-m, determine the amplitude of vibration at 1000 rpm	**(5)**	**CO3**	**4**

5A.	Determine base shear and its distribution for all the floors using equivalent static load method for the **Fig.3**. The structure is a residential apartment with more than 200 occupants, built by ordinary RC frames on medium strength soil in Bangalore. Wall panels are not present in the building. The beam dimension is 230×400mm, columns are 230×500mm and slab is 125 mm thick. Live load on slab is 2.5kN/m^2.	**(8)**	**CO4**	**5**
5B	Explain beam jacketing with neat sketches.	**(2)**	**CO5**	**2**

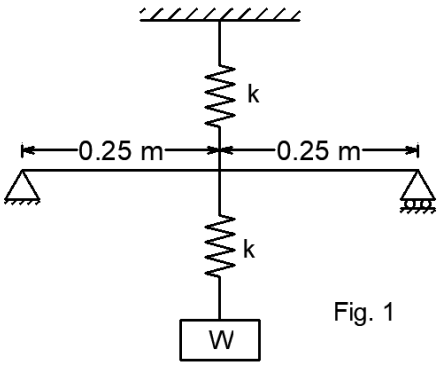

Fig. 1

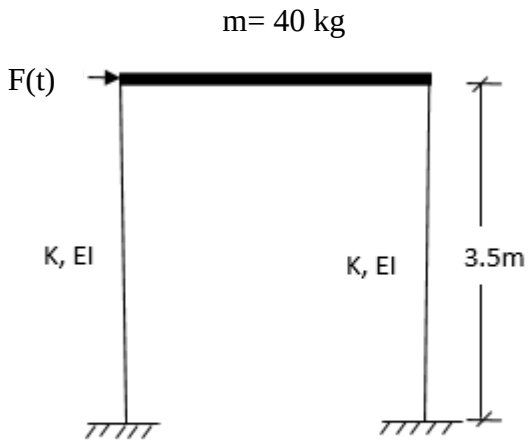

Fig. 2

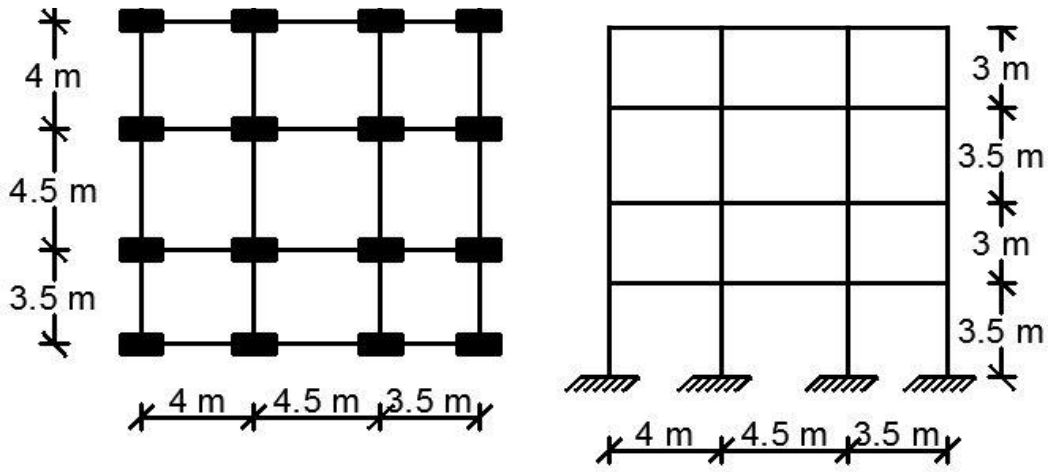

Fig. 3