Roll No……..….. **Total No. of Printed Pages: 2**
Total No. of Questions: [09]

B. Tech. (Civil Engg.) (Semester – 7th)
EARTHQUAKE ENGINEERING
Subject Code: BCIES1722
Paper ID: [19110736]

Time: 03 Hours **Maximum Marks: 60**
Instruction for candidates:

1. Section A is compulsory. It consists of 10 parts of two marks each.
2. Section B consist of 5 questions of 5 marks each. The student has to attempt any 4 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A **(2 marks each)**

Q1. Attempt the following:

a If the logarithmic decrement was 0.1018 and undamped natural frequency is 40 rad/s, determine the damping ratio and damped frequency of SDOF system.
b Is an earthquake's magnitude the same as intensity? Explain.
c What are the factors of resistance to seismic effects?
d Distinguish between static and dynamic loading.
e Distinguish between damped and undamped free vibration.
f Give an example for a structure having a single mass but vibrating in two d.o.f.
g Give an example for periodic and non-periodic dynamic loading occurring in Civil Engineering Structures.
h Draw the basic components of an idealized single degree of freedom system.
i Name the natural and unnatural causes of vibration.
j In structures how will you classify vibration?

Section – B **(5 marks each)**

Q2. The mass of a simple pendulum is attached to an inextensible massless string. The pendulum executes S.H.M. Find its natural period by any one method.

Q3. Show that the gravity force does not have any effect on the equation of motion if the spring is vertical.

Q4. A rigid uniform beam of total mass 'm', and span 'L' is hinged at one end; it is restrained by viscous damper of damping coefficient 'c' at the free end, and by a spring (spring constant k) at a distance 'a' from the hinged end. If the bar is moved in a vertical plane, find the critical damping coefficient.

Q5. What are seismic waves? How many types of waves are available? Explain how they differ?

Q6. A mass of 0.07 kg is suspended from a spring of stiffness 45 N/m. The mass is pulled downwards by 15 mm from its equilibrium position and then released. The upward velocity observed was 25 mm/s. Determine the maximum velocity, maximum acceleration, and the phase angle.

Section – C **(10 marks each)**

Q7. Derive the equation of motion for a cantilever concrete beam, carrying a weight 'w' sustained from a spring at its free end. Modulus of elasticity of concrete, moment of inertia of beam, length of beam and coefficient of stiffness of spring are 22000 MPa, 1.2×10^{-4} kN/m, 3.6 m and 40 kN/m respectively. Neglect the mass of the beam and spring. Also determine the natural circular frequency, natural period of vibration, and natural frequency of a weight of 30 kN suspended as above.

Q8. (a) Derive an expression for the logarithmic decrement of a viscously damped system executing free vibration.

(b) Derive an expression for the magnification factor for a single degree of freedom system subjected to suddenly applied load.

Q9. An elevated water tank weighs 250000 kg when filled with water, the centroid of the mass being at a height of 10 m from the ground. The horizontal spring factor for the tank is 9000 kg per cm. Estimate the maximum shear generated at the base of the water tank by the horizontal inertia force. Assume the ground motion has a period 1.5 seconds and a maximum acceleration of 0.05 g.