



Name :
Roll No. :
Invigilator's Signature :

CS/M.TECH(SE)/SEM-2/SE-202/2013

2013

**STRUCTURAL DYNAMICS
AND
EARTHQUAKE ENGINEERING**

Time Allotted : 3 Hours

Full Marks : 70

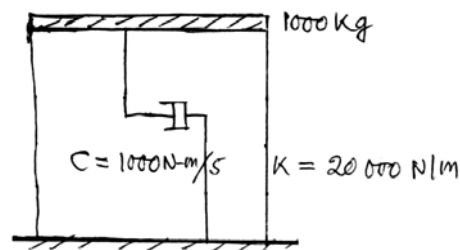
The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Answer any *five* questions.

5 × 14 = 70

1. a) Define the following : 3
- i) Free vibration
 - ii) Natural frequency
 - iii) Forced vibration.
- b) A structure shown in the figure below is released from an initial displacement of 1 cm with initial velocity of – 5 cm/s. Compute damped natural frequency and time history response of the mass.



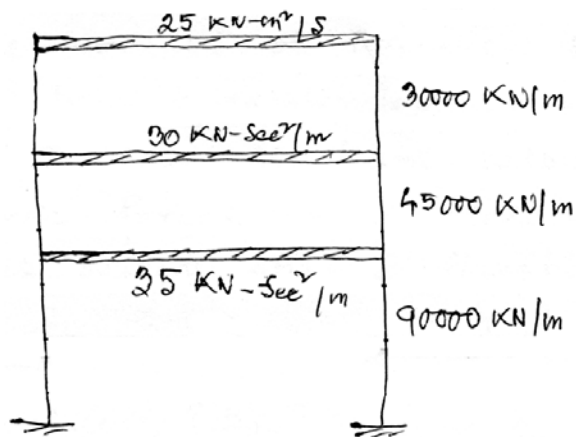
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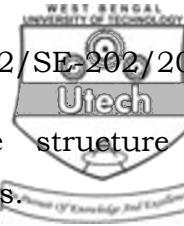
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2. a) Derive the expression for magnification factor M for a damped SDOF system subjected to a sinusoidal force. 10
- b) What is the value of M_{\max} ? Derive the value of M_{\max} and the frequency ratio at which it occurs. 4
3. a) Define Transmissibility. 1
- b) Derive the expression for transmissibility of a mass-spring-damper system subjected to a harmonic force of $f_0 \sin \omega t$. 7
- c) A machine of 100 kg mass is supported on spring of total stiffness of 700 kN/m and an unbalanced rotating element, which results in a disturbing force of 350 N at a speed of 3000 revolutions per minute. Assume a damping ratio of $\xi = 0.2$.
Determine the following :
 - i) Its amplitude of motion due to unbalance
 - ii) Transmissibility
 - iii) The transmitted force. 6
4. a) Formulate the equation of motion for the three-storey structure shown in the figure below from basic principle : 6



- b) Determine the natural frequency of vibration for the above system. 8



5. a) Compute the mode shapes of the structure in
Q. No. 4. Draw the mode shape diagrams. 7
- b) Derive the equation of motion of a typical shear building
frame subjected to translational ground motion. 7
6. What are the basic attributes of an earthquake resistant
structure ? Discuss them briefly. Discuss in brief the load
paths for gravity & lateral loads. Distinguish between rigid
and flexible diaphragms. Discuss mass & stiffness
irregularity. 2 + 4 + 3 + 3 + 2
7. Discuss the concept of Response Spectrum explaining how it
is developed. What are PGA & ZPA ? How does response
spectrum help in assessing the seismic forces on a
structure ? How do earthquakes affect stiff & flexible
structures ? 4 + 2 + 4 + 4
8. Define ductility. How can it be incorporated in RC design ?
What is a shear wall ? What are its advantages ? Distinguish
between static & dynamic analysis w.r.t. IS:1893. 3 + 3 + 3 + 2 + 3

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