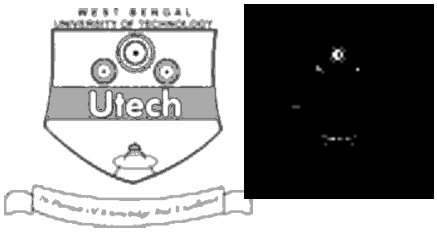
STRUCTURAL DYNAMICS & EARTHQUAKE ENGINEERING (SEMESTER - 8)

CS/B.Tech(CE)/SEM-8/CE-802/5/09



1. .....
Signature of Invigilator

2. .....
Signature of the Officer-in-Charge

Reg. No. | | | | | | | | | | | | | | |

Roll No. of the Candidate | | | | | | | | | | | | | | |

- -

CS/B.Tech(CE)/SEM-8/CE-802/5/09

ENGINEERING & MANAGEMENT EXAMINATIONS, APRIL – 2009

STRUCTURAL DYNAMICS & EARTHQUAKE ENGINEERING (SEMESTER - 8)

Time : 3 Hours] [Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.
2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.
   b) For **Groups – B** & **C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.
3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.
4. Read the instructions given inside carefully before answering.
5. You should not forget to write the corresponding question numbers while answering.
6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.
7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**
8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.
9. Rough work, if necessary is to be done in this booklet only and cross it through.

No additional sheets are to be used and no loose paper will be provided

FOR OFFICE USE / EVALUATION ONLY

Marks Obtained

	Group – A										Group – B			Group – C				
Question Number																	***Total Marks***	***Examiner's Signature***
Marks Obtained																		

.....
Head-Examiner/Co-Ordinator/Scrutineer

8829-5/5 (21/04)

DO NOT WRITE ON THIS PAGE

ENGINEERING & MANAGEMENT EXAMINATIONS, APRIL – 2009

STRUCTURAL DYNAMICS & EARTHQUAKE ENGINEERING

SEMESTER - 8

Time : 3 Hours] [Full Marks : 70

Use of relevant IS codes is permissible in the examination hall.

Assume suitable data not given.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10

i) Earthquake resistant design philosophy matches with

a) no crack b) no damage

c) no failure d) none of these.

ii) Earthquake shaking measuring instrument is

a) seismograph b) seismogram

c) seismoscope d) all of these.

iii) The point of origin of earthquake is called

a) Hypocentre b) Epicentre

c) Seismocentre d) None of these.

iv) Richter scale indicates

a) Earthquake magnitude b) Earthquake intensity

c) Energy relased in earthquake d) Both (a) & (c).

v) The Indian seismic zones are (Modified)

a) Zone-I to Zone - V b) Zone-II to Zone - V

c) Zone-II to Zone - VI d) Zone-I to Zone - VI. ☐

vi) Which type of buildings does not perform well during earthquake ?

a) Circular b) Rectangular

c) '+' shaped. d) All of these. ☐

vii) *P* waves (seismic) involve soil deformation

a) push-pull type b) up & down in the vertical plane

c) sideways in horizontal plane d) both (b) & (c). ☐

viii) Which materials perform better in seismic condition ?

a) Elastic materials b) Ductile materials

c) Brittle materials d) Rigid materials. ☐

ix) Flexural members satisfy the condition(s)

a) Axial stress < $0{\cdot}2\, f_{ck}$ b) Axial stress < $0{\cdot}1\, f_{ck}$

c) Axial stress < $0{\cdot}05\, f_{ck}$ d) Both (b) & (c). ☐

x) Seismic zone III allows the use of which of the following grades of concrete ?

a) M 15 b) M 20

c) M 25 d) Both (b) & (c). ☐

xi) The equivalent spring stiffness of two springs ($k_1 + k_2$) in series is

a) $k_1 + k_2$ b) $\frac{1}{k_1} + \frac{1}{k_2}$

c) $\frac{k_1 + k_2}{k_1 k_2}$ d) $\frac{k_1 k_2}{k_1 + k_2}$. ☐

xii) The spring stiffness of a cantilever massless beam (L, E, I, A) with bumped mass at free end for flexural mode of vibration is

a) $\frac{8\,EI}{L^3}$ b) $\frac{48\,EI}{L^3}$

c) $\frac{4\,EI}{L^3}$ d) none of these. [ ]

xiii) Pick out the correct statement :

a) All periodic motions are simple harmonic motions

b) All simple harmonic motions are periodic motions

c) Aperiodic motions are also SHM

d) None of these. [ ]

GROUP – B

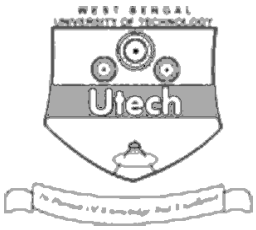
(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. A rigid circular plate of mass M and of radius R is mounted symmetrically at the free end of a vertical cantilever circular shaft having length = L, diameter = d and shear modulus of rigidity = G. Neglect the mass of the shaft as well as damping. Derive the equation of motion for free torsional vibration of the system after drawing free body diagram. 5

3. A freely suspended mass M is attached to one end of a translation spring [K] whose other end is attached to the midpoint of a weightless horizontal both end hinged beam [L, E, I]. Neglect mass of the beam. Also, neglect damping. Derive the equation of motion for free vibration of the mass. Also, determine time period of vibration. 5

4. Explain the following terms with figures : 5



a) Flexural mode of vibration

b) Translational mode of vibration

c) Torsional mode of vibration

d) Rocking mode of vibration

e) D'Alembert's principle.

5. Explain the term 'Damping'. What are the different forms of damping agents ? Also, present the mathematical formulations of different types of damping. 5

6. Determine the normalized modal function for a freely vibrating prismatic cantilever beam having mass m per unit length. The shape function is given as $X = C x^2$. 5

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Determine the response at time $t > \tau$ of a single degree spring (k), mass (m) system due to the forcing function characterised as impulse load of magnitude F having duration $\partial\tau$ at time $t = \tau$. 5

b) Using the result of Prob. No. 7 (a) evaluate the response at any time t of a single degree spring (k), mass (m) system due to the forcing function characterised as

$$F(t) = \frac{P\,t}{t_p} \quad \text{for } 0 \le t \le t_p$$

$$= 0 \text{ for } t > t_p .$$ 10

8. Determine the fundamental natural frequency for free flexural vibration of a cantilever elastic prismatic beam (length = l, mass per unit length = m and flexural rigidity = EI) by Rayleigh Energy method. 15

9. Describe the longitudinal and transverse reinforcement detailing rules for columns as a member of a special moment resisting frame (ductile detailing with special confining reinforcements as per IS : 13920). 15

10. A two-storey building has the following details : 15

Lumped mass of roof = 100000 kg

Lumped mass of first floor = 150000 kg

Storey stiffness of all stories is $2{\cdot}25 \infty 10^{8}$ N/m.

Draw the free body diagram of the floor masses and write the equations of motion for vibration of the masses in the direction normal to the columns. Evaluate the natural frequencies and mode shapes.

11. Using the data of Problem No. 10 and assuming one of the natural frequencies for the structure described in Problem No. 10 as 40 rad/sec, find corresponding mode shape, modal participation factor. Also, determine modal floor forces using response spectrum characterised by constant $\frac{S_a}{g}$ = 0·2 for all time periods. 15

END