VIT
Vellore Institute of Technology

SCHOOL OF CIVIL ENGINEERING

CAT-II B. Tech. Civil Engineering

Course Code : CLE2014 **Duration** : 90 mins. **Slot:** B1

Course Name : Geotechnical Earthquake Engineering **Marks** : 50

Answer ALL the Questions

Use of Code IS 5249 is permitted.

1. (A) Why do we need to evaluate seismic hazard of a site before executing major civil engineering projects? (3 marks)

   (B) List and discuss various steps involved in Deterministic Seismic Hazard Analysis (DSHA). (6 marks)

   (C) Find PGA values for Ooty corresponding to all major faults nearby and indicate your recommendation. (6 marks)

   Seismotectonic map of Ooty and its surroundings is depicted in Fig.

1.

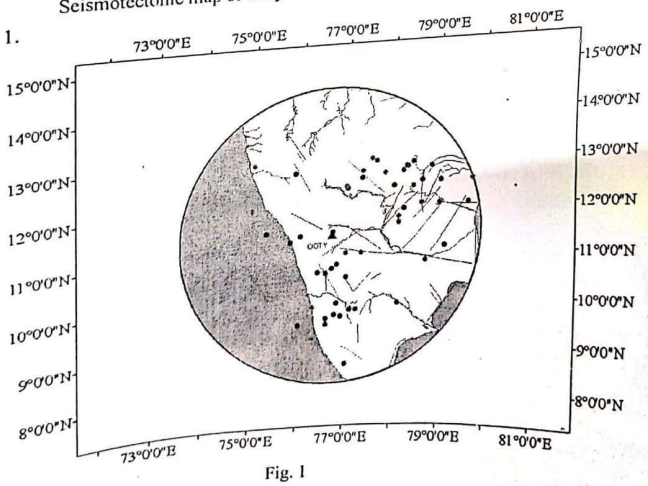

Fig. 1

Table1: Information about major faults near Ooty

Sl. no	Name of the fault	Length of the fault (km)	Max occurred Earthquake (M_W)	Hypocentral distance from Ooty (km)
1.	Bhavali fault	86.90	6.2	37.42
2.	Bhavani shear	102.38	6	29.26
3.	Caurey fault	326.19	5.4	40.51
4.	Moyar shear	119.05	6	26.43
5.	Pattikad-Kollengal fault	40.48	6.2	74.58

Attenuation relationship recommended by National Disaster Management Authority (NDMA 2010):

$$\ln (S_a/g) = C_1 + C_2M + C_3M^2 + C_4r + C_5 \ln (r + C_6 e^{C_7 M}) + C_8 \log(r) f_0 + \ln (\varepsilon)$$

$$f_0 = \max (\ln (r/100),0)$$

Table 2: Coefficients in the attenuation relation for Peninsular India

Period	C1	C2	C3	C4	C5	C6	C7	C8	σ(ε)
0.0000	-5.2182	1.6543	-0.0309	-0.0029	-1.4428	0.0188	0.9968	0.1237	0.3843

2. A vertical vibration test was conducted on a concrete block measuring 1.0 × 1.0 × 1.5 m deep placed at adepth of 1 m in sandy clay soil (Bulk unit weight of soil = 18.5 kN/m^3; Poisson's ratio of soil = 0.25; Unit weight of concrete = 25 kN/m^3). The water table was encountered at the depth 2 m. The saturated unit weight of soil below water table is measured as 19.5 kN/m^3. Mechanical oscillator has a mass of 50 kg. The displacements measured at a number of frequencies are listed below:

Frequency (Hz)	20	25	30	35	40	45	50	60	80
Displacement (mm)	0.05	0.08	0.150	0.22	0.25	0.23	0.21	0.17	0.15

Determine (A) Damping coefficient

(B) Coefficient of elastic uniform compression and dynamic shear modulus for the test condition

(C) Coefficient of elastic uniform compression for actual foundation contact area of 13 m^2.

(D) Dynamic shear modulus at a depth of 3.0 m below the ground surface. (15 marks)

3. How will you evaluate Shear Wave Velocity and Dynamic Shear Modulus Profile of Subsurface using Multi-Channel Analysis of Surface Waves (MASW) Test? (10 marks)

4. In a down-hole survey a seismic source generated SV-waves and the first arrival times were recorded at various depths in a borehole. The depths of the receivers and the arrival times are listed in the table. Calculate the layer thickness, shear wave velocity and estimate the shear modulus of each layer. The water table is at the surface and the saturated density of each soil layer may be assumed to be 1900 kg/m^3. (10 marks)

Depth, (m)	2	3	4	6	8	10	12	14	16	18	20	22	24
Time, (ms - (miili seconds)	13.2	20.0	26.8	38.0	46.0	54.0	62.0	70.0	76.5	80.0	83.5	88.0	90.0