Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME SEMESTER II EXAMINATION – SUMMER 2017

Subject Code: 2724307 **Date:31/05/2017**

Subject Name: Elementary Machine Foundation

Time:02:30 PM to 05:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use Plots 1-3 if required**

Q.1	**(a)**	Define coefficient of elastic uniform compression, coefficient of elastic uniform shear, coefficient of elastic non-uniform shear, coefficient of elastic non-uniform compression, damping ratio, cyclic stress ratio and resonance.	**07**
	(b)	Discuss the various types of machines that generate periodic forces. Explain the general requirements of machine foundations.	**07**
Q.2	**(a)**	Define free and force vibrations. Derive with usual notation equation for forced vibration with damping.	**07**
	(b)	Discuss the use of each laboratory test to determine dynamic soil properties. Also write limitations for each.	**07**
		OR	
	(b)	Discuss in detail with neat sketch and equations: Seismic cross-borehole survey test **or** Vertical block vibration test **or** Cyclic Triaxial test.	**07**
Q.3	**(a)**	What do you mean by Active & Passive isolation? Why they are determined? Enlist the various methods to determine it.	**07**
	(b)	Solve the following: (i) Assuming resonance to have occurred at the frequency of 25cps in a vertical vibration of attest block, 1.0 x 1.0 x 1.0 m size, determine the coefficient of elastic uniform compression (Cu). The weight of oscillator is 70kg and the force produced by it at 12 cps is 120kg. Also compute the maximum amplitude in vertical direction at 12cps. (ii) A simply supported beam of negligible mass spanning 20 m supports a machine of 60 kN at center with an unbalanced rotor applying a vertical force of 150 sin 20t kN. The damping force is 0.45 kN-s/m & Flexural rigidity of beam is 50000 kN-m^2. Determine (i) maximum amplitude of vibration (ii) amplitude of vibration at resonance.	**07**
		OR	

Q.3 A vertical vibration test was conducted on a 1.5 m x 0.75 m x 0.70 m high concrete block in an open pit having depth 2.0 which is equal to the anticipated depth of actual foundation. The test was repeated at different settings (θ) of eccentric masses. The data obtained from the tests are given below: **14**

Sr. No.	θ	f_{nz}	Amplitude at
1	36	43	12
2	73	41	26
3	108	35	34
4	145	31	41

The soil is sandy in nature having angle of internal friction Ø=33° and saturated density γ_{sat}=19.1 kN/ m^3. The water table lies at a depth of 3.0 m below the ground surface. Probable size of the actual foundation 4.0 x 3.0 x 3.5 m high.
Determine the values of Cu, E and G to be adopted for the design of actual foundation. Limiting vertical amplitude of the machine is 150 microns.
Take for test block,σ_{v1} =50 kN/m^2 ,σ_{v2}= 20 kN/m^2 , for actual foundation ,σ_{v1} =75kN/m^2 ,σ_{v2} =85kN/m^2 , Mass of oscillator and motor is 120kg.

Q.4 A reciprocating machine is symmetrically mounted on a block of size 4.0m x 3.0m x 3.5m high. The soil at the site is sandy in nature having Ø = 35° and γ_{sat}=19 kN/m^3. The water table lies at a depth of 3.0m below the ground surface. The block is embedded in the ground by 2.0m depth. The machine vibrating at a speed of 260rpm generates, **14**
Maximum vertical unbalanced force = 2.8kN
Torque about Z-axis = 4.0 kN = 2.0kN at a height of 0.2m above the top of the block. The machine weight is small in comparison to the weight of foundation. Limiting amplitude of the machine is 150 microns. Determine the natural frequencies and amplitudes by linear weightless spring method or Elastic half space theory.
Take, Cu = 3.62 x 10^4 kN/m^3, G = 1.1 x 10^4 kN/m^2, E = 2.98 x 10^4 kN/m^2, μ= 0.36, C_τ = 1.82 x 10^4 kN/m^3, $C_Ø$ = 6.28 x 10^4 kN/m^3,
C_ψ = 2.73 x 10^4 kN/m^3. Assume any other data if required.

OR

Q.4 (a) A 50kg laboratory equipment is to be mounted onto a table in laboratory. The table which is rigidly attached to the floor is vibrating due to operation of other machinery. Measurements indicate that the floor acceleration amplitude is 1.2m/s^2 and it vibrates at 100Hz. Accurate use of the equipment requires that its acceleration amplitude be limited to 0.6 m/s^2. **07**
(i) What is the largest equivalent stiffness of a mounting of damping ratio 0.1 that can be used to limit the acceleration amplitude to 0.6 m/s^2.
(ii) What is the maximum deflection of the mounting?

(b) What do you understand by liquefaction and explain its mechanism with reference to effective stress principle. Enlist the various factors affecting liquefaction potential of a soil. Also discuss anti-liquefaction measures. **07**

Q.5 (a) At a given industrial site a compressor is installed having operating speed of 1100rpm at a distance of 50m from a precision machine. Suggest a suitable open trench barrier to provide effective vibration isolation. The velocity of shear waves at the site was found as 150m/s. Assume suitable data if necessary. **07**

(b) Explain Barkans method and Pauw's analogy of foundation soil system with necessary equations and plots. **07**

OR

Q.5 At a given site, a boring supplemented with standard penetration tests was done upto 15.0 m depth. The results of the boring are as given below: **14**

Depth	Classification	D50	N-Value	D_R
1.5	SP	0.18	4	19
3	SP	0.20	6	30
4.5	SM	0.12	8	35
6	SM	0.14	10	40
7.5	SM	0.13	13	45
9	SP	0.16	18	52
10.5	SW	0.20	21	52
12	SW	0.22	17	46
13.5	SW	0.22	25	60
15	SW	0.24	32	65

position of water table lies 1.5 m below the ground surface (ii) γ_{moist}= 19 kN/m^3 ,γ_{sub} = 10 kN/m^3

The site is located in seismically, active region, and is likely to be subjected by an earthquake, of Magnitude 7.5, Take D=106.

Determine the zone of liquefaction using ,

(a) Seed and ldriss (1971) method

(b) lwasaki (1986) method

Earthquake magnitude, M on Richter's scale	Ns
7	10
7.5	20
8	30

Depth	r_d
0	1
6	0.95
12	0.85

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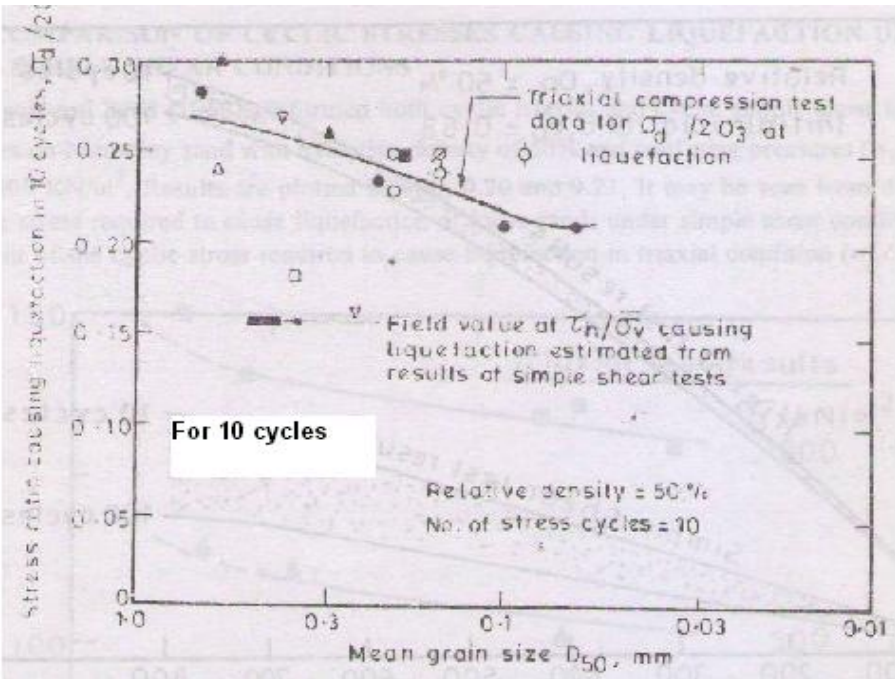
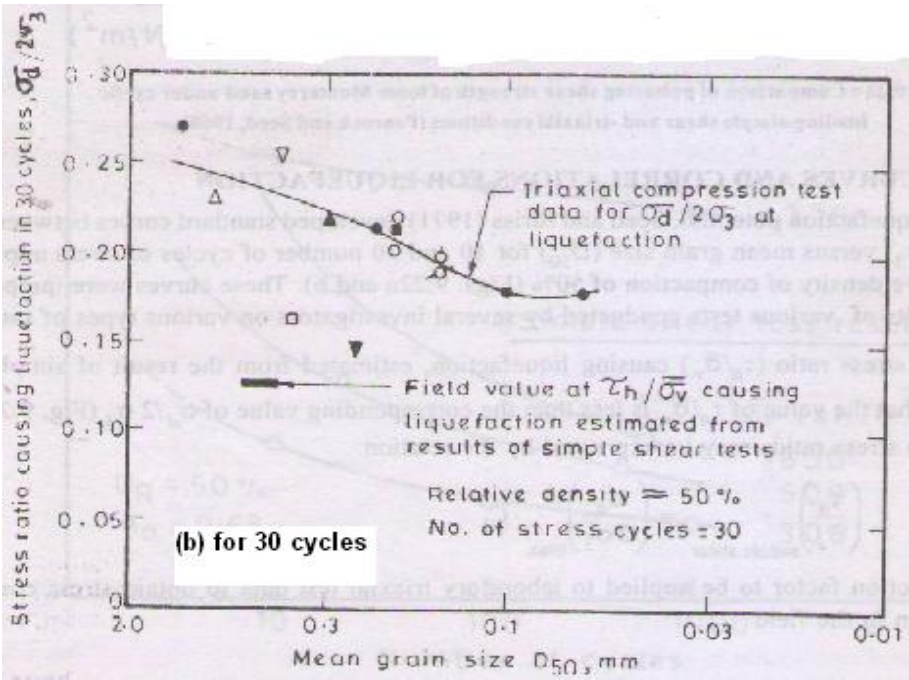
Relative density D_R (%)	C_r
0—50	0.57
60	0.60
80	0.68

Plot 1


Triaxial compression test data for $\sigma_d/2\sigma_3$ at liquefaction
Field value at $\tau_h/\bar{\sigma}_v$ causing liquefaction estimated from results of simple shear tests
For 10 cycles
Relative density = 50 %
No. of stress cycles = 10
0.30
0.25
0.20
0.15
0.10
0.05
0
1.0
0.3
0.1
0.03
0.01
Mean grain size D_{50}, mm

Plot 2


Stress ratio causing liquefaction in 30 cycles, $\sigma_d/2\sigma_3$
Triaxial compression test data for $\sigma_d/2\sigma_3$ at liquefaction
Field value at $\tau_h/\bar{\sigma}_v$ causing liquefaction estimated from results of simple shear tests
Relative density = 50 %
No. of stress cycles = 30
(b) for 30 cycles
0.30
0.25
0.20
0.15
0.10
0.05
0
2.0
0.3
0.1
0.03
0.01
Mean grain size D_{50}, mm

Plot 3