Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER I (NEW) – • EXAMINATION – SUMMER 2016

Subject Code: 2712009 **Date:19/05/2016**

Subject Name: Advanced Foundation Engineering

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 of IS: 8009(part I – II), IS:2911-2010, IS:5249-1992, IS:1904, IS:6403, IS:2950(part I) and other related IS code are permitted.**

Q.1 **(a)** Explain the vertical and horizontal load resisting mechanism in shallow and deep foundation (pile foundation) along with suitable sketches. **07**

(b) Enlist all possible degree of freedoms (vibration mode) to be considered for analysis of machine foundation along with sketch. Also draw a diagram of spring-mass model for a practically possible combined mode of vibration with respective stiffness. **07**

Q.2 **(a)** The successive peaks from a free vibration record obtained from initial displacement(sudden release) test on a block resting on a soil are tabulated are: **07**

Time (s)	0	0.02	0.04	0.06	0.08	0.10	0.12	0.14
Peak amplitude (mm)	16	-12	8	-6	4	-3	2	-1.5

Time (s)	0.16	0.18	0.20	0.22	0.24	0.26	0.28	0.30
Peak amplitude (mm)	1	-0.75	0.5	-0.38	0.25	-0.19	0.13	-0.10

Compute the natural frequency of vibration of the block and also the damping in the foundation as per IS: 5249-1992.

(b) A reciprocating machine is symmetrically mounted on a block of size 4 m x 3m x 3.5 m high as shown in figure below. The soil at the site is sandy in nature having Ø = 35^0 and γ_{sat} = 20 kN/m^3. The water table lies at a depth of 3 m below the ground surface. The block is embedded in the ground by 2 m depth. The machine vibrating vertically at a speed of 250 rpm generates maximum unbalance vertical force 2.5 kN. **07**

The machine weight is small in comparison to the weight of the foundation. The limiting amplitude of the machine is 150 microns. A block resonance test was conducted at the site to evaluate the dynamic elastic constants. The data obtain from the test are:

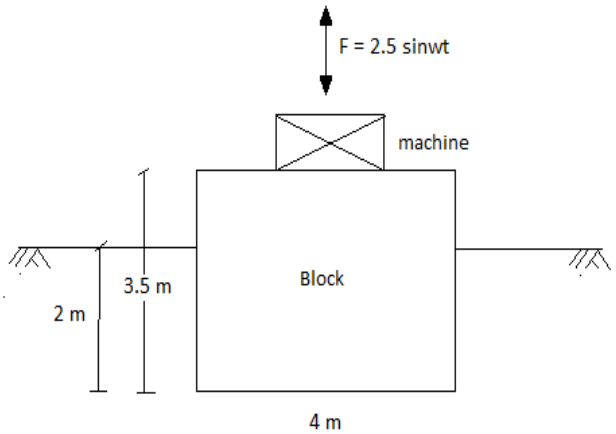
$Cu = 3.62 \times 10^4$ kN/m^3.

$G = 1.10 \times 10^4$ kN/m^2.

$E = 2.98 \times 10^4$ kN/m^2.

$\mu = 0.35$.

Determine the natural frequency and amplitudes by weightless spring-mass model.



OR

(b) Determine the natural frequency and amplitudes in above examples (Q-2, b) by Elastic half space approach. **07**

Q.3 **(a)** Design a friction pile group to carry a load of 2500 kN including the weight of the pile cap at a site where the soil is uniform clay to a depth of 18 m underlain by rock. The average unconfined compressive strength of the clay is 70 kN/m^2. A factor of safety 2.5 is required against shear failure. Assume adhesion factor α = 1. The pile is of 10 m length with 0.5 m diameter. **07**

(b) In the above example (Q-3, a), assuming the clay to be of normal sensitivity and normally loaded with liquid limit of 60 %, compute the settlement of pile group as per guidelines given in IS: 8009(part-II). The unit weight of clay γ = 16 kN/m^3. **07**

OR

Q.3 **(a)** A precast circular concrete pile of 450 mm diameter in a prebored hole is of 15 m length installed in a deposit of sand. If the co-efficient of subgrade reaction Ηh = 10.5 x 10^6 N/m^3. Find the deflection of the pile head as per IS:2911:2010 considering it as free head pile under a horizontal force of 35 kN. Assume E_{pile} = 20 kN/mm^2. **07**

(b) Explain Pile Load test. **07**

Q.4 **(a)** A rectangular shallow footing has a size of 1.8m x 3m has to be transmit a load of a column at a depth of 1.5m. Calculate the safe bearing capacity of a footing as per IS: 6403 with factor of safety 3 against shear failure. The soil has following properties: C = 8 kN/m^2, Ø = 32.5^0, γ = 18 kN/m^3. The depth of footing is 1.5 m from ground level. **07**

(b) Carry out the size proportioning of a TRAPEZOIDAL combined footing for a given data: **07**

1. LHS column (W_1 = 2000 kN) and RHS column (W_2 = 1500 kN)
2. Centre to centre distance between column axis = 7 m.
3. Property lines: 1 m on left side from axis of LHS column.
4. SBC = 140 kPa.

Also draw only S.F. diagram mentioning typical values.

OR

Q.4 **(a)** A footing 4m x 2m in plan, transmits a pressure of 150 kN/m2 on a cohesive soil having E_s = 6 x 10^4 kN/m^2 and μ = 0.5. Determine the immediate settlement of the footing at the centre as per IS:8009(part- I), assuming it to be **07**

1-) a flexible footing and

2-) a rigid footing.

(b) Answer the following w.r.t. Raft foundation: **07**

1-) What is minimum depth of foundation.

2-) Under which situations one can go for raft foundation.

3-) State the criteria for considering raft as rigid or flexible for analysis.

4-) Draw a typical sketch for various types of raft foundation.

Q.5	**(a)**	State the difference between Elastic half space approach and Winkler spring-mass model approach for carrying out Soil-Structure Interaction analysis.	**07**
	(b)	Suggest different measures to be taken for foundation on expansive soil along with suitable justification.	**07**

OR

Q.5	**(a)**	Enlist the conditions responsible for Liquefaction to take place in soil. Also suggest the different way to mitigate the Liquefaction with suitable justification.	**07**
	(b)	Explain the stability analysis of a Well foundation.	**07**

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