Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME SEMESTER II EXAMINATION – SUMMER 2017

Subject Code: 2724309 Date:29/05/2017

Subject Name: Soil Structure Interaction

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.**

Q.1 **(a)** What do you understand by Winkler foundation? Derive its equation for finding slope, deflection, moment, shear and load for a beam resting on elastic foundation. **07**

(b) Differentiate contact pressures under perfectly flexible footings and perfectly rigid footings in detail. Support your answer with neat sketches for sand and clay. **07**

Q.2 **(a)** Estimate the immediate settlement of a concrete footing 1.5m x 1.5m in size founded at a depth of 1.5m in silty soil whose modulus of elasticity is 87kg/cm^2. The footing is expected to transmit a unit pressure of 210 kN/m^2. Take $\mu = 0.34$, $I_f = 0.83$ for rigid footing. **07**

(b) What is mat foundations? Explain rigid method and elastic plate method for the analysis of mat foundation. State the recommendations given by ACI for mat foundation analysis. **07**

OR

(b) Calculate the foundation pressures and moments for a beam of 40m span with three point loads of 2500 kN each spaced equally 10m apart from each other. Take K = 1.32 x 10^7 kg/m^2 and E = 2.01 x 10^9 kg/m^2. **07**

Q.3 **(a)** Show the differential equation of the elastic curve applicable to laterally loaded piles and explain concept of *p-y* curve. **07**

(b) As steel pile of 610mm outside diameter with a wall thickness of 25mm is driven into loose sand (Dr = 30%) under submerged condition to a depth of 20m. The submerged unit weight of the soil is 8.85 kN/m^3 and Ø = 34^o. The EI value of the pile is 4.56 x 10^2 MN-m^2. Compute the ground line deflection of the pile under lateral load of 268 kN at ground level under free head condition by Reese and Matlock method. Assume $\mathbf{n_h}$ = 6 MN/m^3. **07**

OR

Q.3 **(a)** Enlist the various factors affecting the magnitude of the coefficient of subgrade reaction (kv and kh). Explain the influence of width B on coefficient of vertical soil reaction in detail. Support your answer with necessary plots. **07**

(b) A steel pile of 610mm outside diameter and 560mm inside diameter is driven into medium dense sand under submerged condition which is having relative density 60% and angle of internal friction is 38^o. Compute the ultimate resistance of the pile by Broms method. Assume the yield resistance of the pile section as $1.3f_yZ$. Assume f_y = 2800kg/cm^2, submerged unit weight of the soil as 8.75kN/m^3, e/d = 0, non-dimensional yield moment = 462 and non-dimensional lateral resistance = 80. **07**

Q.4 **(a)** What do you mean by curved failure surfaces? Explain logarithmic spiral method for determining passive earth pressure of sand with neat sketch. **07**

(b) A steel pipe pile of outside diameter 650mm and wall thickness of 25mm is driven into saturated cohesive soil upto a depth of 15m. The undrained cohesive strength of the soil is 25kPa. The submerged unit weight of soil is 9.5kN/m3. Construct (p-y) curves for static loadings at depth of 5 & 10 metres. Take $\varepsilon_{50} = 0.02$, $P_u = (3+\gamma' x/c_x + 0.5x/d)c_x d$. **07**

OR

Q.4 **(a)** A 400mm square wooden pile is driven 6m below ground level in pre-loaded clay. The load to be applied is 1m above the ground. Determine the ultimate load that can be applied on a pile with Mu = 130kNm. Assume Kh = 16 MN/m^2, E = 10 X 10^2 MN/m^2 and cohesion of clay = $1kg/cm^2$.Assume e/R = 1.83, Zf/R = 1.42, m = 0.62. Use IS 2911 method only. **07**

(b) Explain in detail Poulos-Davis-Randolph approach for assessing vertical bearing capacity of piled raft foundation. **07**

Q.5 **(a)** 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: **10**

SR No.	θ	fnz	Amplitude at Resonance (Microns)
1	36	41	13
2	72	40	24
3	108	34	32
4	144	31	40

The soil is sandy in nature having angle of internal friction Ø=35° and saturated density γ_{sat}=20 kN/ m^3. The water table lies at a depth of3.0 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. For test block,σ_{v1} =43 kN/m^3 ,σ_{v2}=13.44 kN/m^3

for actual foundation ,σ_{v1} =61kN/m^3 ,σ_{v2} =63.76kN/m^3

Mass of oscillator and motor is 100kg.

(b) 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. **04**

OR

Q.5 **(a)** Discuss in detail Barkans method and Pauw's analogy for foundation soil system. **07**

(b) Design the foundation for a gas engine with vertical cylinder and vertically oscillating parts, for the following data: **07**

i. Total weight of engine = 45 kN
ii. Speed of rotation = 260 rpm
iii. Unbalanced vertical force = 10 kN
iv. Base dimension of the engine = 1m x 2.5m
v. Elevation of machine base above ground = 1m
vi. Weak silty sand exits to a depth of 0.5m followed by a dense sand to a depth of 6m. The unit weight of moist sand is 17 kN/m^3.