INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad -500 043

CIVIL ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**FOUNDATION ENGINEERING**				
Course Code	ACE018				
Programme	B.Tech				
Semester	VIII	CE			
Course Type	Core				
Regulation	**IARE - R16**				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Ms.U.Deepthi,Assistant Professor				
Course Faculty	Mr. N Venkat Rao,Associate Professor Ms.U.Deepthi,Assistant Professor Ms.V.Alivelu mangamma,Assistant Professor				

COURSE OBJECTIVES:
The course should enable the students to:

I	Understand various methods of soil exploration and field tests on soil, planning and preparation of soil investigation programme.
II	Analyze the stability of infinite and finite slopes.
III	Calculate At rest, Active and Passive earth pressures of soil & Analyze the stability of retaining wall against sliding, overturning and bearing capacity failures.
IV	Calculate the bearing capacity of shallow and deep foundation from theoretical & field tests.

COURSE OUTCOMES (COs):

CO 1	Understand the need and various methods of soil exploration, planning and preparation of soil investigation report
CO 2	Analyze the stability of slopes by various methods
CO 3	Understand various earth pressure theories and stability of retaining walls at various conditions
CO 4	Understand shallow and deep foundations according to various bearing capacity theories and analyze Pile foundations in various different soils
CO 5	Understand various shapes and components of wells and analyze, design according to IRC guidelines

COURSE LEARNING OUTCOMES:

Students, who complete the course, will have demonstrated the ability to do the following:

ACE018.01	Understand the need and methods of Soil Exploration
ACE018.02	Understand various methods of sampling and boring
ACE018.03	Learn how to perform field tests such as SPT, DCPT, CPT
ACE018.04	Learn how to perform Plate Load test for finding load bearing capacity, settlements of soils
ACE018.05	Learn how to perform in-situ test using pressure meter
ACE018.06	Understand the importance of geophysical methods
ACE018.07	Learn how to prepare Soil investigation Report
ACE018.08	Understand basic concepts of earth slopes
ACE018.09	Analyze failure of infinite slopes
ACE018.10	Analyze types of failures for finite slopes
ACE018.11	Learn how to find Stability of slopes by Swedish arc Method
ACE018.12	Learn how to find Stability of slopes by Method of Slices for slopes
ACE018.13	Find Stability of slopes by Taylor‘s Stability number
ACE018.14	Understand basic concepts of Stability of slopes of earth dam under different conditions
ACE018.15	Understand concepts of earth pressure theories for stability of Retaining walls
ACE018.16	Calculate active and passive earth pressures from Rakine‘s earth pressure theories
ACE018.17	Calculate active and passive earth pressures from Coulomb‘s & Culmann‘s Method
ACE018.18	Asses the stability of retaining wall against overturning, sliding, bearing capacity
ACE018.19	Understand the concepts of safe bearing capacity, ultimate bearing capacity etc.,
ACE018.20	Calculate the bearing capacity of shallow foundation using Terzaghi, Meyerhof, Skempton and IS Methods.
ACE018.21	Calculate the load carrying capacity of pile using static,dynamic pile formula and pile load test
ACE018.22	Calculate load carrying capacity of pile group in sandsand clay & settlement of pile group
ACE018.23	Learn different shapes of well & components of WellFoundation
ACE018.24	Understand the principle of analysis and design ofwells, Seismic analysis and IRC guidelines

TUTORIAL QUESTION BANK

S. No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
UNIT I				
SOIL EXPLORATION				
Part - A (Short Answer Questions)				
1	Distinguish between disturbed and undisturbed samples	Understand	CO 1	ACE018.02
2	How do you obtain undisturbed samples?	Understand	CO 1	ACE018.02
3	What is Boring log?	Understand	CO 1	ACE018.01
4	List various methods of soil explorations	Remember	CO 1	ACE018.01
5	Explain various methods of drilling holes	Remember	CO 1	ACE018.01
6	What is Reconnaissance? What is its use?	Remember	CO 1	ACE018.02
7	What is split spoon sampler? Why it is use?	Remember	CO 1	ACE018.02
8	Discuss the merits of wash boring method?	Remember	CO 1	ACE018.02
9	What is soil exploration?	Remember	CO 1	ACE018.01
10	What is the purpose of soil investigation?	Understand	CO 1	ACE018.07
11	What is Auger Boring?	Remember	CO 1	ACE018.02
12	Name few geophysical investigation techniques?	Remember	CO 1	ACE018.06
13	What is Area Ratio?	Understand	CO 1	ACE018.02
14	Name few samplers.	Remember	CO 1	ACE018.02
15	Name few field tests for obtaining the strength of soil	Remember	CO 1	ACE018.03
16	What is SPT?	Remember	CO 1	ACE018.03
17	What are the corrections to be applied for SPT value?	Understand	CO 1	ACE018.03
18	Compare the difference between SPT and DCPT test?	Understand	CO 1	ACE018.03
19	What is CPT?	Remember	CO 1	ACE018.03
20	What is rule of thumb for spacing between boreholes for soil exploration?	Understand	CO 1	ACE018.07
Part - B (Long Answer Questions)				
1	Explain briefly various methods of soil exploration techniques?	Understand	CO 1	ACE018.01
2	Write a short note on Auger Boring?	Remember	CO 1	ACE018.02
3	Write a short note on Wash Boring?	Remember	CO 1	ACE018.02
4	Write a detailed note on various types of boring techniques?	Remember	CO 1	ACE018.02
5	Write a short note on Percussion Drilling?	Understand	CO 1	ACE018.02
6	Explain in detail Seismic Refraction Method?	Remember	CO 1	ACE018.06
7	Explain in detail SPT test?	Understand	CO 1	ACE018.03
8	Explain the various parameters which affect the sampling of soil?	Understand	CO 1	ACE018.02
9	Explain briefly various Geophysical methods used for soil Investigation?	Remember	CO 1	ACE018.06
10	Explain the need of Soil Exploration	Understand	CO 1	ACE018.01
11	Discuss in detail about CPT test.	Understand	CO 1	ACE018.03
12	Explain in detail DCPT test.	Remember	CO 1	ACE018.03
13	Explain in detail Pressure meter test?	Remember	CO 1	ACE018.05
14	Explain briefly field permeability tests?	Remember	CO 1	ACE018.04
15	Discuss briefly about plate load test on soil?	Understand	CO 1	ACE018.04
Part – C (Problem Solving and Critical Thinking)				
1	A SPT was conducted in a dense sand deposit of 22m, and a value of 48 was observed for N. the density of the sand was 15kN/m^3. What is the value of N, corrected for overburden pressure?	Understand	CO 1	ACE018.03
2	Compute the area ratio of a thin walled tube samples having an external diameter of 6cm and a wall thickness of 2.25mm. Do you recommend the sampler for obtaining undisturbed soil samplers? Why?	Remember	CO 1	ACE018.02

S. No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
3	A SPT is conducted on fine sand below water table and a value of 25 is obtained for N. What is the corrected value of N?	Understand	CO 1	ACE018.03
4	A SPT was performed at a depth of 20m in a dense sand deposit with a unit weight of 17.5kN/m2. If the observed N-value is 38, what is the N- value corrected for overburden?	Understand	CO 1	ACE018.03
5	Compute the area ratio of a thin walled tube samples having an external diameter of 8cm and a wall thickness of 3.25mm. Do you recommend the sampler for obtaining undisturbed soil samplers? Why?	Understand	CO 1	ACE018.02
6	Determine the area ratios for the following soil samplers and comment on the nature of samples obtained in each of the samplers Type of Sampler / Outer Diameter / Internal Diameter Core Cutter / 165 mm / 150 mm Split Barrel / 51 mm / 35 mm Seamless tube (Shelby) / 51 mm / 48 mm	Remember	CO 1	ACE018.02
7	The cone penetration resistance obtained in a clay soil in a CPT was 50 kg/cm^2. Determine the undrained strength of clay. The total overburden pressure at the depth was 100 kN/m^2.	Remember	CO 1	ACE018.03
8	Determine the area ratio of a Shelby tube sampler having inside and outside diameters of 111mm and 114 mm respectively.	Understand	CO 1	ACE018.02
9	A SPT is conducted on clay at a certain depth is 11. What is the corrected value of N? Estimate unconfined compressive strength of soil based on SPT N value.	Understand	CO 1	ACE018.03
10	Determine the area ratio of a sampler having inside and outside diameters of 125mm and 120 mm respectively.	Remember	CO 1	ACE018.02
UNIT 2				
SLOPE STABILITY				
Part – A (Short Answer Questions)				
1	Define Finite Slope.	Remember	CO 2	ACE018.08
2	Define Infinite Slope.	Remember	CO 2	ACE018.08
3	Name various types of slope failure.	Remember	CO 2	ACE018.08
4	What are the causes of failure of slopes?	Remember	CO 2	ACE018.08
5	Write brief notes on Taylor‘s stability number.	Understand	CO 2	ACE018.13
6	What are different FOS used in stability of slopes.	Understand	CO 2	ACE018.09
7	What is critical height?	Understand	CO 2	ACE018.09
8	Explain the assumptions that are made in analysis of the stability of slopes?	Remember	CO 2	ACE018.10
9	Discuss various methods for improving the stability of slopes?	Remember	CO 2	ACE018.12
10	Explain Under what conditions (i) a base failure and (ii) a toe failure occur?	Remember	CO 2	ACE018.10
11	What is mobilized cohesion?	Remember	CO 2	ACE018.08
12	What are factors effecting slope stability?	Remember	CO 2	ACE018.09
13	What is Rapid Draw down?	Remember	CO 2	ACE018.14
14	What is stability number utility in the analysis of stability of slopes?	Remember	CO 2	ACE018.13
15	Write the assumptions of stability analysis by method of slices?	Remember	CO 2	ACE018.12
Part - B (Long Answer Questions)				
1	Discuss the stability analysis of infinite slopes in cohesion less soils for no seepage condition.	Remember	CO 2	ACE018.09
2	Discuss the stability analysis of infinite slopes in cohesive soils.	Understand	CO 2	ACE018.09
3	Discuss the stability analysis of infinite slopes in cohesion less soils with ground water table at the surface of the slope.	Understand	CO 2	ACE018.09
4	Explain the stability analysis by Swedish slip circle method and derive the factor of safety.	Remember	CO 2	ACE018.11
5	Explain Bishops simplified method for determination of factor of safety of a finite slope.	Remember	CO 2	ACE018.12

S. No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
6	Explain the basis for Taylor‘s stability number and the procedure of its use.	Remember	CO 2	ACE018.13
7	Explain the method of slices for estimation on factor of safety of finite slopes.	Understand	CO 2	ACE018.10
8	Describe the stability of slope of an earthen dam in ―sudden drawdown‖ conditions.	Understand	CO 2	ACE018.14
9	Explain stability of earthen dam in full reservoir condition	Remember	CO 2	ACE018.14
10	Discuss in detail different forms of slip surface in finite slopes	Understand	CO 2	ACE018.10
Part – C (Problem Solving and Critical Thinking)				
1	It is proposed to construct a highway embankment using a c-φ soil having c= 20 kPa, $\gamma = 17kN/m^3$. Determine the critical height up to which the embankment can be built with an inclination of 29° with a factor of safety of 1.50. Given the Taylor‘s stability number for these conditions as 0.0737.	Understand	CO 2	ACE018.13
2	Find factor of safety of a 5m slope of infinite extent having a slope angle of 25°. The slope is made of cohesion less soil with φ = 30°, $\gamma = 17kN/m^3$, $\gamma_{sat} = 19kN/m^3$. Also analyze the slope if it is made of clay having c‘ = $30kN/m^2$, φ‘ = 20°, e = 0.65 and Gs= 2.7 and under the following conditions: When soil is dry When the slope is submerged.	Understand	CO 2	ACE018.09
3	An excavation has to be made with an inclination of 40° in a soil with c‘ =40kPa, φ‘ = 10°, γ = 18kN/m2. What is the maximum height of the slope with a factor of safety of 2.01. The Taylor‘s stability number for the above condition is given as 0.097.	Understand	CO 2	ACE018.13
4	An embankment 10m high is inclined at an angle of 36° to the horizontal. A stability analysis by the method of slices gives the following forces per running meter: Σ shearing forces = 450kN Σ normal forces = 900kN Σ neutral forces = 216kN The length of the failure arc is 27m. Laboratory tests on the soil indicate the effective values c‘ and φ‘ as $20kN/m^2$ and 18° respectively. Determine the factor of safety of the slope with respect to a) Shearing strength b) Cohesion	Understand	CO 2	ACE018.12
5	An embankment is inclined at an angle of 35° and its height is 15m.The angle of Shearing resistance is 15° and the Cohesion intercept is $200kN/m^2$. The unit weight of soil is $18kN/m^3$. If Taylor‘s stability number is 0.06, find the factor of safety with respect to cohesion.	Remember	CO 2	ACE018.13
6	Find factor of safety of a slope of infinite extent having a slope angle of 20°.The slope is made of cohesion less soil with φ = 30°. Also analyze the slope if it is made of clay having c‘ = $35kN/m^2$, φ‘ = 25°, e = 0.60 and Gs= 2.7 and under the following conditions: When soil is dry When the slope is submerged.	Understand	CO 2	ACE018.09
7	An excavation is made with a vertical face in a clay soil which has Cu = 50 kN/m^2, unit weight of soil is $18kN/m^3$. Determine maximum depth so that excavation is stable. Stability number is this case is 0.261.	Understand	CO 2	ACE018.13
8	An excavation has to be made with an inclination of 45° in a soil with c‘ = 30 kPa, φ‘ = 15°, $\gamma = 17kN/m^3$. What is the maximum height of the slope with a factor of safety of 2. The Taylor‘s stability number for the above condition is given as 0.097.	Remember	CO 2	ACE018.13

S. No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
9	An embankment is inclined at an angle of 35° and its height is 10m. The angle of shearing resistance is 20° and the cohesion intercept is 200kN/m^2.The unit weight of soil is 17kN/m^3. If Taylor's stability number is 0.06, find the factor of safety with respect to cohesion.	Remember	CO 2	ACE018.13
10	It is proposed to construct a highway embankment using a c-ϕ soil having c = 25kPa, φ = 20°, γ = 17kN/m^3. Determine the critical height up to which the embankment can be built with an inclination of 30° with a factor of safety of 1.50. Given the Taylor's stability number for these conditions as 0.0737.	Understand	CO 2	ACE018.13
11	A canal having a side slope 1 to 1 is proposed to be constructed in a cohesive soil to a depth of 5m below ground surface. The soil properties of the soil are $\varphi_u = 15^0$, C_u = 12 kN/m^2, e =1, G = 2.65. Find the factor of safety w.r.t. cohesion against failure of the slope When canal is full of water and When there is a sudden drawn down of water in the canal	Understand	CO 2	ACE018.14
12	Find the critical angle of an infinite slope in a clay soil having C' = 20 kN/m^2 , $\varphi' = 20^0$, G =2.72 e= 0.9 for the following cases Soil is dry The slope is submerged with seepage parallel to the surface. A hard stratum exists at a depth of 6m parallel to the ground surface.	Understand	CO 2	ACE018.09
13	A cutting 8 m deep is to be made in a saturated clay soil with γ = 20kN/m^3 , $\varphi_u = 0^0$, C_u = 28 kN/m^2. A hard stratum exists at a depth of 12 m below ground level. Determine the angle of slope at which failure would occur. If FOS = 1.4 what is the maximum slope angle permitted.	Understand	CO 2	ACE018.10
14	A infinite slope is to be constructed of a clay soil at a slope angle of 30^0. The GWT is at ground surface itself, with seepage parallel to the ground. The soil properties are γ = 20kN/m^3 , $\varphi_u = 22^0$, C_u = 15 kN/m^2 what is FOS against movement along a plane parallel to GS at depths of 4 m and 5.5 m.	Remember	CO 2	ACE018.09
15	An embankment is to be made from soil with γ = 20kN/m^3 , $\varphi_u = 20^0$, C_u = 20 kN/m^2. If the FOS is 1.5 w.r.t shear strength. Determine limiting height of the slope if built at a slope angle 25^0	Understand	CO 2	ACE018.11
	UNIT 3			
	EARTH PRESSURE THEORIES AND RETAINING WALL			
	Part – A (Short Answer Questions)			
1	What is Active Earth Pressure?	Understand	CO 3	ACE018.16
2	What is Passive Earth Pressure?	Remember	CO 3	ACE018.17
3	What is At rest Earth Pressure?	Understand	CO 3	ACE018.17
4	Write the assumptions of Rankine's Theory.	Understand	CO 3	ACE018.16
5	Write the assumptions of Coulombs Theory.	Remember	CO 3	ACE018.17
6	Distinguish between active and passive earth pressures.	Understand	CO 3	ACE018.16
7	Write short notes on Culmann's graphical method.	Understand	CO 3	ACE018.17
8	What is Rankine's passive earth pressure coefficient?	Understand	CO 3	ACE018.16
9	What is Rankine's active earth pressure coefficient?	Remember	CO 3	ACE018.16
10	What is lateral earth pressure?	Remember	CO 3	ACE018.15
11	Where do we use earth pressure theories.	Remember	CO 3	ACE018.15
12	What are different modes of failure for retaining wall?	Remember	CO 3	ACE018.18
13	Define gravity retaining walls.	Remember	CO 3	ACE018.18
14	What is the Factor of Safety against Sliding for retaining wall?	Understand	CO 3	ACE018.18
15	What is the factor of safety against overturning for retaining wall?	Remember	CO 3	ACE018.18
16	What are various types of retaining walls?	Understand	CO 3	ACE018.18
17	What is Cantilever retaining wall?	Remember	CO 3	ACE018.18
18	Describe Counter fort retaining wall.	Understand	CO 3	ACE018.18
19	Distinguish between Counter fort and Buttress retaining walls.	Remember	CO 3	ACE018.18
20	Distinguish between gravity and semi-gravity retaining walls.	Understand	CO 3	ACE018.18

S. No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
	Part - B (Long Answer Questions)			
1	Describe briefly Rankine‘s earth pressure theory.	Understand	CO 3	ACE018.16
2	Describe briefly Coulombs earth pressure theory.	Understand	CO 3	ACE018.17
3	Distinguish the Rankine‘s and Coulomb‘s theories for computation of earth pressure and suggest the suitability of these methods.	Remember	CO 3	ACE018.16
4	Explain briefly Culmann‘s Graphical Method.	Understand	CO 3	ACE018.17
5	What is the effect of submergence on active and passive earth pressures?	Understand	CO 3	ACE018.17
6	Derive the expression for coefficient of Active and passive earth pressure coefficients according to coulombs earth pressure theory	Remember	CO 3	ACE018.17
7	Explain in detail various types of Retaining Walls	Understand	CO 3	ACE018.18
8	Explain in detail the design of gravity retaining wall.	Remember	CO 3	ACE018.18
9	Explain in detail various stability conditions that should be checked for the retaining wall?	Remember	CO 3	ACE018.18
10	Explain with neat diagram stability of retaining against sliding	Remember	CO 3	ACE018.18
11	Explain with neat diagram stability of retaining against overturning	Understand	CO 3	ACE018.18
12	Explain with neat diagram stability of retaining against bearing capacity failure.	Understand	CO 3	ACE018.18
13	Derive the expression for coefficient of Active earth pressure coefficients of cohesive backfill	Understand	CO 3	ACE018.16
14	Explain the significance of drainage in performance of retaining walls.	Understand	CO 3	ACE018.18
15	What is the effect of sloping ground surface on coefficient of Active of Cohesion less backfill material?	Understand	CO 3	ACE018.17
	Part – C (Problem Solving and Critical Thinking)			
1	A gravity retaining wall of height 3 m with uniform thickness (.i.e. rectangular in cross section) of 1.20m is constructed in RRM with a unit weight of 24 kN/m^3. The average properties of soil from top to bottom of wall includes c = 0kN/m^2; φ= 30°. Analyze the stability of wall against overturning when the entire backfill is Moist with a unit weight of 18 kN/m^3 ii. Submerged(consider the saturated unit weight in submerged conditions as 9.80kN/m^3)	Understand	CO 3	ACE018.18
2	A retaining wall with a smooth vertical back retains sand backfill for a depth 6m. The backfill has a horizontal surface and the properties of backfill material is c = 0kN/m^2; φ‘= 28°, γ = 16 kN/m^3, γ_{sat} = 20 kN/m^3. Calculate total force acting on wall.	Remember	CO 3	ACE018.18
3	A retaining wall with a smooth vertical back retains sand backfill for a depth 6m. The backfill has a horizontal surface and the properties of backfill material is c = 0kN/m^2; φ‘= 28°, γ = 16 kN/m^3, γ_{sat} = 20 kN/m^3. If the backfill supports a UDL of 25 kN/m^2. Calculate total force acting on wall.	Understand	CO 3	ACE018.18
4	A retaining wall with a smooth vertical backfill is 10 m high and retains a two layers of sand backfill with following properties 0-5 m depth c‘ = 0 kN/m^2; φ‘= 30°, γ = 18 kN/m^3 5-10 m depth c‘ = 0 kN/m^2; φ‘= 34°, γ = 20 kN/m^3. Draw the active earth pressure distribution assuming that WT is well below base of the wall.	Understand	CO 3	ACE018.16
5	A retaining wall 8 m high with smooth vertical back, retains a clay backfill with c‘ = 15 kN/m^2; φ‘= 15°, γ = 18 kN/m^3. Calculate the total active thrust on the wall assuming that tension cracks may develop to the full depth.	Remember	CO 3	ACE018.16

S. No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
6	A 9m high retaining wall is supporting a backfill consisting of two types of soils. The water table is located at a depth of 5m below the top. The properties of soil from 0 to 3m include c = 0 kN/m^2; $\varphi = 33°$; $\gamma = 17kN/m^3$ and those for soil from 3m to 9m include c = 0 kN/m^2; $\varphi = 40°$; $\gamma = 18.50kN/m^3$; γ_{sub} = $20.50kN/m^3$.Plot the distribution of active and passive earth pressure and determine the magnitude and point of application of total active and passive earth pressure acting on the retaining wall.	Understand	CO 3	ACE018.16
7	A 8m high retaining wall is supporting a c – φ backfill having c = $30kN/m^2$; $\varphi = 24°$; $\gamma = 18kN/m^3$. Plot the distribution of active and passive earth pressure and determine the magnitude and point of application of total active and passive earth pressure acting on the retaining wall.	Understand	CO 3	ACE018.16
8	A 10m high retaining wall is supporting a backfill consisting of two types of soils. The water table is located at a depth of 6m below the top. The properties of soil from 0 to 4m include c = $30kN/m^2$; $\varphi = 30°$; γ=17 kN/m^3 and those for soil from 4m to 10m include c = $15kN/m^2$; $\varphi = 40°$; γ = 20 kN/m^3; $\gamma sat = 20.50\ kN/m^3$.Plot the distribution of active and passive earth pressure and determine the magnitude and point of application of total active and passive earth pressure acting on the retaining wall.	Understand	CO 3	ACE018.17
9	A trapezoidal gravity retaining wall of height 6m with top and bottom widths as 0.45m &1.20m respectively is constructed in RCC with a unit weight of 25kN/m3. Its bottom is resting 2m below the GL on soil having c = 0kN/m2; $\varphi = 36°$; $\gamma = 18kN/m3$; the friction angle is 2/3 of φ. The allowable bearing capacity of the soil for this case is found to be 200kN/m2 .The wall is supporting the 4m thick backfill above GL made of soil having c = 0kN/m2; $\varphi = 30°$; $\gamma = 17.50kN/m3$. Analyze the stability of wall against overturning, sliding and bearing capacity.	Remember	CO 3	ACE018.18
10	A trapezoidal masonry retaining wall 1 m wide at top and 3 m wide at its bottom is 4 m high. The vertical face is retaining soil ($\varphi = 30°$) at a surcharge angle of 20° with the horizontal. Determine the maximum and minimum intensities of pressure at the base of the retaining wall. Unit weights of soil and masonry are 20kN/m3 and 24kN/m3 respectively. Assuming the coefficient of friction at the base of the wall as 0.45, determine the factor of safety against sliding. Also determine the factor of safety against overturning.	Understand	CO 3	ACE018.18
11	Design a gravity retaining wall of height 3m with uniform thickness (i.e. rectangular in cross section) constructed in RRM with a unit weight of 24kN/m3. The average properties of soil from top to bottom of wall include c = $0kN/m^2$; $\varphi = 36°$; $\gamma = 18kN/m^3$; the friction angle is 2/3 of φ. The allowable bearing capacity of the soil for this case is found to be $200kN/m^3$. Analyze the stability of the wall against overturning, sliding and bearing capacity	Remember	CO 3	ACE018.18
12	A gravity retaining wall of height 3 m with uniform thickness (i.e. rectangular in cross section) of 1.20m is constructed in RRM with a unit weight of $24kN/m^3$. The average properties of soil from top to bottom of wall includes c = $0kN/m^2$; $\varphi = 30°$. Analyze the stability of wall against overturning when the entire backfill is	Remember	CO 3	ACE018.18

S. No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
	Moist with a unit weight of 18kN/ m^3 Submerged(consider the saturated unit weight in submerged conditions as 9.80 kN/ m^3)		CO 3	
13	A gravity retaining wall of height 3 m with uniform thickness(i.e. rectangular in cross section)of 1.20m is constructed in RRM with a unit weight of 24kN/m^3.The average properties of soil from top to bottom of wall includes c = 0kN/m2; φ = 30°. Subsequently, 1m high fill is placed on top of the existing backfill after constructing a 0.60m thick wall above the existing wall matching with the backfill side face of wall (i.e., the offset is provided on the other side of backfill). Analyze the stability of wall against overturning before and after raising the height of backfill.	Remember	CO 3	ACE018.18
14	An excavation was made in saturated soft clay φ_u = 30°, with its sides more or less vertical. When depth of excavation reached 6m, the sides caved in. What is the approx value of cohesion of clay soil? Take unit weight of clay as 20 kN/ m^3	Remember	CO 3	ACE018.16
15	A retaining wall 12 m high has its back sloping angle of 75^0 with horizontal. The surface of the backfill slopes at an angle of 15^0. The soil properties are c‘ = 0kN/m2; φ‘ = 35°, γ = 24kN/m^3 δ = 25^0. Determine active thrust of wall by coulomb theory.	Remember	CO 3	ACE018.17
	UNIT IV			
	SHALLOW AND DEEP FOUNDATIONS			
	Part – A (Short Answer Questions)			
1	What is bearing capacity?	Remember	CO 4	ACE018.19
2	What is difference between ultimate bearing capacity and Safe bearing capacity?	Understand	CO 4	ACE018.19
3	What is net safe bearing capacity?	Understand	CO 4	ACE018.19
4	Write Terzaghi ultimate bearing capacity equation for continuous footing.	Remember	CO 4	ACE018.20
5	Write Terzaghi ultimate bearing capacity equation for square footing.	Understand	CO 4	ACE018.20
6	What is settlement of footing as per plate load test?	Understand	CO 4	ACE018.19
7	What are the various types of settlements in foundations?	Remember	CO 4	ACE018.20
8	Define foundation	Remember	CO 4	ACE018.19
9	Write Terzaghi ultimate bearing capacity equation for rectangular footing.	Remember	CO 4	ACE018.20
10	Define end bearing pile.	Understand	CO 4	ACE018.21
11	Define friction pile.	Remember	CO 4	ACE018.21
12	Differentiate between uniform settlement and differential settlement.	Remember	CO 4	ACE018.22
14	Classify piles based on their method of installation.	Remember	CO 4	ACE018.21
15	Classify piles based on their type of application.	Understand	CO 4	ACE018.21
16	What are the various classifications of piles?	Understand	CO 4	ACE018.21
17	Write a note on dynamic formula of piles.	Remember	CO 4	ACE018.21
18	Write Engineering News Record formula for load carrying capacity of piles.	Remember	CO 4	ACE018.21
19	What is the ultimate load capacity of pile	Understand	CO 4	ACE018.22
20	Make a note on plate load test.	Understand	CO 4	ACE018.20
	Part - B (Long Answer Questions)			
1	Explain in detail Terzaghi‘s Bearing Capacity Theory	Understand	CO 4	ACE018.20
2	Discuss in detail various types of bearing capacities	Understand	CO 4	ACE018.19
3	Explain in detail Meyerhof Bearing Capacity Theory	Remember	CO 4	ACE018.20
4	Write in detail about Indian Standard Bearing Capacity equation	Understand	CO 4	ACE018.20
5	Explain in detail plate load test.	Remember	CO 4	ACE018.20
6	What is the Safe bearing pressure based on N value?	Understand	CO 4	ACE018.20
7	Explain the Dynamic formulae for Estimating the load carrying	Remember	CO 4	ACE018.21

S. No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
	capacity of a single driven pile			
8	Explain the Static method for Estimating the load carrying capacity of a single pile driven in cohesive soil.	Understand	CO 4	ACE018.21
9	Explain the in- situ penetration tests for Estimating the load carrying capacity of a single driven pile	Remember	CO 4	ACE018.21
10	What are the effects of Effects of pile driving?	Understand	CO 4	ACE018.21
11	Explain how the Group capacity of piles can be found by different Methods	Understand	CO 4	ACE018.22
12	What is the load carrying of the pile group in sands and clays?	Remember	CO 4	ACE018.22
13	What is the load carrying capacity of the pile in cohesion less soil?	Remember	CO 4	ACE018.21
14	Estimate the settlement of Pile group	Understand	CO 4	ACE018.22
15	Estimate the settlement of foundation by plate load test.	Remember	CO 4	ACE018.21
	Part – C (Problem Solving and Critical Thinking)			
1	Design a strip footing for load bearing wall transmitting a force of 200kN/m proposed to be laid at a depth of 1.50 m below the G.L on a c-φ soil with c=40 kPa and φ=20°, γ=17kN/m3. Given N_C=11.80, Nq=3.90, Nγ=1.70.	Remember	CO 4	ACE018.19
2	A 2m wide square footing is laid at a depth of 1.2 m below the GL on a C- φ soil with c=40 kPa and φ=20°, γ=17kN/ m3. Given NC=11.80. Nq=3.90, Nγ=1.70. Using Terzaghi's theory, compute the ultimate bearing capacity (q) when the GWT is, 5 m below G.L At GL 2 m below G.L	Remember	CO 4	ACE018.20
3	Determine the ultimate bearing capacity of a strip footing, 1.5 m wide, with its base at a depth of 1m, resting on a dry sand stratum take γ_d=17kN/m^3, c'= 0 kPa and φ=38°. Use Terzaghi theory	Understand	CO 4	ACE018.20
4	Determine the ultimate bearing capacity of a footing, 1.5 m wide, with its base at a depth of 1m, resting on a dry sand stratum take γ_d=17kN/m^3, c'= 0 kPa and φ=38°. Use bearing capacity factors recommended by Meyerhof. Ignore Embedment effect.	Remember	CO 4	ACE018.20
5	Determine the ultimate bearing capacity of a strip footing, 1.5 m wide, with its base at a depth of 1m, resting on a sand stratum take γ_d=17kN/m^3, c'= 0 kPa and φ=32°. Use Terzaghi theory	Understand	CO 4	ACE018.20
6	Determine the ultimate bearing capacity of a strip footing, 1.5 m wide, with its base at a depth of 1m, resting on a sand stratum take γ_d=17kN/m^3, c'= 0 kPa and φ=32°. If GWT is located at a depth 0.5 m below GS b) At a depth 0.5 m below the base of footing γ_{sat}= 20 kN/m^3 . Use Terzaghi theory	Remember	CO 4	ACE018.20
7	Calculate net ultimate bearing capacity of a rectangular footing 2m X 4m in plan, founded at a depth 1.5 m below GL. The load on the footing is 200 kN/m^2. γ_{sat}= 18 kN/m^3 c'= 15 kPa and φ=25°. GWT is at 2m below GL. Use Terzaghi's theory.	Understand	CO 4	ACE018.20
8	A pile is driven with a single acting steam hammer of weight 15kN with a free fall of 900 mm. The final set, the average of the last three blows, is 27.5 mm. Find the safe load using the Engineering News Formula.	Remember	CO 4	ACE018.21
9	A pile is driven in uniform clay of large depth. The clay has unconfined compression strength of 90kN/ m^2. The pile is 30 cm diameter and 6 m long. Determine the safe frictional resistance of the pile, assuming a factor of safety of 3. Assume the adhesion factor = 0.7.	Understand	CO 4	ACE018.21
10	A group of 16 piles of 50 cm diameter is arranged with a centre to centre spacing of 1.0 m. The piles are 9 m long and are embedded in	Remember	CO 4	ACE018.22

S. No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
	soft clay with cohesion 30kN/m^2. Bearing resistance may be neglected for the piles—Adhesion factor is 0.6. Determine the ultimate load capacity of the pile group.		CO 4	
11	Design a square pile group to carry 400kN in clay with unconfined compression strength of 60kN/m^2. The piles are 30 cm diameter and 6 m long. Adhesion factor may be taken as 0.6.	Understand	CO 4	ACE018.22
12	A square pile 25 cm size penetrates soft clay with unit cohesion of 75kN/m^2 for a depth of 18 m and rests on stiff soil. Determine the capacity of the pile by skin friction. Assume an adhesion factor of 0.75.	Remember	CO 4	ACE018.22
13	A square pile group of 9 piles of 25 cm diameter is arranged with a pile spacing of 1 m. The length of the piles is 9 m. Unit cohesion of the clay is 75kN/ m2. Neglecting bearing at the tip of the piles determine the group capacity. Assume adhesion factor of 0.75.	Understand	CO 4	ACE018.22
14	Determine the group efficiency of a rectangular group of piles with 4 rows, 3 piles per row, the uniform pile spacing being 3 times the pile diameter. If the individual pile capacity is 100kN, what is the group capacity according to this concept?	Understand	CO 4	ACE018.22
15	A footing 4m X 2m in plan transmits a pressure of 150 kN/m^2 on a cohesive soil having E = 6 X 10^4 kN/m^2 and μ = 0.5. Determine the immediate settlement of the footing at the centre, assuming it to be a) flexible, b) Rigid footing	Understand	CO 4	ACE018.20
	UNIT V			
	WELL FOUNDATION			
	Part – A (Short Answer Questions)			
1	What is open caisson?	Understand	CO 5	ACE018.23
2	What is Pneumatic caisson?	Understand	CO 5	ACE018.23
3	What are the forces acting on well foundation?	Understand	CO 5	ACE018.23
4	Write the equation for allowable bearing pressure for well in cohesion less soil.	Understand	CO 5	ACE018.24
5	Define scouring	Remember	CO 5	ACE018.23
6	What is well cap?	Understand	CO 5	ACE018.23
7	What is Cutting Edge?	Understand	CO 5	ACE018.23
8	Name various Components of Well.	Remember	CO 5	ACE018.23
9	Write a note on floating caisson foundation.	Understand	CO 5	ACE018.23
10	How well foundations are classified?	Remember	CO 5	ACE018.23
11	Explain the process of well sinking.	Remember	CO 5	ACE018.24
12	What are the forces acting on well foundation?	Remember	CO 5	ACE018.23
13	Explain the design the criteria for well curb.	Remember	CO 5	ACE018.24
14	How skin friction effects the well sinking?	Remember	CO 5	ACE018.23
15	Discuss the various types of shapes of well foundations.	Remember	CO 5	ACE018.23
16	What is the procedure for sinking of pneumatic caisson?	Understand	CO 5	ACE018.23
17	Write a note on floating caisson foundation.	Understand	CO 5	ACE018.23
18	What is top plug?	Remember	CO 5	ACE018.23
19	What is Dredge hole?	Remember	CO 5	ACE018.23
20	What is bottom plug?	Remember	CO 5	ACE018.23
	Part - B (Long Answer Questions)			
1	Describe various types of caisson foundations and comment on their ability.	Remember	CO 5	ACE018.23
2	Explain in detail the procedure of sinking of well foundations.	Understand	CO 5	ACE018.23
3	Describe the component parts of a Pneumatic Caisson with a neat sketch.	Understand	CO 5	ACE018.23
4	What is a _Floating Caisson‘? How is its stability checked? What are the merits and demerits of a Floating Caisson when compared with other types?	Remember	CO 5	ACE018.23

S. No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
5	Discuss the various kinds of forces likely to act on a well foundation.	Remember	CO 5	ACE018.24
6	Discuss the different shapes of Cross-sections of wells used in practice, giving the merits and demerits of each.	Remember	CO 5	ACE018.23
7	Sketch and describe the various components of a well foundation, indicating the function of each.	Remember	CO 5	ACE018.23
8	What are the advantages and disadvantages of a Pneumatic Caisson when compared with other types?	Remember	CO 5	ACE018.23
9	Explain the various kinds of forces likely to act on a well foundation.	Remember	CO 5	ACE018.24
10	What are _Tilts and Shifts‘? What are the remedial measures to control these?	Understand	CO 5	ACE018.23
11	Explain the effect of water and earth pressure on well foundations.	Understand	CO 5	ACE018.24
12	How is the load-carrying capacity of an Open Caisson determined?	Remember	CO 5	ACE018.24
13	What are the merits and demerits of an Open Caisson?	Understand	CO 5	ACE018.23
14	Explain an _Open Caisson‘ with a neat sketch showing all the component parts.	Remember	CO 5	ACE018.23
15	Describe the –Scour Depth‖ ,‖Grip Length‖. How are they related in finalizing the depth of sinking of caissons?	Understand	CO 5	ACE018.24
	Part – C (Problem Solving and Critical Thinking)			
1	A circular well of 6m external diameter and 4m internal diameter is embedded to a depth of 15m below the maximum scour level in a sandy soil deposit. The well is subjected to a horizontal force of 800kN acting at a height of 8m above the scour level. Determine the allowable total equivalent resisting force due to the earth pressure assuming the rotation is about a point above the base. Take γsat = 30kN/m^3, φ = 20°, factor of safety for passive resistance = 2. Use Terzaghi‘s analysis.	Understand	CO 5	ACE018.24
2	A cylindrical well of external diameter 6 m and internal diameter 4 m is sunk to a depth 16 m below the maximum scour level in a sand deposit. The well is subjected to a horizontal force of 1000kN acting at a height of 8 m above the scour level. Determine the total allowable equivalent resisting force due to earth pressure, assuming that (*a*) the well rotates about a point above the base, and (*b*) the well rotates about the base. Assume γ‘=10kN/m^3, φ = 30°, and factor of safety against passive resistance = 2. Use Terzaghi‘s approach.	Remember	CO 5	ACE018.24
3	A square footing carries a load of 1000 kN. The depth of footing is 2 m. The properties of soil are C = 10 kPa and Φ= 48^0, γ = 19.5 kN/m^3. Determine the size of footing for FOS = 3 against shear failure. What will be changes in size of footing? If WT rises to G.L. Give that N_c = 42, N_q = 39 and N_γ = 45.	Understand	CO 5	ACE018.24
4	A circular well of 4.5 m external diameter and 0.75m steining thickness embedded to a depth of 12m in a sandy soil deposit. The properties of soil γsat = 30kN/m^3, φ = 30°. The well is subjected to a resultant horizontal force of 500kN and a moment of 400 kN-m at the scour level. Determine the allowable total equivalent resisting force due to the earth pressure. A FOS = 2 may be adopted for soil resistance. Determine the magnitude and point of maximum Bending moment at well steining.	Remember	CO 5	ACE018.24
5	Design a strip footing for a load bearing wall transmitting a force of 200 kN/m proposed to be laid at a depth of 1.5 m below GL on C-Φ soil with C = 40 kPa, Φ= 20^0, γ = 17 kN/m^3 given that N_c = 11.8, N_q = 3.9 and N_γ = 1.7.	Remember	CO 5	ACE018.24
6	A 2m wide square footing is laid at a depth of 1.2 m below G.L on C-Φ soil with C = 40 kPa and Φ= 20^0, γ = 17 kN/m^3. Give that N_c = 11.8, N_q = 3.9 and N_γ = 1.7. using Terzaghi‘s theory calculate bearing capacity when	Understand	CO 5	ACE018.24

S. No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes
	a) GWT is at 5 m below GL b) 2 m below GL c) At Gl. Assume change in parameters due to saturation is negligible.			
7	A continuous footing of width 2.5 m rests 1.5 m below GL in clay. The unconfined strength of clay is 150 kN/m^2. Calculate the ultimate bearing capacity of footing when there is no effect of water table and when W.T reaches GS. Take $\gamma = 17\ kN/m^3$ $\gamma_{sat} = 20\ kN/m^3$	Understand	CO 5	ACE018.24
8	A square footing carries a load of 800 kN. The depth of footing is 1.5 m. The properties of soil are C = 0 kPa and $\Phi = 38^0$, $\gamma = 18.5\ kN/m^3$. Determine the size of footing for FOS = 3 against shear failure. What will be changes in size of footing? If WT rises to G.L. Give that N_c = 52, N_q = 49 and N_γ = 64.	Remember	CO 5	ACE018.24
9	A 2m wide square footing is laid at a depth of 1.2 m below G.L on C-Φ soil with C = 30 kPa and $\Phi = 10^0$, $\gamma = 18\ kN/m^3$. Give that N_c = 12, N_q = 17 and N_γ = 25. using Terzaghi's theory calculate bearing capacity when a) GWT is at 2 m below GL b) 5 m below GL Assume change in parameters due to saturation is negligible.	Understand	CO 5	ACE018.24
10	A Cylindrical Well is of 6 m external diameter and 3.6 m internal diameter, and is to be sunk to a depth of 15 m below the scour level. It is subjected to a horizontal load of 600kN at a height of 9 m above the scour level. Determine the allowable resisting force due to earth pressure, using Terzaghi's approach assuming that (a) the well rotates about a point above base, and (b) the well rotates about the base. $\gamma' = 9.9kN/m3$; $\varphi = 30°$, and factor of safety against passive resistance = 2.5.	Remember	CO 5	ACE018.24

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