FINITE ELEMENTS

Q1: In two dimensional problems, the global stiffness matrix size is N × N, where N is: -

A- The number of elements.
B- The number of nods.
C- The total degrees of freedom of the structure.
D- The number of joints.

Q2: The physical constraint applied on the finite element model is defined as: -

A- Shape function.
B- Degree of freedom.
C- Boundary conditions.
D- loading type

Q3: Mesh convergence, in finite element method, is defined as a method that determines the number of _____ in the model to ensure that the strains and stress in the interested points will not be affected by decreasing the size of _____.

A- Degree of freedom, mesh.
B- Elements, mesh.
C- Mesh, element
D- Nodes, element.

Q4: Stresses due to rigid body motion are _____

A- Zero
B- Infinite
C- Considered
D- Not Considered

Q5: Finite element method uses the concept of _____

A- Shape function
B- Assembling
C- Nodes and elements
D- Nodal displacement

Q6: If the structure is divided into discrete areas or volumes then it is called an _____

A- Boundaries
B- Structure
C- Matrix
D- Element

Q7: In finite element modeling nodal points are connected by unique _____

A- Shape
B-Eigen values
C- Surface
D- Matrix

Q8: In one dimensional problem, each node has _____ degrees of freedom.

A- 2 degrees of freedom
B- No degrees of freedom
C- 3 degrees of freedom
D- 1 degree of freedom

Q9: Which relations are used in one dimensional finite element modeling?

A- Total potential energy; Stress-strain relation; Strain-displacement relation.
B- Stress-strain relation
C- Strain-displacement relation
D- Total potential energy

Q10: One dimensional element is the linear segments which are used to model _____

A- Solids
B- Bars and trusses
C- Plates and beams
D- Structures

Q11: Modeling is defined as _____

A- Elemental area with non-uniform cross section
B- Elemental area with uniform cross section
C- Structural area with uniform cross section
D- Nonstructural area with non-uniform cross section

Q12: The loading on an element includes _____

A- Point load
B- Body force
C- Traction force
D- Body force, Traction force & Point load

Q13: Global nodes corresponds to _____

A- On surface
B- On interface
C- Entire body
D- On element

Q14: For constant strain elements the shape functions are ____

A- Linear
B- Polynomial
C- Quadratical
D- Spherical

Q15: Finite element method uses the concept of _____

A- Assembling
B- Shape functions
C- Nodal displacement
D- Nodes and elements

Q16: For a triangular element, element displacement vector can be denoted as ___

A- $q= [q1, q2]^T$
B- $q= [q1, q2, q3]^T$
C- Load vector
D- $q= [q1, q2…q6]^T$

Q17: Element stiffness is obtained with respect to its ___

A- Degrees of freedom
B- Nodes
C- Axes
D- Elements

Q18: Linear combination of these shape functions represents a _____

A- Linear surface
B- Plane surface
C- Square surface
D- Combinational surface

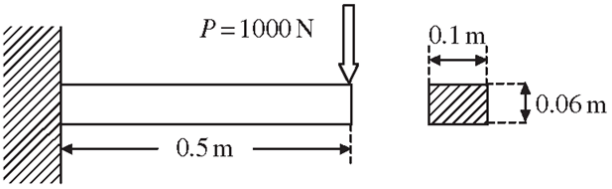
Q19: For plane stress or plane strain, the element stiffness matrix can be obtained by taking _____

A- Shape functions, N
B- Iso parametric representation, u
C- Material property matrix, D
D- Degrees of freedom, DoF

Q20: In finite element method, F} =[K] {d}, K is called:-

A- the member stiffness matrix in the local coordinate system
B- the member stiffness matrix in the global coordinate system
C- the element stiffness matrix in the global coordinate system
D- the structure stiffness matrix in the global coordinate system

Q21: Consider the cantilever beam as shown in Figure. The beam is fixed at one end. If P = 1000 N, use the Finite Element Method (FEM) to determine the end deflection of the cantilever beam? **Hint:** the modulus of elasticity is 69 GPa.



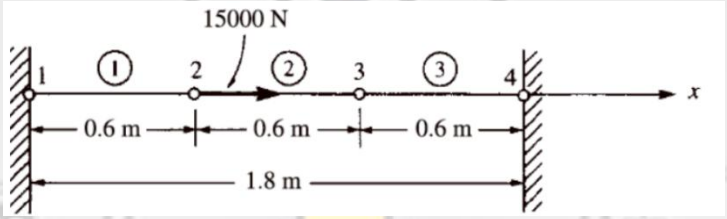
A- 0.1122 mm

B- 0.4455 mm.

C- 0.3355 mm

D- 0.2244 mm.

Q22: For the three-bar assemblage shown in the figure below, determine the displacement of node 2. A force of 1.5 kN is applied in the x direction at node 2. The length of each element is 0.6 m. Let E= 200 GPa and A= 600 mm^2 for element 1 and 2 and let E= 100 GPa and A= 1200 mm^2 for element 3. Nodes 1 and 4 are fixed.



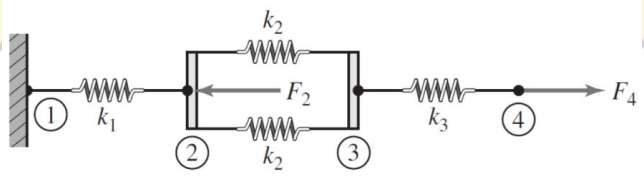
A- 0.05 mm

B- 0.1 mm

C- 0.15 mm

D- 0.2 mm

Q23: For the figure shown below, the vertical members at nodes 2 and 3 are to be considered rigid. determine the displacement of node 4 if: K_1=4 N/mm, K_2=6 N/mm, K_3=3 N/mm, F_2= -30 N, F_4=50N. Node 1 is fixed.



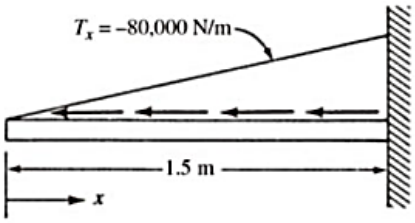
A- 0. 0025 mm

B- 2.5 mm

C- 5.0 mm

D- 0.005 mm

Q24: For the rod loaded axially as shown in figure below, determine the axial displacement at the free end. Let E= 200 GPa, A= 1250 mm^2, and L=1.5 m.



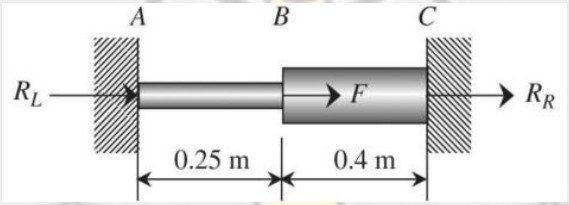
A- 0.15mm

B- 0.18 mm

C- 1.8 mm

D- 1.5 mm

Q25: Use finite element method to determine the reactions at the supports. Let E= 100 GPa, $A_{(AB)}$=100 mm^2, and $A_{(BC)}$=200 mm^2.



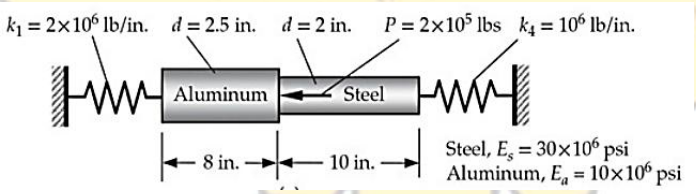
A- 4.44 kN, 5.55 kN

B- 3.33 kN, 5.55 kN

C- 4.44 kN, 2.22 kN

D- 2.22 kN, 3.33 kN

Q26: Determine the displacement in each spring. Neglect the weight of the bar and assume that the bar experiences only axial displacement.



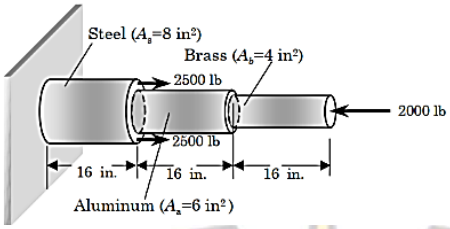
A- 0.0325 in, 0.075 in

B- 0.0125 in, 0.025 in

C- 0.0625 in, 0.025 in

D- 0.0625 in, 0.075 in

Q27: Find the stress Brass bar shown in figure below. $E_s=30\times10^6$ psi, $E_a=1\times10^6$ psi, and $E_b=15\times10^6$psi.



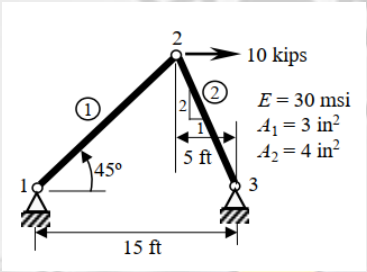
A- 250 psi

B- 350 psi

C- 500 psi

D- 300 psi

Q28: For the truss structure shown in figure below, determine the horizontal displacement at node 2.



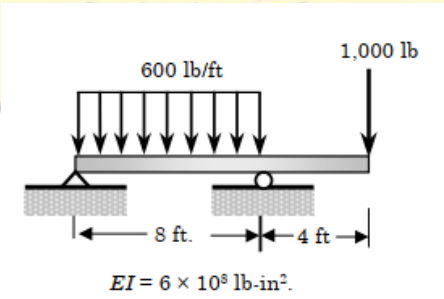
A- 0.023 in

B- 0.042 in

C- 0.035 in

D- 0.075 in

Q29: For the overhanging beam shown in figure below, determine the vertical displacement under point load 1000 lb.



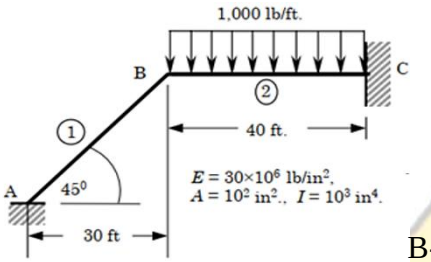
A- 0.1in

B- 0.2 in

C- 0.25 in

D- 0.15 in

Q30: For the frame shown in figure below, determine the rotation at point B.



A- 0.001

B- 0.0033

C- 0.0045

D- 0.0025

Advance Soil Mechanics

Q1: Which of the following boundary conditions is typically applied during a consolidated undrained (CU) triaxial test?

A. Constant volume throughout
B. Drained during shear
C. Undrained during shear
D. Constant deviator stress

Q2: In Critical State Soil Mechanics, which of the following statements correctly describes the **Critical State Line (CSL)** in *p′-q-v* space?

A. The CSL is curved in all projections
B. The CSL corresponds to the state of zero shear stress
C. The CSL defines the limit of elastic behavior in soils
D. The CSL is linear in *p′-q* space and logarithmic in *v-ln p′* space

Q3: Which of the following correctly describe the **Hvorslev Surface** in Critical State Soil Mechanics?

A. It represents the set of states from which an over consolidated sample can move parallel to the critical state in compression
B. It intersects the Critical State Line at the point of maximum void ratio
C. It is defined only for normally consolidated soils
D. It typically lies above the Critical State Line in *q-p′* space

Q4: In critical state soil mechanics, the critical state line (CSL) for sand is often approximated by:

A. A straight line in q-p' space passing through the origin
B. A line with slope M in q-p′ space where $q=Mp'$
C. A curve showing nonlinear relationship between q and p'
D. Independent of sand density

Q5: Which of the following soil parameters primarily governs the stiffness behavior before failure?

A. Plasticity index
B. Small-strain shear modulus G_{max}
C. Critical state friction angle
D. Ultimate shear strength

Q6: For slope stability analysis, which parameter primarily controls the **shear strength** of soil?

A. Small-strain shear modulus G_{max}
B. Cohesion c′c'c′ and friction angle ϕ′
C. Compressibility λ
D. Void ratio

Q7: A saturated clay sample is loaded isotopically from an effective stress of p'_1=100 kPa to p'_2=400 kPa. The **compression index** is λ=0.25, and the initial **void ratio** is e_1=1.0 What is the new void ratio e_2?

A. 0.75
B. 0.70
C. 0.65
D. 0.60

Q8: Which of the following best describes a **drained triaxial compression test** stress path in the p′p'p′-qqq space?

A. Vertical path, because q changes while p' remains constant
B. Horizontal path, because p' changes and q remains constant
C. Linear upward path due to simultaneous increase in p' and q.
D. Curved path approaching the critical state line without increasing q.

Q9: Which of the following best describes the stress condition at failure in critical state soil mechanics?

A. Maximum total stress
B. Maximum volumetric strain
C. Constant effective stress ratio
D. Zero pore pressure

Q10: A normally consolidated clay is tested in a **drained triaxial compression test**. Which of the following conditions must be true at the **critical state**?

A. Volumetric strain continues to increase
B. The stress ratio q/p' is constant and equal to M
C. Effective stress continues to increase
D. The sample gains strength with further shear strain

Q11: Which of the following factors most significantly influence the peak strength of sand?

A. Void ratio and particle shape
B. Soil mineralogy and pH
C. Water viscosity and temperature
D. Organic content and salt concentration

Q12: During unloading, an overconsolidated soil's mean effective stress reduces from 400 kPa to 100 kPa. Using the elastic bulk modulus K=5000 kPa, estimate the volumetric strain ϵ_v during unloading assuming linear elasticity:

A. −0.06
B. −0.08
C. 0.060
D. 0.080

Q13: In soil mechanics, the **stress path** before failure in an undrained triaxial test is primarily influenced by:

A. Initial void ratio and drainage conditions
B. Soil mineralogy and temperature
C. Depth of water table
D. Type of pore fluid

Q14: In an **undrained test on saturated clay**, which of the following stress path behaviors is expected in the p′-q plane?

A. Vertical line due to constant mean effective stress
B. Horizontal line due to constant deviator stress
C. Curved path due to change in pore pressure and constant total stress
D. Radial line from the origin since both qqq and p′p'p′ increase proportionally

Q15: When a normally consolidated soil is subjected to isotropic loading beyond its yield stress, which behavior is typically observed?

A. Elastic expansion with reversible deformation
B. Plastic contraction with significant decrease in void ratio
C. Shear dilation without any volume change
D. Purely elastic behavior with recoverable strains

Q16: An overconsolidated clay sample has:

- Preconsolidation pressure $p_c' = 400$ kPa
- Current mean effective stress $p' = 100$ kPa
- Stress ratio at critical state $M = 1.2$

During an undrained triaxial test, the deviator stress q reaches 180 kPa. What is the current stress ratio q/p', and does it exceed the critical state stress ratio?

A. $q/p' = 1.8$, exceeds M
B. $q/p' = 1.5$, exceeds M
C. $q/p' = 1.8$, does not exceed M
D. $q/p' = 1.5$ does not exceed M

Q17: Which of the following best describes the typical volumetric behavior of normally consolidated clay during shearing before failure?

A. Volume remains constant
B. Volume decreases (contraction)
C. Volume increases (dilation)
D. Volume first decreases then increases

Q18: An overconsolidated clay has an initial mean effective stress $p'_i = 400$ and is unloaded to $p_o' = 100$kPa, then tested in undrained triaxial compression. Given the CSL equation $q = Mp'$, and the Hvorslev surface describes behavior at higher stress ratios than CSL, which of the following must be true?

A. The sample's stress path will exceed $q/p' = M$ before reaching critical state
B. The sample will never reach the critical state
C. The sample will shear at a constant stress ratio less than M
D. The sample will collapse in drained conditions at p'_o

Q19: During a drained triaxial test on dense sand, which behavior is typically observed?

A. Initial contraction followed by dilation
B. Constant volume throughout shear
C. Immediate dilation from the start of shear
D. Volume increase followed by volume decrease

Q20: Before failure, the shear strength of soil is best described by:

A. Peak shear strength only
B. Residual shear strength only
C. Both peak and mobilized shear strength depending on strain level
D. Undrained shear strength only

Q21: Which soil parameter is most critical for estimating **bearing capacity** of foundations?

A. Plasticity index
B. Effective friction angle ϕ'
C. Permeability coefficient
D. Void ratio

Q22: Which of the following best describes the **Normal Compression Line (NCL)** in an *e–ln p′* plot for saturated clays?

A. A curved line representing elastic response under loading
B. A horizontal line indicating constant void ratio during compression
C. A straight line with negative slope indicating plastic compression
D. A vertical line indicating increasing stress without change in void ratio

Q23: Which of the following statements **correctly distinguishes** the **Cambridge Simple Shear apparatus** from the **NGI Simple Shear apparatus**?

A. The NGI apparatus allows application of vertical stress under constant volume, while the Cambridge version maintains constant vertical strain.
B. In the Cambridge apparatus, the sample is sheared at constant vertical stress, whereas in the NGI device, the vertical stress is uncontrolled.
C. The Cambridge apparatus permits measurement of pore pressure, unlike the NGI apparatus.
D. The NGI apparatus applies shear through rotation of the base, while the Cambridge apparatus applies vertical loading only.

Q24: A saturated normally consolidated clay follows the critical state relationship:

$v = \Gamma - \lambda \ln p'$

where:

- $\Gamma = 2.3$, $\lambda = 0.13$, $p' = 200$ kPa

What is the specific volume v at critical state?

A. 1.61
B. 1.85
C. 2.00
D. 2.15

Q25: **Which shear test provides the most control over drainage and pore pressure measurement?**

A. Direct shear test
B. Simple shear test
C. Triaxial shear test
D. Ring shear test

Q26: Which parameter is used to estimate **settlement** under a load in clayey soils?

A. Critical state parameter M
B. Compression index Cc
C. Effective friction angle ϕ'
D. Undrained shear strength Su

Q27: Which of the following best describes the behavior of loose sand during drained triaxial shearing?

A. Contractive behavior with an increase in volume
B. Dilative behavior with a decrease in volume
C. Contractive behavior with a decrease in volume
D. Dilative behavior with an increase in volume

Q28: In a direct shear test, failure occurs along:

A. The weakest natural plane
B. A randomly developed failure surface
C. A predetermined horizontal plane
D. A vertical plane of maximum stress

Q29: Regarding the **Roscoe Surface** in critical state theory, which of the following statements is correct?

A. It represents states leading to the critical state from overconsolidated soils
B. It is a surface of constant specific volume
C. It represents the boundary of yielding in normally consolidated soils
D. It lies entirely below the CSL in *v-ln p'* space

Q30: An **overconsolidated clay** sample is tested in **undrained triaxial compression**. Which of the following behaviors are likely to occur before reaching the critical state?

A. Decrease in pore pressure
B. Increase in specific volume
C. Shear stress decreases with axial strain
D. The stress path curves toward the Hvorslev surface after reaching the CSL

Advanced Concrete Design

1- In a reinforced concrete beam with plain round bars and no chemical adhesion, which phenomenon would most likely occur under flexural loading?

2- A beam reinforced with deformed bars exhibits wide flexural cracks and excessive deflection. What bond-related mechanism is most likely compromised?

3- Splitting failures along reinforcement are primarily caused by:

4- Which factor has the most significant impact on reducing required development length for tensile reinforcement?

5- In a beam with lightweight concrete, why might development lengths need to be increased compared to normalweight concrete?

6- A hooked bar fails by splitting the concrete in the plane of the hook. Which design detail could best mitigate this failure?

7- Why do epoxy-coated bars require longer development lengths compared to uncoated bars?

8- In a beam with excess reinforcement, why can the development length be reduced?

9- A beam with closely spaced bars and minimal cover fails prematurely due to bond. Which failure mode is most likely?

10- What is the primary role of the "tail extension" in a standard 90° hook?

11. In reinforced concrete beams, primary (equilibrium) torsion is distinguished from secondary (compatibility) torsion by:

12. The cracking torque *Tcr* for a solid rectangular beam depends primarily on:

13. In the space truss analogy for torsion, the diagonal concrete struts resist:

14. For a beam subjected to combined shear and torsion, the critical shear stress limit is governed by:

15. The closed stirrups required for torsion are most critical for:

16. The longitudinal reinforcement in torsional design is primarily required to:

17. In a hollow section subjected to torsion, the critical location for checking shear stress is:

18. The torsional moment *Tu* in compatibility torsion may be reduced during design because:

19. When designing for combined shear and torsion, the minimum area of transverse reinforcement is governed by:

20. The anchorage of closed stirrups in torsional reinforcement requires 135° hooks primarily to:

21. In a spirally reinforced column, the primary reason for the higher strength reduction factor (φ = 0.75) compared to tied columns (φ = 0.65) is:

22. For a rectangular column under eccentric loading, the balanced failure condition occurs when:

23. In the interaction diagram of a column, the region where increasing axial load reduces the moment capacity corresponds to:

24. The plastic centroid of an unsymmetrically reinforced column is defined as:

25. Which statement about spiral reinforcement in columns is false?

26. A column with distributed reinforcement (bars placed uniformly around the perimeter) subjected to large eccentricity will most likely experience:

27. In the strain compatibility analysis of a column, if the neutral axis depth c is greater than the balanced condition depth cb , the failure mode is:

28. The confinement stress $f2'$ provided by spiral reinforcement is directly proportional to:

29. For a column with lightweight concrete, the required development length for longitudinal bars is increased primarily because of:

30. In a tied column with minimal eccentricity, sudden failure is characterized by:

31. A column fixed at both ends in a braced frame typically has an effective length factor *k* closest to:

32. For unbraced columns, ACI allows ignoring slenderness effects if *klu*/*r* is less than:

33. Calculate the moment magnification factor *δns* if *Cm*=0.8, *Pu*=1500kN, and *Pc*=8000kN:

34. A column with $EI=2\times10^{10}$kN-mm^2, *k*=1.2, and *lu*=4m. Its critical load *Pc* is closest to:

35. The term *βdns* in nonsway frames accounts for:

36. In sway frames, secondary moments primarily:

37. As a column becomes more slender, its interaction diagram shifts inward because:

38. The equation *EI*=0.4*EcIg*/ 1+*βdns* is conservative because it:

39. The ACI requires $M_{2,min}$ to address:

40. If *Q*=0.15, the sway moment magnification factor *δs* is approximately:

41. A D-region in a reinforced concrete member is defined as a portion:

42. Which statement about bottle-shaped struts is false?

43. A nodal zone resisting three compressive forces is classified as:

44. The effective compressive strength *fce* for a bottle-shaped strut with transverse reinforcement is:

45. For deep beams, the minimum horizontal reinforcement *Avh* must satisfy:

46. If the anchorage length of a tie exceeds the extended nodal zone, the ACI Code requires:

47. A hydrostatic nodal zone is designed to ensure:

48. According to ACI Code 11.8.3, the maximum nominal shear strength *Vn* for a deep beam is:

49. Transverse reinforcement in bottle-shaped struts is primarily used to:

50. An efficient strut-and-tie model prioritizes:

Advanced Foundation Engineering

1. In the Standard Penetration Test (SPT), what does a high N-value generally indicate about the soil?

A. The soil is very loose and soft

B. The soil is saturated with water

C. The soil is dense and compact

D. The soil has high organic content

2. The Cone Penetration Test (CPT) is best suited for which type of soils?

A. Very gravelly soils

B. Hard rocks

C. Soft to medium stiff cohesive soils

D. Organic peat

3. Which of the following parameters can be directly obtained from a Pressuremeter Test?

A. Liquid Limit

B. Soil Permeability

C. In-situ horizontal stress

D. Plasticity Index

4. The depth of foundation should be greater than the width of the foundation to:

A. Avoid punching shear failure

B. Minimize settlement

C. Improve accessibility

D. Prevent differential settlement

5. According to Terzaghi's bearing capacity theory, which term accounts for soil shear strength?

A. Shape factor

B. Cohesion term (cNc)

C. Depth factor

D. Unit weight term (0.5γBNγ)

6. In CPT, what is the significance of the friction ratio?

A. Indicates soil compressibility

B. Helps classify soil type

C. Measures groundwater level

D. Determines soil suction pressure

7. Which assumption is NOT part of Terzaghi's bearing capacity theory?

A. Soil is homogeneous and isotropic

B. Load is applied eccentrically

C. Failure surface is well-defined

D. Foundation is shallow

8. What is the impact of groundwater table at footing base on bearing capacity?

A. Increases effective stress

B. Decreases unit weight of soil above water table

C. Reduces effective stress and bearing capacity

D. Has no significant impact

9. For pressuremeter tests, Menard pressuremeter modulus is defined as:

A. The slope of the unloading curve

B. The ratio of applied pressure to cavity strain

C. The area under the pressure-strain curve

D. None of the above

10. A drilled pier is more suitable than a driven pile when:

A. Groundwater is high

B. Minimal noise and vibration are required

C. Dense gravels are present

D. Rapid construction is needed

11. Which of the following statements best explains why the Pressuremeter Test provides more reliable in-situ stress-strain behavior of soil compared to SPT and CPT?

A. It measures soil resistance through direct penetration.

B. It uses dynamic impact loading for soil strength estimation.

C. It allows controlled lateral expansion of the probe to measure deformation.

D. It requires undisturbed samples to determine the modulus of elasticity.

12. When determining the depth of foundation using the criterion of minimum depth to avoid seasonal moisture variation, which parameter plays the most critical role?

A. **Groundwater table level**

B. **Plasticity Index of the soil**

C. **Average annual rainfall**

D. **Depth of frost penetration**

13. Which of the following corrections is NOT required while interpreting SPT N-values for granular soils below the water table?

A. **Overburden pressure correction**

B. **Dilatancy correction**

C. **Hammer energy correction**

D. **Effective stress correction**

14. According to Meyerhof's theory, which factor primarily governs the shape factor in ultimate bearing capacity for rectangular footings?

A. **Depth of foundation**

B. **Length to width ratio of the footing**

C. **Type of soil**

D. **Soil cohesion**

15. In the settlement prediction, the immediate settlement for a footing on a clayey soil is primarily influenced by:

A. **Primary consolidation characteristics**

B. **Coefficient of secondary compression**

C. **Elastic modulus of soil and Poisson's ratio**

D. **Permeability of the clay layer**

16. Which failure mechanism is most commonly observed in drilled pier foundations in expansive clay zones?

A. **End bearing failure**

B. **Negative skin friction failure**

C. **Swelling pressure-induced uplift**

D. **Piping failure at the base**

17. Which of the following conditions is most critical for settlement estimation in layered soils?

A. The consolidation coefficient of the bottommost layer
B. The thickness and compressibility of the most compressible layer
C. The permeability contrast between layers
D. The depth to the water table

18. Skin friction along the shaft of drilled piers is most effective in:

A. Gravelly soils

B. Soft clay

C. Loose sand

D. Stiff clay or dense sand

19. Which of the following factors primarily governs the selection of a safe bearing pressure for a foundation subjected to both vertical and moment loads?

A. Total applied load and moment magnitude
B. Soil shear strength and eccentricity of loading
C. Foundation size and soil permeability
D. Factor of safety and allowable settlement

20. The underreamed base in drilled piers is used to:

A) Reduce settlement

B) Enhance uplift resistance

C) Increase end bearing area

D) All of the above

21. Main concern in drilled pier construction is:

A. Shrinkage

B. Excessive uplift

C. Borehole wall caving

D. Vibration

22. Immediate settlement occurs in:

A. Saturated clay
B. Dry sand
C. Loose gravel
D. Dry or saturated soil under elastic compression

23. Which of the following parameters is directly measured in a cone penetration test (CPT)?

A. Shear strength
B. Pore-water pressure
C. Cone resistance
D. Void ratio

24. In pressuremeter testing, the unload-reload modulus primarily represents:

A. Initial stiffness of soil
B. Shear modulus
C. Consolidation modulus
D. Elastic modulus

25. The net ultimate bearing capacity is defined as:

A. Total capacity including overburden
B. Net pressure applied minus overburden
C. Gross capacity including footing weight
D. Minimum pressure to prevent failure

26. What does the CPT sleeve friction indicate?

A. Soil cohesion
B. Relative density
C. Pile skin friction
D. Soil sensitivity

27. Which of the following construction defects in drilled piers is most critical and often undetectable without specialized testing?

A. Over-excavation of the borehole

B. Use of tremie concrete

C. Soil caving during casing withdrawal

D. Incomplete cleaning of the base

28. In a drilled shaft bearing on stiff clay, which failure mechanism is most likely under axial compression?

A. Punching shear failure at the base

B. General shear failure of surrounding clay

C. Shaft buckling

D. Combined base and skin friction failure

29. The load transfer in drilled piers under uplift loads primarily depends on:

A. End bearing resistance

B. Shaft adhesion and friction

C. Tip grouting pressure

D. Poisson's effect on pile shaft

30. Drilled shafts constructed in expansive clay soils must account for:

A. Increased end bearing capacity

B. Reduced overburden pressure

C. Negative skin friction due to heave

D. Positive side friction due to suction

seepage

1. What is the definition of seepage in soil?
A. Movement of air in soil pores
B. Flow of water through connected voids in soil
C. Compression of soil particles
D. Settlement of structures

2. Which condition must be met to apply Darcy's Law?
A. High Reynolds number
B. Laminar flow
C. Turbulent flow
D. Fully saturated air gaps

3. Which of the following factors affects permeability?
A. Soil color
B. Grain size distribution
C. Soil pH
D. Wind speed

4. What does the seepage velocity represent?
A. Water velocity outside the soil
B. Theoretical flow through a pipe
C. Actual water velocity through soil pores
D. Speed of rainfall

5. What is the hydraulic gradient?
A. The ratio of temperature to viscosity
B. The change in head per unit length
C. A type of soil test
D. Change in water content

6. What is the role of a flow net?
A. Estimate wind velocity
B. Graphical method to analyze two-dimensional flow
C. Test pore pressure
D. Measure surface runoff

7. How do equipotential lines interact with flow lines?
A. They run parallel
B. They intersect at 45°
C. They intersect at 90°
D. They never meet

8. What is porosity?
A. Ratio of solids to voids
B. Ratio of voids to total volume
C. Ratio of solids to water
D. Ratio of permeability to head loss

9. What happens when the effective stress in soil becomes zero?
A. Soil becomes denser
B. Static liquefaction may occur
C. Water drains out
D. Soil expands

10. Which test is suitable for fine-grained soils?
A. Constant head test
B. Falling head test
C. Triaxial test
D. Proctor test

11. What causes capillary rise in soils?
A. Water temperature
B. Electrostatic repulsion
C. Adhesion and cohesion forces
D. Surface dryness

12. What is the function of a sheet pile wall in seepage control?
A. Measure velocity
B. Reduce flow path
C. Increase porosity
D. None of the above

13. Darcy's law becomes invalid at:
A. Reynolds number < 1
B. Reynolds number > 10
C. Saturation = 100%
D. Porosity = 0.4

14. Which of the following increases permeability?
A. Smaller particle size
B. Higher degree of saturation
C. Decreased temperature
D. Higher viscosity

15. Which factor affects capillary height the most?
A. Soil moisture
B. Void ratio
C. Pore size
D. Grain shape

16. Which formula is used for Reynolds number in soils?
A. Re = μρvd
B. Re = ρvd/μ
C. Re = vρμ/d
D. Re = dμ/ρv

17. Flow lines in a flow net represent:
A. Zones of equal pressure
B. Paths followed by water particles
C. Layers of different soil
D. Contours of elevation

18. How many families of curves are in a flow net?
A. One
B. Two
C. Three
D. Four

19. What happens if i > icr?
A. Piping may occur
B. Flow stops
C. Saturation decreases
D. Viscosity increases

20. What is the main reason for drawing equipotential lines?
A. Track surface flow
B. Calculate soil weight
C. Show hydraulic head
D. Measure capillary rise

21. Given k = $1e^{-4}$ m/s, i = 0.5, A = 2 m^2. What is q?
A. $1e^{-4}$ m^3/s
B. $1e^{-5}$ m^3/s
C. $1e^{-3}$ m^3/s
D. $2e^{-4}$ m^3/s

22. Total head at A = 6 m, at B = 2 m, distance = 2 m. What is i?
A. 1
B. 2
C. 3
D. 0.5

23. Porosity = 0.35, seepage velocity = 0.007 m/s. What is Darcy velocity?
A. 0.002 m/s
B. 0.005 m/s
C. 0.00245 m/s
D. 0.001 m/s

24. In a constant-head test, Q=350 cm^3, A=100 cm^2, h=50 cm, L=25 cm, t=150 sec. Find k (cm/sec):
A. 0.0003
B. 0.0093
C. 0.0001
D. 0.003

25. In a falling-head test: a=1, A=20, L=15, h1=60, h2=20, t=180. Find k:
A. 0.00015
B. 0.00045
C. 0.00075
D. 0.001

26. D10 = 0.3 mm. What is k using $k = 100(D10)^2$?
A. 0.009 cm/s
B. 0.002 cm/s
C. 0.001 cm/s
D. 0.004 cm/s

27. Total head = 6.2 m, pressure head = 0.8 m. What is elevation head?
A. 5.4 m
B. 5.0 m
C. 5.2 m
D. 5.6 m

28. i = 1.2, k = $2e^{-5}$ m/s, n = 0.4. Find Vs:
A. $6e^{-5}$ m/s
B. $4e^{-5}$ m/s
C. $2e^{-5}$ m/s
D. $3e^{-5}$ m/s

29. Flow net: H=5m, Nf=4, Nd=5, k=1e^{-5}. Find q:

A. 2e^{-5}
B. 1e^{-5}
C. 4e^{-5}
D. 3e^{-5} m^3/s/m

30. Layers with k1=1e^{-4}, k2=2e^{-5}, k3=5e^{-5} (equal thickness). Find horizontal k_eq:

A. 4.5e^{-5}
B. 6e^{-5}
C. 3.5e^{-5}
D. 2e^{-5}

Mechanics of Solids

1. For a cylindrical steel vessel of mean diameter (D) and wall thickness of (t) . The longitudinal stress is equal to :

A. $\sigma_h = \sigma_l$ B. $\sigma_l = 4\,\sigma_h$ C. $\sigma_l = 2\sigma_h$ D. $\sigma_l = 4\,\sigma_h$

2. The term of (Shearing Strain) it is symbolized by :

A. τ_{max} B. γ_{xy} C. J D. q

3. The term (ω_{xy}) is defined as a :

A. Angle of twist
B. Rigid –body rotation
C. Ratio of Shearing strain to the normal strain
D. Axial deformation

4. The mathematical symbol (ϕ) in two - dimensional problems , denotes for :

A. plates deflection
B. stress resistance
C. stress function
D. strain distribution

5. The theory of maximum distortion (or shear) energy , is defined by :

A- Von Mises theory
B - Rankine theory
C- Tresca theory
D - Hook's theory

6. A displacements in a deformed body (in x y –plane) are given by:

$u = 0.008\,x^2 y + 0.04$, $v = 0.02\,y^2 + 0.05\,x\,y$? The shearing strain at a point $(0.75, 2.25)$, is equal to :

A- (0.212) B - (0.065) C- (0.117) D - (0.025)

7. If the displacements in a deformed raft foundation of the pier (in x y – plane) are given by :

$u = 0.005\, x^2 y + 0.02$, $v = 0.01\, y^2 + 0.003\, x^2 y$? The strains and the rigid body rotation at a point (0.6 , 0.3) ; are equal to :

8. A semi-infinite elastic plate (of unit width) is under a pressure (p) on the left side of the top surface as shown in the Fig. Try the stress function : $\phi = -\frac{P}{2\pi} r^2 (\theta - \frac{1}{2} \sin 2\theta)$; Where $\nabla^2 = (\partial^2/\partial r^2 + 1/r \cdot \partial/\partial r + 1/r^2 \cdot \partial^2/\partial \theta^2)$. The σ_r – value equal to :

A- $\varepsilon_x = 0.0018$, $\varepsilon_y = 0.00708$ And ω_{xy} = 0.00036 rad.

B - $\varepsilon_x = 0.0045$, $\varepsilon_y = 0.0035$ And ω_{xy} = 0.00081 rad.

C- $\varepsilon_x = 0.0077$, $\varepsilon_y = 0.00975$ And ω_{xy} = 0.00022 rad.

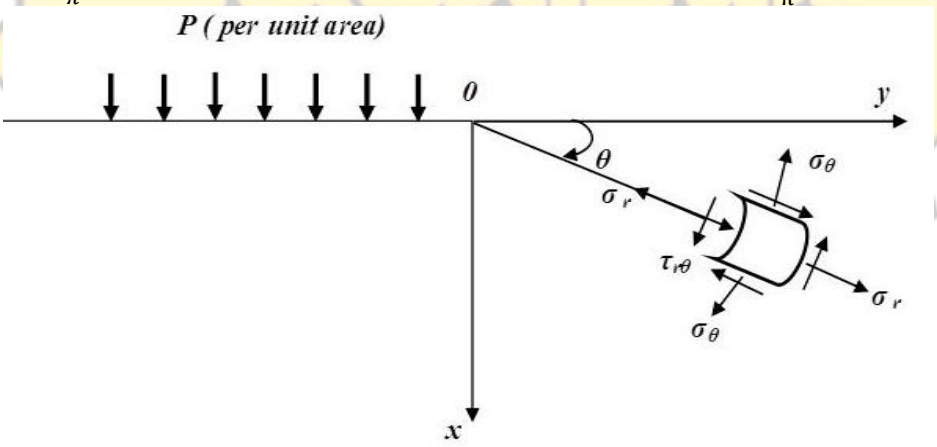
D - $\varepsilon_x = 0.0025$, $\varepsilon_y = 0.00453$ And ω_{xy} = 0.00015 rad.

A- $\sigma_r = -\frac{2P}{\pi} (\theta + \frac{1}{2} \sin 2\theta)$

B - $\sigma_r = \frac{P}{2\pi} (1 - \cos 2\theta)$

C- $\sigma_r = -\frac{4P}{\pi} (\theta + \frac{1}{2} \cos 2\theta)$

D - $\sigma_r = -\frac{P}{\pi} (\theta + \frac{1}{2} \sin 2\theta)$



9. In a semi - infinite elastic plate under a pressure on the top surface , the stresses in polar coordinates are :

A- σ_θ and $\tau_{r\theta}$.

B - σ_r , σ_θ and $\tau_{r\theta}$.

C- σ_r and σ_θ .

D - σ_r and $\tau_{r\theta}$.

10. The term J is defined as a :

A- Shear flow

B - Rigid body rotation

C- Torsional Constant

D – Axial strain

11. For the closed- thin walled square tubing section? If the tube dimensions are (200 × 200 mm) and the wall thickness is (t = 4 mm) , thus (J) - value is equal to :

A- (32.703×10^6 mm^4)

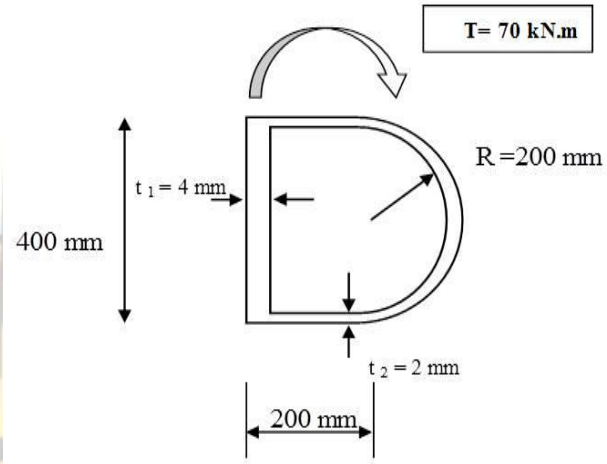
B - (27.179×10^6 mm^4)

C- (26.703×10^6 mm^4)

D - (41.753×10^6 mm^4)

12. A steel tube of length (L = 1.8m) and closed combined section as shown, Fig.(2), is under a torque of 70 kN.m at free end and fixed at the other end. Calculate the angle of twist ?

Use G=100 GPa.(where 1GPa =10 ^{3} MPa).



A- ɵ = 0.00234 rad

B - ɵ = 0.01058 rad

C- ɵ = 0.0754 rad

D - ɵ = 0.00948 rad

13. A steel boiler has a diameter of (2.0 m) and height (6 m). The wall thickness is 4 mm and the yield stress of steel is 310 MPa. Also, E=200GPa and v = 1/3. Use Rankin or Tresca criteria of failure to calculate the safe internal pressure , which is equal to :

A- 1.24 MPa

B - 2.75 MPa

C- 1.56 MPa

D - 3.25 MPa

14. The term ω_{xy} is defined as a :

A- Angle of twist

B - Ratio of Shearing strain to the normal strain

C- Axial deformation

D - Rigid –body rotation

15. A volumetric strain term ($\varepsilon_{vol.}$) it is used in :

A- plain strain problems

B - two - dimensional pressure problems

C- hydrostatic pressure problems

D - linear strain problems

16. A shear flow (q) value it is defined by :

A- τ and σ

B - τ and ε

C- E and σ

D - τ and t

17. A reinforced concrete circular raft foundation of (0.5 m) thickness and $\gamma_c = 24\ kN/m^3$, supports a circular water tank of (3.8 m) water table height and (10 m) of diameter? The maximum compressive stress on the soil under the tank foundation at center is equal to :

A- $\sigma_c = 64.5\ kN/m^2$

B- $\sigma_c = 49.3\ kN/m^2$

C- $\sigma_c = 54.7\ kN/m^2$

D- $\sigma_c = 38.5\ kN/m^2$

18. If the displacements in a deformable steel plate (in $x\ y$ – plane) are given by :

$u = 0.007\ x^2\ y + 0.02\ y$, $v = 0.01\ x\ y^2 + 0.005\ x^2\ y$? The rigid body rotation at a point (0.75 , 0.45) is equal to :

A- $\omega_{xy} = 0.009752$ rad.

B- $\omega_{xy} = 0.002471$ rad.

C- $\omega_{xy} = 0.006556$ rad.

D- $\omega_{xy} = 0.003765$ rad.

19. A spherical steel vessel of mean diameter (5.5 m) , wall thickness (4 mm) will be filled by a high pressure gas , the yield strength is 414 MPa , also E = 200 GPa and v = 1/3 . The maximum safe pressure equal to :

A- $p = 1.204\ MPa$
B- $p = 1.465\ MPa$
C- $p = 1.652\ MPa$
D- $p = 1.123\ MPa$

20. The equation shown here in : $G = \frac{E}{2(1+v)}$, deals with :

A- Modulus of Elasticity
B- Stiffness Ratio
C- Modulus of Rigidity
D- Torsional Capacity

21. The equation shown here in : $J = \frac{1}{3} b.t^3$; deals with :

A- Torsion constant for rectangular section
B- Torsion constant for thin rectangular section
C- Torsion constant of circular section
D- Torsion constant of any section

22. For the closed thin-walled sections (or cells) , the term (q) is defined as :

A- Normal stress
B- Enclosed area
C- Applied torsion
D- Shear flow

23. A (11×11) m reinforced concrete raft foundation of 0.7 m thickness , supports a 9 - R.C. columns , distributed at 5 m span in both direction (c-c) , where each one column carry a 240 kN ? Determine the maximum compressive stress on a soil under the critical loading area of the foundation ? $\gamma_c = 24\ kN/m^3$.

A- $\sigma_c = 26.4\ kN/m^2$
B- $\sigma_c = 17.75\ N/m^2$
C- $\sigma_c = 34.55\ kN/m^2$
D- $\sigma_c = 48.5\ kN/m^2$

24. A (4 – bolts) of mean diameter 20 mm are used to connect the steel plates of a cylindrical vessel ? Bolts under a tensile force of 120 kN , fy = 414MPa , the safe shearing force on the bolt according to Rankin theory equal to :

A. $V_{safe} = 130.55$ kN B. $V_{safe} = 114.07$ kN C. $V_{safe} = 94.75$ kN D. $V_{safe} = 75.25$ kN

25. The equation shown here in : $J = \frac{1}{3} b.t^3$; deals with :

A. Torsion constant for rectangular section
B. Torsion constant for thin rectangular section
C. Torsion constant of circular section
D. Torsion constant of any section

26. For the closed- thin walled tubing section? If the interior diameter is (D = 150 mm) and the wall thickness is (t = 4 mm) , thus (J) - value is equal to :

A. J = (32.703×10^6 mm^4) B. J = (21.346×10^6 mm^4)

C. J = (10.602×10^6 mm^4) D. J = (17.746×10^6 mm^4)

27. In a rectangular block of stresses , the maximum shearing stress is equal to :

A. ($\tau_{max} = \sigma_{max} - \sigma_{min}$) B. $\tau_{max} = 1/2(\sigma_{max} - \sigma_{min})$

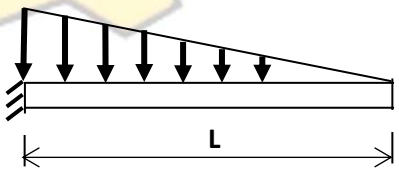
C. $\tau_{max} = (\sigma_{max} - \sigma_{min})^2$ D. $\tau_{max} = (\sigma_{max} - \sigma_{min})^{1/2}$

28. The term $c \int ds/t$, defined by :

A. constant perimeter B. contour integral C. determinate integral D. partial integral

29. For the Cantilever beam shown , the maximum bending moment equal to :

($q = q_o$)



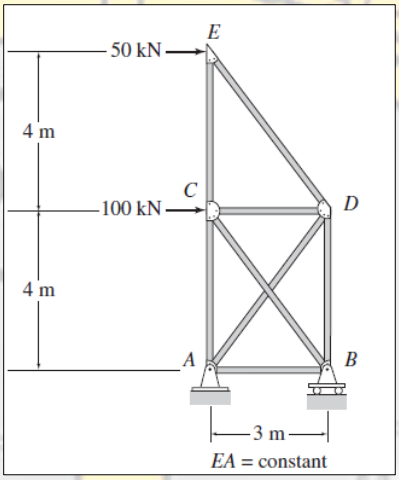
A. $M=(q_o L^2 / 4)$ B. $M= (q_o L^2 / 2)$ C. $M=(q_o L^2 / 6)$ D. $M=(q_o L^2 / 8)$

30. The tube of diameter (40 mm) and wall thickness (2mm) is under a torque of T=3kN.m. The shear flow equal to :

A. 1940 N/mm B.1256 N/mm C. 1473 N/mm D. 1652 N/mm

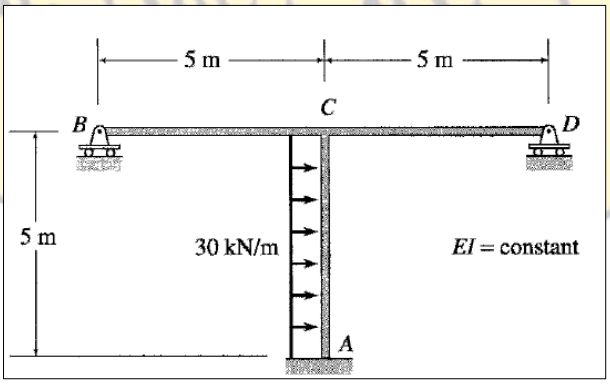
Advanced Structures

Q1: The degrees of freedom of the plane truss using matrix stiffness method is



A- 5 B- 7
C- 6 D- 8

Q2: The degrees of freedom of the frame using matrix stiffness method is:



A- 6 B- 8
C- 7 D- 9

Q3: Q=ku, u in equation is represent the:

A- Global displacements vector
B- Global forces vector
C- Local forces vector
D- Local displacements vector

Q4: A ----------is a rectangular array of quantities arranged in rows and columns that is often used to aid in expressing and solving a system of algebraic equations.

A- vector
B- matrix
C- vectors
D- matrix's

Q5: The expression for the frame stiffness coefficient is

A- $k = \frac{EI}{L}$
B- $k = \frac{EA}{D}$
C- $k = \frac{EA}{I}$
D- $k = \frac{EG}{L}$

Q6: The term '----------' refers to rotations and displacements that are associated with each joint.

A- unknown
B- unknowns
C- degrees of freedom
D- degree of freedom

Q7: The expression for the truss stiffness coefficient is

A- $k = \frac{EA}{D}$
B- $k = \frac{EI}{L}$
C- $k = \frac{EA}{L}$
D- $k = \frac{EG}{L}$

Q8: A (6 m) simply supported beam is loaded of 5 kN/m ($EI = 20000\ kN.m^2$), the maximum deflection is

A- 4.1 mm
B- 4.5 mm
C- 4 mm
D- 4.2 mm

Q9: The maximum deflection is (50 mm) of the (5 m) cantilever beam ($EI = 10000\ kN.m^2$), with w on entire beam is

A- 6.4 kN/m
B- 38.4 kN/m
C- 3.84 kN/m
D- 8.5 kN/m

Q10: The fixed end moment at left support of the beam with both ends fixed (10 m length) (5 kN force at 3 m from left support) is:

A- (7.35) kN.m
B- (- 3.75) kN.m
C- (- 7.35) kN.m
D- (3.75) kN.m

Q11: A ----------is a rectangular array of quantities arranged in rows and columns that is often used to aid in expressing and solving a system of algebraic equations.

A- matrix's
B- vectors
C- matrix
D- vector

Q12: The expression for the truss stiffness coefficient is

A- $k = \frac{EI}{L}$
B- $k = \frac{EA}{D}$
C- $k = \frac{EA}{I}$
D- $k = \frac{EG}{L}$

Q13: The term '----------' refers to rotations and displacements that are associated with each joint.

A- unknown
B- degrees of freedom
C- unknowns
D- degree of freedom

Q14: The expression for the beam stiffness coefficient is

A- $k = \frac{EA}{D}$
B- $k = \frac{EI}{L}$
C- $k = \frac{EA}{L}$
D- $k = \frac{EG}{L}$

Q15: The fixed end moment at right support of the beam with both ends fixed (17 m length) (10 kN force at 4m from left support) is:

A- (7.20) kN.m
B- (- 21.51) kN.m
C- (- 7.20) kN.m
D- (21.51) kN.m

Q16: The maximum deflection is (50 mm) of the (5 m) cantilever beam (EI= 10000 kN.m^2), with w on entire beam is

A- 3.8 kN/m
B- 38.4 kN/m
C- 3.84 kN/m
D- 6.4 kN/m

Q17: A (10 m) simply supported beam is loaded of 9 kN/m (EI= 10000 kN.m^2), the maximum deflection is

A- 48 mm
B- 94 mm
C- 28 mm
D- 18 mm

Q18: A ----------is a rectangular array of quantities arranged in rows and columns that is often used to aid in expressing and solving a system of algebraic equations.

A- matrix's
B- matrix
C- vectors
D- vector

Q19: The expression for the beam stiffness coefficient is

A- $k = \frac{EI}{L}$
B- $k = \frac{EA}{D}$
C- $k = \frac{EA}{I}$
D- $k = \frac{EG}{L}$

Q20: The term '----------' refers to rotations and displacements that are associated with each joint.

A- unknown
B- degree of freedom
C- unknowns
D- degrees of freedom

Q21: The expression for the stiffness coefficient is

A- $k = \frac{EA}{D}$
B- $k = \frac{EI}{D}$
C- $k = \frac{EA}{L}$
D- $k = \frac{EG}{L}$

Q22) The maximum deflection is (30 mm) of the (5 m) cantilever beam (EI= 10000 kN.m^2), with w on entire beam is:

A. 38.4 kN/m
B. 8.3 kN/m
C. 3.8 kN/m
D. 3.84 kN/m

Q23) The fixed end moment at right support of the beam with both ends fixed (15 m length) (10 kN force at 4m from left support) is:

A. 21.51 kN.m
B. - 21.51 kN.m
C. 7.82 kN.m
D. - 7.82 kN.m

Q24) A (8 m) simply supported beam is loaded of 9 kN/m (EI= 10000 kN.m^2), the maximum deflection is

a- 38 mm
b- 48 mm
c- 28 mm
d- 29 mm

Q25) The expression for 2-D truss the stiffness coefficient is

A. $k = \frac{EA}{I}$

B. $k = \frac{EG}{L}$

C. $k = \frac{EA}{D}$

D . Not any one

Q26) The expression for the beam stiffness coefficient is

A. $k = \frac{EA}{I}$

B. $k = \frac{EG}{L}$

C. $k = \frac{EA}{D}$

D . $k = \frac{EA}{G}$

Q27) The term '----------' refers to rotations and displacements that are associated with each joint.

A. unknown
B. degree of freedom
C. unknowns
D . degrees of freedom

Q28) A ----------is a rectangular array of quantities arranged in rows and columns that is often used to aid in expressing and solving a system of algebraic equations.

A. Vector
B. Vectors
C. matrix's
D . matrix

Q29) The maximum deflection is (30 mm) of the (5 m) cantilever beam (EI= 10000 kN.m^2), with w on entire beam is:

A. 38.4 kN/m
B. 3.84 kN/m
C. 8.3 kN/m
D. 3.8 kN/m

Q30) The expression for the truss stiffness coefficient is

A. $k = \frac{EA}{I}$

B. $k = \frac{EG}{L}$

C. $k = \frac{EA}{L}$

D. $k = \frac{EA}{G}$

Advanced Concrete Technology

Q1: The following table represents the sieve analysis of fine aggregate symbol :

	Percentage of individual fraction retained	مقاس المنخل
	2	4.75 mm
	13	2.36 mm
	25	1.18 mm
	15	0.6 mm
	22	0.3 mm
	20	0.15 mm
	3	pan

Thus, the fineness modulus (F.M) of fine aggregate is :

A- 2.86 B- 3.15

C- 5.5 D- 0

Q2: A concrete mix is design according to BS method and have the following materials quantities per cub meter. The **absorption** capacity of fine aggregate is 3% and for coarse aggregate is 3%. If the aggregate **moisture** content is: for Fine aggregate = 2% and for coarse aggregate = 5%. Then, the required water quantity is :

Water (kg)	Fine Aggregate (kg)	Coarse Aggregate (kg)
200	900	1500

A-200 B- 226

C- 256 D- 179

Q3: If the cylinder compressive strength of concrete is 30 MPa, and its density is about (2350) kg/m^3 , then estimated modulus of elasticity of a concrete specimen is :

A- 26.7 GPa
B- 25.9 GPa
C- 30.3 GPa
D- 18.7 GPa

Q4: In the using ultrasonic test, the presence of transverse steel in concrete will result:

A- Higher time for wave travel
B- - Lower time for wave travel
C- The device will not record the wave travel time
D- not of all

Q5: The concrete creep is:

A- decrease of concrete strain under constant applied load
B- increase of concrete stress under constant applied load
C- increase of concrete strain under constant applied load
D- decrease of concrete volume

Q6: The Ultrasonic Velocity Method is a type of :

A- surface hardening methods
B- magnetic methods
C- vibration Methods
D- electrical methods

Q7: A steel fiber of square cross section (1mm * 1mm) and length is 50 mm. what is the fiber aspect ratio?

A- 0.02
B- 50
C- 0.0025
D- 44.3

Q8: - The Poisson's ratio of concrete _____ concrete modulus of elasticity

A- proportion to B- proportion inverse to C- Not depend on D- v= 4700 E

Q9: One of the disadvantages of glass fibers used in concrete is:

A- have high cost B-Have low insulating properties

C-low chemical resistance D-low tensile modulus E

Q10: The following table represents the sieve analysis of fine aggregate symbol :

Percentage of individual fraction retained	مقاس المنخل
10	4.75 mm
13	2.36 mm
25	1.18 mm
15	0.6 mm
20	0.3 mm
23	0.15 mm
3	pan

Thus, the fineness modulus (F.M) of fine aggregate is :

A- 2.67 B- 3.33

C- 2.92 D- 0

Q11 : The concrete creep is:

A- decrease of concrete strain under constant applied load B- increase of concrete stress under constant applied load

C- increase of concrete strain under constant applied load D- decrease of concrete volume

Q12: The **C–S–H** gel is produce from reaction of _____ with water .

A- Tricalcium silicate only B- Bicalcium silicate only

C- Both of them (A and B) D- Tetracalcium aluminoferrite only

Q13. Which **NDT** technique is best suited to detect voids and delamination in concrete slabs?

a) Rebound Hammer b) Impact-Echo Test
c) Half-Cell Potential Test d) Windsor Probe Test

Q14: The Pull-Out Test measures:

a) Surface hardness b) Bond strength between concrete and reinforcement
c) Permeability d) Thermal conductivity

Q15: Which factor does NOT affect Rebound Hammer test results?

a) Surface smoothness b) Moisture content c) Concrete age d) All of them

Q16 Which standard requires a minimum cement content for durability in aggressive environments?

a) BS 8500 b) ACI 211 c) Both BS and ACI d) Neither

Q17 The "Fineness Modulus" of sand in ACI 211 influences the selection of:

a) Coarse aggregate content b) Cement type
c) water content d) cement content

Q18 Which fiber type is most resistant to chemical corrosion in aggressive environments?

a) Steel b) Polypropylene c) Asbestos d) Carbon

Q19 Which standard governs FRC testing for residual flexural strength?

a) EN 14651 (European standard)
b) ACI 318
c) BS 8110
d) ASTM C39

Q20 A plain concrete mix has a slump of 120 mm. Adding 0.8% steel fibers reduces the slump by 35%. The new slump is:
a) 45 mm
b) 78 mm
c) 85 mm
d) 92 mm

Q21 Seel fibers cost \$2.50/kg, and polypropylene fibers cost \$1.80/kg. For a 0.5% Vf in 1 m^3 concrete (steel density = 7,850 kg/m^3, PP density = 910 kg/m^3), the cost difference is:
a) \$62.50 (steel more expensive) b) \$50.00 c) \$37.50 d) \$25.00

Q22 For a steel fiber with diameter = 0.3 mm and bond strength = 4 MPa, the critical length (Lc) to prevent pull-out failure is:
a) 12.5 mm
b) 18.8 mm
c) 25.0 mm
d) 30.2 mm

Q23 At 35°C, retarder dosage is 0.5% by cement weight. For every 5°C above 25°C, dosage increases by 0.1%. Correct dosage at 42°C is:
a) 0.6%
b) 0.84%
c) 1.0%
d) 1.2%

Q24 Concrete cured at 30°C for 3 days. Maturity index (°C·hrs)is: (assuming datum temperature is -10 ^{0}C)
A- 1,080 B- 2,160 C- 3,240 D- 4,320

Q25 - The "Carbonation shrinkage" is being caused by the reaction of _____ with the carbon dioxide (CO_2) present in the atmosphere.

A- $CaCO_3$ B- $Ca(OH)_2$ C- $CaSO_2$ D- SiO_2

Q26- The creep in concrete can be caused by the applied:

A- Live Load B- Impact Load C- Dead Load D- All of them

Q27 - The relation between concrete modulus of elasticity "E" and concrete moisture of content :

A- Proportion B- Proportion inversely C- Not affected
D- Depend on concrete temperature

Q28 - The temperature range for clinker formation in a rotary kiln is approximately**:**

A- 800–1000°C B- 1000–1200°C C- 1400–1500°C D- 1600–1800°C

Q29- Which phase in cement contributes most to heat liberation during hydration?

A- C_3S B- C_2S C- C_3A D- C_4AF

Q30- The primary environmental concern in cement production is:

A- Noise pollution B- CO_2 emissions from limestone calcination
C- Dust from grinding D- Water consumption