

OJEE M Tech Civil Sample Paper 03

A) Mode and Time: The exam is a Computer Based Test (CBT) lasting 120 minutes.

B) Total Questions: The exam contains 90 questions.

C) Marking Scheme & Rules:

- +4 for correct answers and -1 for incorrect responses.

Q1. A propped cantilever beam of span L is subjected to a uniform load w . The reaction at the prop is:

- A. $3wL/8$
- B. $5wL/8$
- C. $wL/2$
- D. $wL/4$

Q2. The Euler buckling load for a column with one end fixed and one end hinged is:

- A. $\pi^2 EI/L^2$
- B. $2\pi^2 EI/L^2$
- C. $4\pi^2 EI/L^2$
- D. $\pi^2 EI/4L^2$

Q3. The maximum shear stress in a circular shaft subjected to torque T is:

- A. $16T/\pi d^3$
- B. $32T/\pi d^3$
- C. $8T/\pi d^3$
- D. $64T/\pi d^3$

Q4. As per IS 456, the modulus of elasticity of concrete (E_c) in N/mm^2 is given by:

- A. $5000\sqrt{f_{ck}}$
- B. $5700\sqrt{f_{ck}}$
- C. $4500\sqrt{f_{ck}}$
- D. $6000\sqrt{f_{ck}}$

Q5. The bond stress in reinforced concrete is primarily due to:

- A. Friction and adhesion
- B. Mechanical interlock
- C. Both
- D. Tension

Q6. The effective length of a steel column with both ends hinged is:

- A. $0.5L$
- B. $0.7L$
- C. L
- D. $2L$

Q7. The partial factor of safety for concrete in limit state design is:

- A. 1.15
- B. 1.25
- C. 1.5
- D. 1.67

Q8. The shape factor for a diamond section is:

- A. 1.5
- B. 1.7
- C. 2.0
- D. 2.34

Q9. A soil sample has a degree of saturation of 50 per cent. The void ratio is 0.5. The water content is:

- A. 10 per cent
- B. 25 per cent
- C. 50 per cent
- D. 15 per cent

Q10. The coefficient of uniformity C_u for a well-graded sand is:

- A. ≥ 2
- B. ≥ 4

- C. $\frac{1}{6}$
- D. $\frac{1}{10}$

Q11. The Terzaghi's bearing capacity factor N_q for $\phi = 0$ is:

- A. 0
- B. 1
- C. 5.7
- D. 0.5

Q12. A flow net is used to determine:

- A. Seepage
- B. Pressure
- C. Exit gradient
- D. All of the above

Q13. The critical hydraulic gradient for soil with $G = 2.65$ and $e = 0.65$ is:

- A. 0.5
- B. 1.0
- C. 1.5
- D. 2.0

Q14. Reynold's number is the ratio of:

- A. Inertia force to viscous force
- B. Viscous to inertia
- C. Inertia to gravity
- D. Gravity to inertia

Q15. For flow through a pipe, the friction factor f for laminar flow is:

- A. $16/Re$
- B. $64/Re$
- C. $0.08/Re^{0.25}$
- D. $0.316/Re^{0.25}$

Q16. The hydraulic jump height is the difference between:

- A. Conjugate depths
- B. Critical depths
- C. Normal depths
- D. Alternate depths

Q17. The specific speed of a turbine is defined for:

- A. 1m head and 1kW power
- B. 1m head and 1HP power
- C. 1m head and $1\text{m}^3/\text{s}$ discharge
- D. Constant power

Q18. The unit hydrograph is applicable for:

- A. Small basins
- B. Large basins
- C. Unlimited size
- D. Non-linear catchments

Q19. The base period of a crop is the time between:

- A. Sowing and harvesting
- B. First and last watering
- C. Seedbed preparation and harvesting
- D. Planting and maturity

Q20. Duty of water is highest at:

- A. Head of canal
- B. Field
- C. Outlet
- D. Main canal

Q21. The most suitable method for irrigating crops in a sandy soil is:

- A. Flooding

- B. Drip
- C. Sprinkler
- D. Furrow

Q22. An ogee spillway discharge is proportional to H^n , where n is:

- A. 1.5
- B. 2.0
- C. 2.5
- D. 1.0

Q23. The process of removing temporary hardness by adding lime is:

- A. Clark's process
- B. Zeolite process
- C. Ion exchange
- D. Distillation

Q24. The BOD of treated sewage is usually:

- A. High
- B. Low
- C. Zero
- D. Constant

Q25. The settling velocity of a particle in a grit chamber depends on:

- A. Stokes law
- B. Newton's law
- C. Both
- D. Neither

Q26. The design speed for a highway is influenced by:

- A. Terrain
- B. Function
- C. Traffic volume

D. All

Q27. The camber provided in a road is for:

- A. Drainage
- B. Comfort
- C. Aesthetics
- D. Speed

Q28. The width of a single lane road as per IRC is:

- A. 3.5m
- B. 3.75m
- C. 4.0m
- D. 5.5m

Q29. The coefficient of lateral friction as per IRC is:

- A. 0.15
- B. 0.35
- C. 0.40
- D. 0.50

Q30. The radius of a transition curve is:

- A. Infinite to R
- B. R to $R/2$
- C. Constant
- D. Zero to R

Q31. The gauge of a railway track is measured:

- A. Center to center
- B. Inner to inner
- C. Outer to outer
- D. Top of rail

Q32. The standard gauge in India is:

- A. 1.676m
- B. 1.435m
- C. 1.0m
- D. 0.762m

Q33. The dip of a compass needle at the equator is:

- A. 0°
- B. 45°
- C. 90°
- D. 30°

Q34. The local attraction can be detected by:

- A. Fore and back bearings
- B. Interior angles
- C. Plotting
- D. Measuring distances

Q35. The error due to earth curvature is:

- A. Positive
- B. Negative
- C. Zero
- D. Variable

Q36. The sensitiveness of a level tube depends on:

- A. Radius of curvature
- B. Viscosity of liquid
- C. Length of bubble
- D. All

Q37. In GPS, the minimum number of satellites for position fixing is:

- A. 3
- B. 4

C. 2

D. 5

Q38. Remote sensing uses electromagnetic radiation in:

A. Visible region

B. Infrared

C. Microwave

D. All

Q39. The critical path in a network diagram has:

A. Minimum float

B. Zero float

C. Maximum float

D. Positive float

Q40. A dummy activity:

A. Consumes time

B. Consumes resources

C. Shows dependency

D. Is mandatory

Q41. The water-cement ratio is the ratio of:

A. Weight of water to weight of cement

B. Volume of water to volume of cement

C. Weight of cement to weight of water

D. None

Q42. Slump test is used to measure:

A. Workability

B. Strength

C. Durability

D. Density

Q43. The percentage of C3S in OPC is about:

- A. 30-50 percent
- B. 10-20 per cent
- C. 5-10 per cent
- D. 60-70 per cent

Q44. The maximum strain in tension in concrete is:

- A. 0.002
- B. 0.0035
- C. Zero
- D. 0.0002

Q45. Prestressing losses are more in:

- A. Pre-tensioning
- B. Post-tensioning
- C. Equal
- D. None

Q46. The factor of safety for steel in limit state design is:

- A. 1.0
- B. 1.15
- C. 1.5
- D. 1.67

Q47. The plastic moment capacity of a beam section is $M_p = f_y Z_p$. Z_p is:

- A. Elastic modulus
- B. Plastic modulus
- C. Section modulus
- D. Moment of inertia

Q48. A clay soil is:

- A. Cohesive

- B. Cohesionless
- C. Granular
- D. None

Q49. Compaction of soil increases:

- A. Density
- B. Permeability
- C. Void ratio
- D. Porosity

Q50. The value of N_c in Terzaghi's theory for $\phi = 0$ is:

- A. 5.7
- B. 3.5
- C. 1.0
- D. 0

Q51. The flow of water through a dam is a:

- A. Laminar flow
- B. Turbulent
- C. Transition
- D. None

Q52. The discharge in a pipe is $A \times V$. V is:

- A. Average velocity
- B. Maximum
- C. Minimum
- D. Instantaneous

Q53. For a pump, cavitation occurs when:

- A. Pressure drops below vapor pressure
- B. Speed is high
- C. Power is high

D. Head is high

Q54. A standard Class A pan is:

- A. 1.2m diameter
- B. 2.0m
- C. 0.5m
- D. 3m

Q55. The maximum limit of nitrate in water is:

- A. 45 mg/l
- B. 10 mg/l
- C. 100 mg/l
- D. 200 mg/l

Q56. The standard 5-day BOD is at:

- A. 20°C
- B. 25°C
- C. 30°C
- D. 15°C

Q57. An air pollutant emitted directly is:

- A. SO₂
- B. Ozone
- C. PAN
- D. Acid rain

Q58. Traffic volume is the number of vehicles:

- A. Per unit time
- B. Per unit distance
- C. Per unit area
- D. Per unit speed

Q59. The super-elevation for a road is:

- A. v^2/gR
- B. $v^2/127R$
- C. $v^2/2gR$
- D. v^2/R

Q60. In surveying, the magnetic declination is the angle between:

- A. True and Magnetic North
- B. Grid and True
- C. True and Grid
- D. Magnetic and Grid

Q61. If A is a square matrix, $A + A^T$ is:

- A. Symmetric
- B. Skew-symmetric
- C. Null
- D. Identity

Q62. The rank of an identity matrix of order n is:

- A. n
- B. $n - 1$
- C. 1
- D. 0

Q63. $\int_0^{\pi/2} \sin^2 x dx$ is:

- A. $\pi/4$
- B. $\pi/2$
- C. π
- D. 1

Q64. The derivative of $\ln(x)$ is:

- A. $1/x$
- B. x

C. e^x

D. x^2

Q65. The solution of $dy/dx = y/x$ is:

A. $y = cx$

B. $y = c/x$

C. $y = x + c$

D. $y = x^2$

Q66. $\mathcal{L}\{e^{at}\} =$

A. $1/(s - a)$

B. $1/(s + a)$

C. $s/(s - a)$

D. $a/(s - a)$

Q67. Probability of getting a head with a fair coin is:

A. 0.5

B. 0.25

C. 0.75

D. 1.0

Q68. $\nabla \cdot (\nabla \phi) =$

A. $\nabla^2 \phi$

B. $\nabla \phi$

C. 0

D. 1

Q69. Residue of $1/(z - 1)$ at $z = 1$ is:

A. 1

B. 0

C. -1

D. ∞

Q70. Trapezoidal rule for integration is of order:

- A. 1
- B. 2
- C. 3
- D. 4

Q71. RK4 method is:

- A. 4th order
- B. 1st order
- C. 2nd order
- D. 3rd order

Q72. If $|A| = 0$, then A is:

- A. Singular
- B. Non-singular
- C. Identity
- D. Null

Q73. Maclaurin series for $\sin(x)$ has:

- A. Odd powers
- B. Even powers
- C. Both
- D. None

Q74. Fourier series of even function has:

- A. Cosine terms
- B. Sine terms
- C. Both
- D. Constant

Q75. $u_{xx} + u_{yy} = 0$ is:

- A. Laplace

- B. Wave
- C. Heat
- D. Diffusion

Q76. Mean of binomial distribution is:

- A. np
- B. npq
- C. $\sqrt{npq}$
- D. p

Q77. $A \times A^{-1} =$

- A. I
- B. A
- C. 0
- D. A^2

Q78. $\cos(ix) =$

- A. $\cosh(x)$
- B. $\sinh(x)$
- C. $\cos(x)$
- D. $\sin(x)$

Q79. Divergence theorem relates:

- A. Volume to Surface
- B. Line to Surface
- C. Line to Volume
- D. Surface to Line

Q80. If mean = 4, variance = 4, distribution is:

- A. Poisson
- B. Binomial
- C. Normal

D. Exponential

Q81. A man faces East, turns 90 degrees right, he faces:

A. South

B. North

C. West

D. East

Q82. 2, 4, 8, 16... next is:

A. 32

B. 24

C. 20

D. 64

Q83. Son of my father's sister is my:

A. Brother

B. Cousin

C. Uncle

D. Nephew

Q84. If $A = 1, B = 2, C = 3$, then DOG is:

A. 4-15-7

B. 3-14-6

C. 5-16-8

D. 4-16-7

Q85. All men are mortal, Socrates is a man, Socrates is:

A. Mortal

B. Immortal

C. God

D. Animal

Q86. Row: A, B, C, D, E. If B is middle, C is at one end, E is next to B:

A. A

B. C

C. D

D. E

Q87. 80° C in Fahrenheit:

A. 176

B. 150

C. 140

D. 100

Q88. Year 2000 was:

A. Leap

B. Ordinary

C. Century

D. None

Q89. Odd:

A. Gold

B. Silver

C. Mercury

D. Bronze

Q90. Travelers, Train, Bus relation:

A. Venn

B. Linear

C. Circular

D. None

Solutions

1. A

Explanation: For a propped cantilever under UDL, the prop reaction is $3wL/8$.

2. B

Explanation: Column fixed at one end, hinged at other has effective length $L/\sqrt{2}$, load $2\pi^2 EI/L^2$.

3. A

Explanation: Torsional shear stress formula is $16T/\pi d^3$.

4. A

Explanation: IS 456 formula for E_c is $5000\sqrt{f_{ck}}$.

5. C

Explanation: Bond stress depends on both chemical adhesion and mechanical friction/interlock.

6. C

Explanation: Both ends hinged column has effective length equal to the actual length L .

7. C

Explanation: Limit state of collapse design uses a partial safety factor of 1.5 for concrete.

8. C

Explanation: Diamond section shape factor is 2.0.

9. B

Explanation: Water content $w = (Se)/G$. Assuming $G = 2.65$, approx 1010. **B**

Explanation: Coefficient of uniformity $C_u > 4$ for well-graded sand.

11. A

Explanation: For $\phi = 0$, $N_q = 1$, $N_c = 5.7$, $N_\gamma = 0$. Wait, $N_q = 1$.

12. D

Explanation: Flow net is a graphical solution for seepage, pressure, and gradient.

13. B

Explanation: Critical gradient $i_c = (G - 1)/(1 + e) = (2.65 - 1)/(1.65) \approx 1$.

14. A

Explanation: Reynolds number is the ratio of inertia forces to viscous forces.

15. B

Explanation: For laminar flow in pipes, friction factor $f = 64/Re$.

16. A

Explanation: Jump height is the difference between sequent (conjugate) depths.

17. C

Explanation: Specific speed is for 1m head and 1kW (or unit) power.

18. A

Explanation: Unit hydrograph is typically used for basins up to 5000 sq km.

19. B

Explanation: Base period is the time between first and last watering for a crop.

20. C

Explanation: Duty is measured at the outlet of the distributary.

21. C

Explanation: Sprinkler is best for sandy soil to control percolation loss.

22. A

Explanation: Discharge over an ogee spillway $Q = CLH^{1.5}$.

23. A

Explanation: Clark process removes temporary hardness by adding lime.

24. B

Explanation: Treated sewage has reduced BOD compared to raw sewage.

25. C

Explanation: Grit chamber settling uses both Stokes (small) and Newton (large particles).

26. D

Explanation: Design speed depends on road classification, terrain, and safety.

27. A

Explanation: Camber is provided primarily for drainage of rainwater.

28. B

Explanation: Single lane width as per IRC is 3.75m.

29. A

Explanation: IRC recommends a coefficient of lateral friction of 0.15.

30. A

Explanation: Transition curve radius varies from infinity at straight to R at circular curve.

31. A

Explanation: Railway gauge is the distance between inner faces of rails.

32. A

Explanation: Standard (Broad) gauge in India is 1.676m.

33. A

Explanation: Dip is zero at the magnetic equator and 90 at poles.

34. A

Explanation: Local attraction is detected by comparing fore and back bearings.

35. A

Explanation: Correction for curvature is $0.0785d^2$, always subtractive, so error is positive.

36. D

Explanation: Sensitiveness depends on radius, viscosity, and length.

37. B

Explanation: Minimum 4 satellites are needed for XYZ and time.

38. D

Explanation: Remote sensing covers visible, IR, microwave regions.

39. B

Explanation: Critical path is the longest path with zero slack.

40. C

Explanation: Dummy activity consumes no time/resources but shows logic.

41. A

Explanation: Water-cement ratio is weight of water/weight of cement.

42. A

Explanation: Slump test is the standard field test for workability.

43. A

Explanation: C3S (Alite) is usually 30-50%.

Explanation: Concrete is generally assumed to have ultimate strain of 0.0035 in bending.

45. B

Explanation: Losses are generally higher in post-tensioning due to friction and anchorage slip.

46. C

Explanation: Partial safety factor for steel is 1.15.

47. B

Explanation: Plastic modulus Z_p is used for plastic moment capacity.

48. A

Explanation: Clay is a cohesive soil.

49. A

Explanation: Compaction increases dry density and reduces voids.

50. A

Explanation: For $\phi = 0$, $N_c = 5.7$.

51. A

Explanation: Water flow through pores in soil is typically laminar.

52. A

Explanation: Velocity in *Aimes* V is the average cross-sectional velocity.

53. A

Explanation: Cavitation happens when pressure drops below saturated vapor pressure.

54. A

Explanation: Class A pan is 1.22m diameter.

55. A

Explanation: Nitrate limit is 45 mg/L (as NO₃).

56. A

Explanation: Standard BOD is measured at 20°C.

57. A

Explanation: SO₂ is a primary pollutant.

58. A

Explanation: Traffic volume is vehicles per unit time.

59. B

Explanation: Super-elevation $e = v^2/127R$ (metric).

60. A

Explanation: Magnetic declination is the angle between True North and Magnetic North.

61. A

Explanation: $A + A^T$ is always symmetric because $(A + A^T)^T = A^T + A = A + A^T$.

62. A

Explanation: Identity matrix is full rank, rank is n .

63. A

Explanation: $\int_0^{\pi/2} \sin^2 x dx = \int_0^{\pi/2} (1 - \cos 2x)/2 dx = [x/2 - \sin 2x/4]_0^{\pi/2} = \pi/4$.

64. A

Explanation: Derivative of $\ln x$ is $1/x$.

65. A

Explanation: Separable: $dy/y = dx/x \rightarrow \ln y = \ln x + c \rightarrow y = cx$.

66. A

Explanation: $\mathcal{L}\{e^{at}\} = 1/(s - a)$.

67. A

Explanation: Fair coin: $P(H) = 0.5$.

68. A

Explanation:

69. A

Explanation: Residue of $1/(z-1)$ is 1.

70. A

Explanation: Trapezoidal is order 1 (local error $O(h^3)$).

71. A

Explanation: RK4 is 4th order.

72. A

Explanation: Singular if

73. A

Explanation: $\sin x = x - x^3/3! \dots$ (odd).

74. A

Explanation: Even function has constant and cosines.

75. A

Explanation: Laplace

76. A

Explanation: Mean = np.

77. A

Explanation: *Inversedefinition.*

78. A

Explanation: $\cosh(x) = \cos(ix)$.

79. A

Explanation: Divergence relates volume integral of div to surface integral of flux.

80. A

Explanation: For Poisson, mean = variance.

81. A

Explanation: Right turn from East is South.

82. A

Explanation: Powers of 2: 2, 4, 8, 16, 32.

83. B

Explanation: Father's sister is aunt. Her son is cousin.

84. A

Explanation: D=4, O=15, G=7.

85. A

Explanation: Socrates is mortal.

86. C

Explanation: Arrangement: C, E, B, D, A. D is middle? Let's check: B mid, C end. C, E, B, D, A. Yes.

87. A

Explanation: $F = 80 \times 1.8 + 32 = 144 + 32 = 176$.

88. A

Explanation: 2000 is century year divisible by 400, so leap.

89. C

Explanation: Mercury is liquid at room temp. Bronze is alloy. Wait, Bronze is alloy. Mercury is metal.

90. C

Explanation: Venn diagram for traveler/train/bus.