

QUESTION PAPER

1. A cohesive soil yields a maximum dry density of  $18 \text{ kN/m}^3$  during a standard proctor compaction test. If the specific gravity is 2.65, what would be its void ratio? (Adopt unit of water as  $10 \text{ kN/m}^3$ )
  - (a) 0.5523
  - (b) 0.4722
  - (c) 0.7121
  - (d) 0.5835
2. A footing  $2 \text{ m} \times 1 \text{ m}$  exerts a uniform pressure of  $150 \text{ kN/m}^2$  on the soil. Assuming a load dispersion of 2 vertical to 1 horizontal, the average vertical stress in ( $\text{kN/m}^2$ ) at 1.0 m below the footing is
  - (a) 50
  - (b) 75
  - (c) 80
  - (d) 100
3. Match List I with List II and select the correct answer using the code given below the lists:

List I	List II
A. Axel Bendixen	1. The mathematical theory of elasticity
B. Hardy Cross	2. Theory of curved bars
C. Winkler	3. Slope-deflection method
D. St. Venant	4. Moment distribution

- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 1 | 2 | 3 | 4 |
| (b) | 3 | 4 | 2 | 1 |
| (c) | 1 | 2 | 4 | 3 |
| (d) | 3 | 2 | 4 | 1 |

4. The standard size of brick is
  - (a)  $20 \text{ cm} \times 10 \text{ cm} \times 10 \text{ cm}$
  - (b)  $19 \text{ cm} \times 9 \text{ cm} \times 9 \text{ cm}$
  - (c)  $18 \text{ cm} \times 9 \text{ cm} \times 9 \text{ cm}$
  - (d)  $18 \text{ cm} \times 10 \text{ cm} \times 10 \text{ cm}$

5. The velocity of flow of water in a pipe of 150 mm dia is 0.3 m/s, a diaphragm with a central hole 80 mm in diameter is placed in the pipe obstructing the flow. With coefficient of contraction  $C_c = 0.60$ , the loss of head from Vena Contracta to a point downstream will be
  - (a) 0.1083 m
  - (b) 0.2250 m
  - (c) 1.2054 m
  - (d) 0.8250 m
6. If the depletion of oxygen is found to be 5 ppm after incubating a 2.5% solution of sewage sample for 5 days at  $20^\circ\text{C}$ , B.O.D of the sewage is
  - (a) 50 ppm
  - (b) 100 ppm
  - (c) 150 ppm
  - (d) 200 ppm
7. A trapezoidal section of an open channel has side slope  $2H:1V$ . If bottom width is ' $b$ ' and depth ' $d$ ', the relation between  $b$  and  $d$  for most economical trapezoidal section of the channel is:
  - (a)  $b = 0.472d$
  - (b)  $b/d = 0.5$
  - (c)  $b^2 = 0.3d^2$
  - (d)  $d = \sqrt{b}$
8. If the difference in elevation of an edge of the pavement 9 m wide and its crown is 15 cm, the camber of the pavement is
  - (a) 1 in 60
  - (b) 1 in 45
  - (c) 1 in 30
  - (d) 1 in 15

9. The scour depth  $D$  of a river during flood, may be calculated from the Lacey's equation
- (a)  $D = 0.47 \left( \frac{Q}{f} \right)^{1/2}$   
 (b)  $D = 0.47 \left( \frac{Q}{f} \right)$   
 (c)  $D = 0.47 \left( \frac{Q}{f} \right)^{1/4}$   
 (d)  $D = 0.47 \left( \frac{Q}{f} \right)^{1/3}$
10. The Glycerine is flowing at  $25^\circ\text{C}$  in a pipe of diameter 150 mm with a velocity of 3.6 m/s. The flow is
- (a) Laminar  
 (b) Turbulent  
 (c) Critical  
 (d) Rectilinear
11. A concrete column  $200 \times 200$  mm in cross-section is reinforced with steel bars of  $1200 \text{ mm}^2$ , total cross-sectional area. Calculate the safe load for the column if permissible stress in concrete is  $5 \text{ N/mm}^2$  and  $E_s$  is  $15 E_c$
- (a) 264 kN  
 (b) 274 kN  
 (c) 284 kN  
 (d) 294 kN
12. For design of Flexure members, the strain in the reinforcing bars under tension at ultimate state as per IS 456-2000 shall not be less than
- (a)  $\frac{f_y}{1.15E}$   
 (b)  $\frac{f_y}{1.15E_s} + 0.002$   
 (c)  $\frac{f_y}{E_s}$   
 (d)  $\frac{f_y}{E_s} + 0.002$
13. A soil has liquid limit of 35, plastic limit of 20 and moisture content 25%. What will be its liquidity index and plasticity index?
- (a) 0.67, 15  
 (b) 0.33, 15  
 (c) 0.67, 25  
 (d) 0.33, 20
14. If the moment of inertia of a section about its axis is  $I$  and its effective sectional area is  $A$ , its radius of gyration  $r$  about the axis is
- (a)  $r = \frac{I}{A}$   
 (b)  $r = \sqrt{\frac{I}{A}}$   
 (c)  $r = \sqrt[3]{\frac{I}{A}}$   
 (d)  $r = \sqrt{\frac{A}{I}}$
15. A uniform cantilever beam has a span of 2 m and carries a point load of 6 kN at free end. The magnitude of moment to be applied at free end for zero vertical deflection at that point is (neglect self-wt. of the beam)
- (a) 5 kN m  
 (b) 10 kN m  
 (c) 11 kN m  
 (d) 8 kN m
16. A bar 40 mm in diameter and subjected to a tensile force of 40,000 kgs. Undergoes elongation resulting in decrease in diameter considering the properties of the material as  $E = 2 \times 10^5 \text{ N/mm}^2$  and Poisson's ratio  $\nu$  as 0.3, the modulus of rigidity will be:
- (a) 76923.07  $\text{N/mm}^2$   
 (b)  $20 \times 10^4 \text{ kg/cm}^2$   
 (c) 56898.50  $\text{N/mm}^2$   
 (d)  $3 \times 10^5 \text{ kg/cm}^2$
17. If the volume of a liquid weighing 3000 kg is 4 cubic metres, 0.75 is its
- (a) Specific weight  
 (b) Specific mass  
 (c) Specific gravity  
 (d) Specific volume
18. The height of water level in a tank above the centre of a circular hole 2.5 cm in diameter is 50 m. The velocity of water flowing through the hole is (neglect friction between jet and wall)
- (a) 20.53 m/s  
 (b) 25.85 m/s  
 (c) 31.32 m/s  
 (d) 40.40 m/s
19. A simply supported beam is considered as a deep beam if the ratio of effective span to overall depth is less than
- (a) 1  
 (b) 2  
 (c) 3  
 (d) 4

20. In two dimensional stress system, the radius of the Mohr's circles represents
- Maximum normal stress
  - Minimum normal stress
  - Minimum shear stress
  - Maximum shear stress
21. If  $5x + 3y + 7z = 5$ ,  $3x + 2by + 2z = 9$ ,  $7x + 2y + 10z = 5$ , be a system of equations, then
- It has only trivial solution,  $x = 0$ ,  $y = 0$ ,  $z = 0$
  - System is consistent and has infinite solution
  - System is consistent and has unique solution
  - System is inconsistent
22. What is the angle between the tangents to the curve  $x = t$ ,  $y = t^2$ ,  $z = t^3$ , at  $t = \pm 1$
- $\cos^{-1}\left(\frac{-3}{7}\right)$
  - $\cos^{-1}\left(\frac{1}{7}\right)$
  - $\cos^{-1}\left(\frac{3}{7}\right)$
  - $\cos^{-1}\left(\frac{-1}{7}\right)$
23. What is the Laplace transform of  $e^{-3t}(2 \cos 5t - 3 \sin 5t)$
- $2s + \frac{9}{s^2} + 6s + 34$
  - $3s - \frac{9}{s^2} + 6s + 34$
  - $2s - \frac{9}{s^2} + 6s + 34$
  - $s + \frac{9}{s^2} + 6s + 34$
24.  $x$  is a uniformly distributed random variable that takes values between 0 and 1. The value of  $E\{x^2\}$  will be
- 0
  - $\frac{1}{8}$
  - $\frac{1}{4}$
  - $\frac{1}{2}$
25. The earth pressure of a soil at rest, is proportional to
- $\tan(45^\circ - \phi)$
  - $\tan(45^\circ + \phi)$
  - $(1 - \sin \phi)$
  - $(1 + \sin \phi)$
26. The slope of the  $e$ -log  $p$  curve for a soil mass gives:
- Coefficient of permeability,  $k$
  - Coefficient of consolidation,  $C_v$
  - Compression index,  $C_c$
  - Coefficient of volume compressibility,  $m_v$
27. Stress produced in a bar by a suddenly applied load is  $x$  the one produced by the same load when applied gradually. The value of  $x$  is
- Twice
  - Thrice
  - Same as
  - Half of
28. Two circular mild steel bars  $A$  and  $B$  of equal lengths have diameters 2 cm and 3 cm respectively. Each is subjected to a tensile load of magnitude  $T$ . The ratio of elongations of the bars  $I_A/I_B$  is
- $\frac{2}{3}$
  - $\frac{5}{8}$
  - $\frac{4}{9}$
  - $\frac{2}{5}$
29. A pipe of 0.1 m<sup>2</sup> cross sectional area suddenly enlarges to 0.3 m<sup>2</sup> cross sectional area. If the discharge of the pipe is 0.3 m<sup>3</sup>/s, the head loss is
- $2/g$  m of water
  - $g/2$  m of water
  - 1 g m of water
  - $\sqrt{g}$  m of water
30. The length of hydraulic jump in rectangular channel is roughly
- 2 to 3 times its height
  - 3 to 5 times its height
  - 5 to 7 times its height
  - 10 to 12 times its height
31. The absolute minimum radius of horizontal curve for a design speed of 60 Kmph is nearly
- 151 m
  - 210 m
  - 360 m
  - 129 m

32. If whole circle bearing of a line is  $120^\circ$ , its reduced bearing is  
 (a) S  $20^\circ$  E  
 (b) S  $60^\circ$  E  
 (c) N  $120^\circ$  E  
 (d) N  $60^\circ$  E
33. If,  
 $A$  = Cross sectional area  
 $E$  = Young's modulus of elasticity  
 $G$  = Modulus of rigidity  
 $J$  = Polar moment of inertia  
 Then torsional rigidity is given by,  
 (a)  $AE$   
 (b)  $GE$   
 (c)  $EI$   
 (d)  $GJ$
34. The Muller-Breslau principle in structural analysis is used for,  
 (a) Drawing influence line diagram for any force function  
 (b) Superimposition of load effects  
 (c) Writing virtual work equation  
 (d) Calculating strain energy
35. Minimum stopping distance as per IRC for moving vehicles on road with a design speed of 80 km/h is  
 (a) 80 m  
 (b) 100 m  
 (c) 120 m  
 (d) 150 m
36. The bearing of  $C$  from  $A$  is N  $30^\circ$  E and from  $B$ , 50 metres east of  $A$ , is N  $60^\circ$  W. The departure of  $C$  from  $A$  is  
 (a) 50 m  
 (b)  $50\sqrt{3}$  m  
 (c)  $25\sqrt{3}$  m  
 (d) 25 m
37. Which one of the following conditions is valid in case of unconfined compression test in comparison to triaxial test?  
 (a) Minor principal stress = 0  
 (b) Minor principal stress =  $0.5 \times$  major principal stress  
 (c) Minor principal stress = major principal stress  
 (d) Major principal stress =  $3 \times$  minor principal stress
38. A rod of uniform cross-section  $A$  and length  $L$  is deformed by  $\delta$ , when subjected to a normal force  $P$ . The Young's Modulus  $E$  of the material is  
 (a)  $E = \frac{P\delta}{AL}$   
 (b)  $E = \frac{A\delta}{PL}$   
 (c)  $E = \frac{PL}{A\delta}$   
 (d)  $E = \frac{AL}{P\delta}$
39. A simply supported beam has an effective span of 16 m. What shall be the limiting ratio of span to effective depth as per IS 456-2000?  
 (a) 26  
 (b) 20  
 (c) 12.5  
 (d) 15
40. If the depletion of oxygen is found to be 2.5 mg/L after incubating 2.5 mL of sewage diluted with 250 mL water for 5 days at  $20^\circ\text{C}$ , B.O.D of the sewage is  
 (a) 50 mg/L  
 (b) 100 mg/L  
 (c) 200 mg/L  
 (d) 250 mg/L
41. The number of bricks per CUM of brickwork in CM is about  
 (a) 200 numbers  
 (b) 500 numbers  
 (c) 700 numbers  
 (d) 800 numbers
42. The slope correction for a length of 30 m along a gradient of 1 in 20, is  
 (a) 3.75 cm  
 (b) 0.375 cm  
 (c) 37.5 cm  
 (d) 2.75 cm
43. Both Reynolds and Froude numbers assume significance in one of following examples  
 (a) Motion of submarine at large depths  
 (b) Motion of ship in deep seas  
 (c) Cruising of missile in air  
 (d) Droplet formation

44. The flow in open channel is said to be subcritical if the Froude number is
- Less than 1.0
  - Equal to 1.0
  - Greater than 1.0
  - Zero
45. An ideal vertical curve to join two gradients is
- Cubic
  - Parabolic
  - Elliptical
  - Hyperbolic
46. For the differential equation  $dy/dx + ay = 0$  with  $y(0) = 1$ , solution is
- $e^{at}$
  - $e^{-at}$
  - $ae^{-at}$
  - $e^{\sqrt{-at}}$
47.  $y = cx - c^2$  is a general solution of the differential equation
- $\left(\frac{dy}{dx}\right)^2 - x\left(\frac{dy}{dx}\right) + y = 0$
  - $\frac{d^2y}{dx^2} = 0$
  - $\frac{dy}{dx} = c$
  - $\frac{d^3y}{dx^3} = 0$
48. The triangle formed by three points A(1, -2, -3), B(2, -3, -1), C(3, -1, -2) is
- Isosceles right angled  $\Delta$
  - Equilateral  $\Delta$
  - Scalene  $\Delta$
  - Acute  $\Delta$
49. The partial differential equation  $\frac{5\partial^2 z}{\partial x^2} + \frac{6\partial^2 z}{\partial y^2} = xy$  is
- Elliptic
  - Parabolic
  - Hyperbolic
  - Sinusoidal
50. If  $A$  is a  $3 \times 3$  matrix and  $|A| = 3$ , then  $|3A|$  is
- 9
  - 27
  - 81
  - 243
51. The relationship between void ratio ( $e$ ) and porosity ratio ( $n$ ) is:
- $n = \frac{1+e}{1-e}$
  - $e = \frac{1+n}{1-e}$
  - $n = \frac{e}{1+e}$
  - $e = n(1+e)$
52. If  $D_1$  and  $D_2$  are depths of water up-stream and down-stream of a hydraulic jump in rectangular channel, the loss of head at the jump is
- $\frac{(D_2 - D_1)^3}{D_1 D_2}$
  - $\frac{(D_2 - D_1)^3}{2D_1 D_2}$
  - $\frac{(D_2 - D_1)^3}{3D_1 D_2}$
  - $\frac{(D_2 - D_1)^3}{4D_1 D_2}$
53. Modular ratio  $m$  for M25 grade of concrete is
- 18.67
  - 13.33
  - 10.98
  - None
54. The minimum reinforcement in slabs should not be less than \_\_\_\_\_% of the total cross-sectional area when HYSD bars are used in the either direction,
- 0.10
  - 0.12
  - 0.15
  - 0.18

55. A cantilever beam carries a uniformly distributed total load  $W$  over its whole length and a concentrated upward load  $W$  at its free end. The net vertical deflection at the free end is
- Zero
  - $\frac{5WL^3}{24EI}$  downwards
  - $\frac{5WL^3}{24EI}$  upwards
  - $\frac{5WL^3}{48EI}$  downwards
56. As per IS 1893 [Part-I] – 2002, Bangalore falls under which earthquake zone
- I
  - II
  - III
  - IV
57. The maximum shear stress in a rectangular beam is \_\_\_\_\_ times of average shear stress
- 1.15
  - 1.25
  - 1.5
  - 1.75
58. Minimum cement content required for M35 grade of concrete for very severe exposure condition as per IS 456-2000 is \_\_\_\_\_  $\text{kg m}^{-3}$
- 300
  - 320
  - 340
  - 360
59. Permissible deviation from specified dimensions of cross-section of column and beams as per IS standards is \_\_\_\_\_ mm
- + 10 mm and – 4 mm
  - + 12 mm and – 6 mm
  - + 14 mm and – 8 mm
  - None
60. Soundness of cement is measured by
- Vicat apparatus
  - Le Chatelier apparatus
  - Rebound hammer
  - Ultra sonic pulse velocity apparatus
61. The moment of Inertia of a thin rod of mass  $m$  and length  $l$ , about its axis through its center of gravity and perpendicular to its length is
- $\frac{ml^2}{4}$
  - $\frac{ml^2}{6}$
  - $\frac{ml^2}{8}$
  - $\frac{ml^2}{12}$
62. The ratio of static friction to dynamic friction is always
- Equal to 1
  - Less than 1
  - Greater than 1
  - None
63. Laterite is chemically classified as
- Calcareous rock
  - Argillaceous rock
  - Siliceous rock
  - Metamorphic rock
64. The compressive strength of granite is
- 50 to 70  $\text{MN/m}^2$
  - 70 to 130  $\text{MN/m}^2$
  - 130 to 170  $\text{MN/m}^2$
  - 170 to 200  $\text{MN/m}^2$
65. A first class brick should not absorb water more than \_\_\_\_\_ of its own dry weight after 24 hours of immersion in cold water
- 10%
  - 15%
  - 20%
  - 25%
66. For RCC construction the maximum size of coarse aggregate is limited to
- 10 mm
  - 15 mm
  - 20 mm
  - 25 mm

67. The propagation of shear crack in prestressed concrete member depends on
- Tensile reinforcement
  - Compression reinforcement
  - Shear reinforcement
  - Shape of the cross-section of beam
68. A doubly reinforced section is used,
- When the members are subjected to alternate external loads and bending moment in the section reverses
  - When the members are subjected to loading eccentric on either side of the axis
  - When the members are subjected to accidental lateral loads
  - All the above
69. The material having particle size varying from 0.007 mm to 0.06 mm is termed as,
- Silt
  - Clay
  - Sand
  - None of the above
70. In a manufacture of cement, the dry and wet mixture of calcareous and argillaceous materials are burnt at a temperature of
- 900°C to 1000°C
  - 1000°C to 1200°C
  - 1200°C to 1500°C
  - 1500°C to 1600°C
71. A method of differential levelling is used in order to find the differences in elevation between the two points when,
- They are too far apart
  - There are obstacles between two
  - The differences between them is too great
  - All the above
72. If the depth is kept constant for a beam of uniform strength, then its width will vary in proportion to \_\_\_\_\_, where  $M$  is the bending moment.
- $M$
  - $\sqrt{M}$
  - $M^2$
  - $M^3$
73. A lead ball with certain velocity is made to strike a wall, it falls down; but a rubber ball of the same mass and with same velocity strikes the same wall, it rebounds. Select the reason from the following:
- Both the balls undergo an equal change in the momentum
  - The change in momentum suffered by rubber ball is more than the lead ball
  - The change in momentum suffered by rubber ball is less than the lead ball
  - None of the above
74. A large tank open to the atmosphere is filled with water to a height of 5 m from the outlet tap. A tap near the bottom of tank is now opened, and water flows out from the smooth and rounded outlet. Determine the maximum velocity at the outlet,
- 9.2 m/s
  - 9.9 m/s
  - 19.8 m/s
  - None
75. The loss of pressure in Venturimeter,
- Reduces with decrease in cone angle in the outlet cone.
  - Reduces with decreasing cone angle in the inlet cone.
  - Increases with decreasing cone angle in the outlet cone.
  - Increase with decreasing cone angle in the inlet cone.
76. Bending equation is
- $\frac{M}{I} = \frac{R}{E} = \frac{F}{Y}$
  - $\frac{I}{M} = \frac{E}{R} = \frac{Y}{R}$
  - $\frac{M}{I} = \frac{E}{R} = \frac{F}{Y}$
  - $\frac{M}{I} = \frac{R}{E} = \frac{Y}{F}$

77. For a prismatic beam of length  $L$  and moment of inertia  $I$ , the stiffness factor is

- (a)  $\frac{IE}{L}$
- (b)  $\frac{2EI}{L}$
- (c)  $\frac{3EI}{L}$
- (d)  $\frac{4EI}{L}$

78. In case of SHM, the period of oscillation ( $T$ ) is given by,

- (a)  $T = \frac{2\omega}{\pi^2}$
- (b)  $T = \frac{2\pi}{\omega}$

(c)  $T = \frac{\omega}{2\pi}$

(d)  $T = \frac{\pi}{2\omega}$

79. One newton force is,

- (a)  $10^3$  dynes
- (b)  $10^4$  dynes
- (c)  $10^5$  dynes
- (d)  $10^6$  dynes

80. If 2, 3, 4 are the eigen values of  $A$ , then the eigen values of  $4A$  will be

- (a) 2, 3, 16
- (b) 2, 12, 4
- (c) 8, 12, 16
- (d) 8, 3, 4