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Subject Code :

0 7

Test Booklet No. : 00743

## TEST BOOKLET CIVIL ENGINEERING

Time Allowed : 2 (Two) Hours

Full Marks : 200

### INSTRUCTIONS

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2. **Space provided for Series in the Answer Sheet is not applicable for Optional Subject. So the space shall be left blank.**
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[ No. of Questions : 100 ]

SEAL

1. Which of the following is a scalar quantity?

- (A) Momentum
- (B) Impulse
- (C) Energy
- (D) Torque

2. One megapascal is equal to

- (A)  $10^6 \text{ N/m}^2$
- (B)  $1 \text{ kgf/m}^2$
- (C)  $1 \text{ N/mm}^2$
- (D)  $1 \text{ N/m}^2$

3. The centre of gravity of a quadrant of a circle lies along its central radius  $R$  at a distance of

- (A)  $\frac{2R}{3\pi}$
- (B)  $\frac{4R}{3\pi}$
- (C)  $\frac{8R}{3\pi}$
- (D)  $\frac{2\pi R}{3}$

4. The ratio of moment of inertia of a rectangle to that of a triangle having same base and height about their bases is

- (A) 1
- (B) 2
- (C) 3
- (D) 4

5. When a beam is loaded transversely, the maximum bending compressive stress develops on

- (A) top fibre
- (B) bottom fibre
- (C) neutral axis
- (D) the section passing through the c.g.

6. A simply supported beam carries two equal concentrated loads  $W$  at distances  $L/3$  from either support. The maximum bending moment in the beam will be

- (A)  $\frac{WL}{2}$
- (B)  $\frac{WL}{3}$
- (C)  $\frac{WL}{6}$
- (D)  $\frac{WL}{8}$

7. A cantilever beam having moment of inertia  $I$ , modulus of elasticity  $E$  and length  $L$  carries a uniformly distributed load  $w$  per unit run over the entire span. The deflection at the free end will be

- (A)  $\frac{wL^4}{8EI}$
- (B)  $\frac{wL^4}{3EI}$
- (C)  $\frac{wL^3}{3EI}$
- (D)  $\frac{wL^3}{8EI}$

8. A 60 mm diameter shaft is subjected to a torque of 4 kN-m. The maximum shear stress induced in the shaft is

- (A) 47.15 N/mm<sup>2</sup>
- (B) 94.30 N/mm<sup>2</sup>
- (C) 23.60 N/mm<sup>2</sup>
- (D) 69.08 N/mm<sup>2</sup>

9. A solid shaft 125 mm in diameter transmits 120 kW at 160 r.p.m. The mean torque to which the shaft is subjected is approximately

- (A) 7162 N-m
- (B) 7.2 N-m
- (C) 93.75 N-m
- (D) 15 N-m

10. A rectangular bar is subjected to an axial tensile load producing a tensile stress  $p$  on a section normal to the axis of loading. The tangential stress induced on any oblique plane at an angle  $\theta$  to the cross-section is

- (A)  $p \cos^2 \theta$
- (B)  $\frac{p}{2} \cos 2\theta$
- (C)  $\frac{p}{2} \sin 2\theta$
- (D)  $\frac{p}{2} \sin^2 \theta$

11. The shear force diagram for a cantilever beam carrying uniformly distributed load per unit length will be a/an

- (A) rectangle
- (B) isosceles triangle
- (C) right-angled triangle
- (D) parabola

12. When two unequal like principal stresses  $p_1$  and  $p_2$  act, then the radius of Mohr's circle will be

- (A)  $\frac{p_1 + p_2}{2} \cos \theta$
- (B)  $\frac{p_1 - p_2}{2} \cos \theta$
- (C)  $\frac{p_1 + p_2}{2}$
- (D)  $\frac{p_1 - p_2}{2}$

13. For a column of actual length  $l$  whose both ends are fixed, the crippling load is

- (A)  $\frac{\pi^2 EI}{4l^2}$
- (B)  $\frac{4\pi^2 EI}{l^2}$
- (C)  $\frac{2\pi^2 EI}{l^2}$
- (D)  $\frac{\pi^2 EI}{2l^2}$

14. If a stable simply supported beam has roller support at one end, then the other end will be

- (A) free
- (B) fixed
- (C) hinged
- (D) on rollers

15. The ratio of average shear stress to maximum shear stress for a circular section is

- (A) 2
- (B)  $\frac{2}{3}$
- (C)  $\frac{1}{2}$
- (D)  $\frac{3}{4}$

16. What will be the relation between  $E$  (Young's modulus) and  $K$  (bulk modulus) when  $\mu$  (Poisson's ratio) is 0.25?

- (A)  $E = K$
- (B)  $E = 2K$
- (C)  $E = 1.5K$
- (D)  $E = K = 0$

17. If a shaft of diameter  $d$  and length  $l$  has been loaded axially, then ratio of change in diameter to the original diameter is called

- (A) longitudinal strain
- (B) shear strain
- (C) volumetric strain
- (D) lateral strain

18. The bending moment for a certain portion of a beam is constant. For that portion, shear force would be

- (A) zero
- (B) increasing
- (C) decreasing
- (D) constant

19. The area under a stress-strain curve represents

- (A) breaking strength of material
- (B) toughness of material
- (C) hardness of material
- (D) energy required to cause failure

20. The plastic section modulus for a rectangular section of width  $b$  and depth  $d$  is

- (A)  $\frac{bd^3}{3}$
- (B)  $\frac{bd^2}{6}$
- (C)  $\frac{bd^2}{4}$
- (D)  $\frac{bd^2}{12}$

21. A loose uniform sand with rounded grains has effective grain size of 0.05 cm. The coefficient of permeability of the sand is

- (A) 0.25 cm/sec
- (B) 0.50 cm/sec
- (C) 1.00 cm/sec
- (D) 1.25 cm/sec

22. In a saturated soil deposit having a density of  $22 \text{ kN/m}^3$ , the effective normal stress on a horizontal plane at 5 m depth will be
- (A)  $22 \text{ kN/m}^2$   
 (B)  $50 \text{ kN/m}^2$   
 (C)  $60 \text{ kN/m}^2$   
 (D)  $110 \text{ kN/m}^2$
23. Net ultimate bearing capacity of a soil is  $25 \text{ t/m}^2$  and density  $1.7 \text{ t/m}^3$ . The safe bearing capacity at 1 m below the ground surface taking a factor of safety 2.5 will be
- (A)  $10 \text{ t/m}^2$   
 (B)  $25 \text{ t/m}^2$   
 (C)  $11.7 \text{ t/m}^2$   
 (D)  $62.5 \text{ t/m}^2$
24. A saturated clay layer with single drainage takes 4 years to attain 50% degree of consolidation. If the clay layer had double drainage, then the time to attain 50% degree of consolidation is
- (A) 8 years  
 (B) 4 years  
 (C) 2 years  
 (D) 1 year
25. A soil sample has void ratio of 0.5. Its porosity will be close to
- (A) 50%  
 (B) 66%  
 (C) 100%  
 (D) 33%
26. The efficiency of a pile group
- (A) will be always less than 100%  
 (B) will be always more than 100%  
 (C) may be less than 100% or more than 100%  
 (D) will be more than 100% in cohesive soil and less than 100% in cohesionless soil
27. Two footings, one circular and the other square, are founded on a surface of a purely cohesionless soil. The diameter of the circular footing is same as the side of the square footing. The ratio of their ultimate bearing capacities is
- (A)  $\frac{3}{4}$   
 (B)  $\frac{4}{3}$   
 (C) 1.0  
 (D) 2.0
28. Which of the following corrections is/are required while using standard penetration test values?
- (A) Overburden pressure  
 (B) Dilatancy  
 (C) Ground water  
 (D) All of the above
29. A soil has a liquid limit of 40% and plasticity index of 20%. The plastic limit of the soil is
- (A) 20%  
 (B) 30%  
 (C) 40%  
 (D) 60%

30. The behaviour of sand mass to cause liquefaction during an earthquake largely depends on
- member of stress cycles
  - amplitude of earthquake
  - angle of internal friction of sand
  - relative density of sand
31. Swelling nature of black cotton soil is primarily due to the presence of
- kaolinite
  - illite
  - vermiculite
  - montmorillonite
32. For local shear failure (if  $\phi$  = angle of internal friction)
- $\phi > 28^\circ$
  - $\phi > 36^\circ$
  - $\phi < 28^\circ$
  - $\phi < 36^\circ$
33. For a soil having angle of shearing resistance is  $30^\circ$ , the coefficient of active earth pressure is
- $\frac{1}{3}$
  - 3
  - $\frac{1}{2}$
  - 2
34. Relative density of soil is determined for
- cohesive soil
  - cohesionless soil
  - c- $\phi$  soil
  - all types of soil
35. For fully saturated soil, the degree of saturation is
- 0.5
  - 1.0
  - 0.8
  - 0.67
36. If a particular size of particle is missing in a soil mass, it is termed as
- uniformly graded soil
  - well graded soil
  - gap graded soil
  - poorly graded soil
37. A silty soil of high compressibility is represented by the symbol
- SM
  - ML
  - OI
  - MH

38. Compaction is a process of
- rearrangement of soil particles by dynamic pressure
  - rearrangement of soil particles by static pressure
  - decrease in pore water without replacement by air
  - changes in water content without change in volume
39. The force of attraction between the individual particles of soil which keeps the soil particles bound together is known as
- compaction
  - cohesion
  - internal friction
  - dilatancy
40. The dimensions of coefficient of permeability are
- $LT^{-1}$
  - $MT^{-1}$
  - $ML^{-2}$
  - Dimensionless
41. The angle of friction for purely cohesive soil is
- $45^\circ$
  - $30^\circ$
  - $15^\circ$
  - zero
42. A plate load test is performed to determine
- bearing capacity of foundation
  - settlement of foundation
  - both bearing capacity and settlement
  - consolidation of soil
43. Along a phreatic line in an earth dam
- pressure is atmospheric
  - pressure is greater than atmospheric
  - pressure is less than atmospheric
  - pressure head is constant but not zero
44. The permeability of soil varies
- as grain size
  - as square of grain size
  - inversely as square of grain size
  - inversely as grain size
45. The metacentric height is the distance between the
- original centre of buoyancy of the floating body and the new centre of buoyancy
  - centre of buoyancy of the floating body and the meta-centre
  - c.g. of the floating body and the centre of buoyancy
  - c.g. of the floating body and the metacentre

46. Reynolds number is defined as

(A)  $\frac{\text{Inertia force}}{\text{Gravity force}}$

(B)  $\frac{\text{Inertia force}}{\text{Viscous force}}$

(C)  $\frac{\text{Gravity force}}{\text{Viscous force}}$

(D)  $\frac{\text{Viscous force}}{\text{Inertia force}}$

47. Hydraulic gradient line represents the sum of

(A) pressure head and kinetic head

(B) datum head and pressure head

(C) kinetic head and pressure head

(D) pressure head, kinetic head and datum head

48. Separation of boundary layer takes place in case of

(A) negative pressure gradient

(B) positive pressure gradient

(C) zero pressure gradient

(D) hydraulic jump

49. When a liquid flows in a circular pipe of diameter  $D$  with an average velocity  $V$ , the head loss due to friction ( $h_f$ ) in a pipe of length  $L$  and of friction factor  $f$  is given by

(A)  $h_f = \frac{fLV^2}{gD}$

(B)  $h_f = \frac{4fLV^2}{2gD}$

(C)  $h_f = \frac{4fLV^2}{gD}$

(D)  $h_f = \frac{fLV^2}{2gD}$

50. Pitot tube is a device used in flowing fluid to measure

(A) discharge

(B) pressure head

(C) velocity

(D) viscosity

51. The velocity components in  $x$  and  $y$  directions of stream function ( $\psi$ ) are

(A)  $u = \frac{\partial\psi}{\partial x}, v = -\frac{\partial\psi}{\partial y}$

(B)  $u = -\frac{\partial\psi}{\partial x}, v = \frac{\partial\psi}{\partial y}$

(C)  $u = \frac{\partial\psi}{\partial y}, v = \frac{\partial\psi}{\partial x}$

(D)  $u = \frac{\partial\psi}{\partial x}, v = \frac{\partial\psi}{\partial y}$

52. In a rectangular channel

- (A) Critical depth = Specific energy
- (B) Critical depth  
 $= \frac{3}{4} \times \text{Specific energy}$
- (C) Critical depth  
 $= \frac{2}{3} \times \text{Specific energy}$
- (D) Critical depth  
 $= \frac{1}{2} \times \text{Specific energy}$

53. The hydraulic depth in a triangular channel section with side slope  $H:V = z:1$  for a depth of flow  $y$  is

- (A)  $\frac{y}{\sqrt{2}}$
- (B)  $\frac{y}{2}$
- (C)  $\frac{zy}{\sqrt{2}}$
- (D)  $\frac{zy}{2}$

54. If in a hydraulic jump, supercritical depth and subcritical depth are 1.0 m and 2.5 m respectively, the loss of energy in hydraulic jump in a rectangular channel is

- (A) 0.15 m
- (B) 0.3375 m
- (C) 0.225 m
- (D) 0.880 m

55. In case of a steady jump, the range of Froude's number  $F_1$  is

- (A)  $1.0 < F_1 \leq 1.7$
- (B)  $1.7 < F_1 \leq 2.5$
- (C)  $2.5 < F_1 \leq 4.5$
- (D)  $4.5 < F_1 \leq 9.0$

56. Infiltration capacity

- (A) is a constant factor
- (B) changes with time
- (C) changes with location
- (D) changes with both time and location

57. A current meter is used to measure the

- (A) velocity of flow of water
- (B) depth of flow of water
- (C) discharge
- (D) None of the above

58. An ideal fluid is

- (A) one which obeys Newton's law of viscosity
- (B) frictionless and incompressible
- (C) very viscous
- (D) frictionless and compressible

59. The horsepower transmitted through a pipe is maximum when the ratio of loss of head to friction and total head supplied is

- (A)  $\frac{1}{3}$
- (B)  $\frac{1}{4}$
- (C)  $\frac{1}{2}$
- (D)  $\frac{2}{3}$

60. For laminar flow in circular pipes, Darcy's friction factor  $f$  is equal to

- (A)  $\frac{16}{Re}$
- (B)  $\frac{32}{Re}$
- (C)  $\frac{64}{Re}$
- (D)  $\frac{1}{Re}$

where  $Re$  is Reynolds number.

61. Which of the following scales is the largest one?

- (A) 1 cm = 50 m
- (B) 1 mm = 20 m
- (C) 1:4000
- (D) RF = 1/200000

62. A well-conditioned triangle should not have angles more than

- (A)  $30^\circ$
- (B)  $60^\circ$
- (C)  $120^\circ$
- (D)  $150^\circ$

63. The sum of measured interior angles for a closed traverse shall be equal to ( $N$  = number of sides of traverse)

- (A)  $(N-4) \times 90^\circ$
- (B)  $(2N-4) \times 90^\circ$
- (C)  $(2N-3) \times 90^\circ$
- (D)  $(2N+3) \times 90^\circ$

64. Correction to be applied for a 30 m long chain length along slope  $\alpha$  is

- (A)  $30(1 - \cos\alpha)$
- (B)  $30\cos\alpha$
- (C)  $30(\cos\alpha - 1)$
- (D)  $30(\sec\alpha - 1)$

65. Height of instrument method of levelling as compared to rise and fall method is

- (A) more accurate
- (B) less accurate
- (C) more tedious
- (D) less tedious

66. Which of the following weirs is not classified on the basis of shape of the opening?

- (A) Rectangular weir
- (B) Cipolletti weir
- (C) Ogee-shaped weir
- (D) Triangular weir

67. Equipotential line represents

- (A) constant value of velocity potential
- (B) constant value of stream function
- (C) uniform variation of velocity potential
- (D) uniform variation of stream function

68. The reading on a differential manometer containing mercury (specific gravity = 13.6) is 25 cm. If mercury is replaced with water, the reading on differential manometer would be

- (A) 3.15 m
- (B) 3.4 m
- (C) 34 cm
- (D) 31.5 cm

69. For an element subjected to pure shear stress  $\tau$ , the maximum principal stress will be

- (A)  $2\tau$
- (B)  $\frac{\tau}{2}$
- (C)  $\tau$
- (D)  $4\tau$

70. A torsion test gives the shear modulus of a specimen as  $12 \times 10^4$  N/mm<sup>2</sup>. When the same sample was subjected to a tensile test, its elastic modulus was found to be  $3 \times 10^5$  N/mm<sup>2</sup>. Poisson's ratio of the material would be

- (A) 0.35
- (B) 0.16
- (C) 0.75
- (D) 0.25

71. For a thin-walled cylindrical pressure vessel, the ratio of circumferential stress to longitudinal stress is

- (A) 2
- (B)  $\frac{1}{2}$
- (C) 1
- (D) 3

72. A material is referred to as perfectly rigid if modulus of elasticity of the material is

- (A) infinity
- (B) zero
- (C) unity
- (D) greater than infinity

73. A uniform bar of length  $L$ , cross-sectional area  $A$  and material density  $\rho$  is suspended vertically from one end. Axial elongation of the bar will be

- (A)  $\frac{\rho g L^2}{2E}$
- (B)  $\frac{\rho g L}{2E}$
- (C)  $\frac{\rho g L}{AE}$
- (D)  $\frac{\rho g L^2}{AE}$

74. A body having a weight of 200 N is placed on a rough horizontal plane. If coefficient of friction between the body and the horizontal plane is 0.3, the horizontal force required to just slide the body on the plane is

- (A) 120 N
- (B) 200 N
- (C) 60 N
- (D) 666.67 N

75. A body falls from rest. Find the velocity of the body at the instant it has fallen through a height of  $h$  metres.

- (A)  $gh$
- (B)  $2gh$
- (C)  $\sqrt{2}gh$
- (D)  $\sqrt{2gh}$

76. A soil sample of specific gravity 2.65 has a void ratio of 0.8. The water content in percentage required to saturate the soil is

- (A) 40
- (B) 30
- (C) 20
- (D) 10

77. Discharge velocity of a soil is  $8 \times 10^{-7}$  m/s and void ratio is 0.40. Its seepage velocity will be \_\_\_\_\_  $\times 10^{-7}$  m/s.

- (A) 28
- (B) 2.8
- (C) 24
- (D) 18

78. Surge tanks are used

- (A) for storage of water
- (B) to increase velocity in pipeline
- (C) as overflow valves
- (D) to guard against water hammer

79. The dimensions of surface tension are

- (A)  $ML^{-1}$
- (B)  $L^2T^{-1}$
- (C)  $ML^{-1}T^{-2}$
- (D)  $MT^{-2}$

80. Kinematic similarity between model and prototype means

- (A) similarity of forces
- (B) similarity of shape
- (C) similarity of motion
- (D) similarity of discharge

81. When a chain is used at a temperature more than the temperature it was calibrated, the error in the measured length will be

- (A) cumulative
- (B) compensating
- (C) negative
- (D) observational error

82. If the magnetic bearing of a line is  $62^\circ 20'$  and the magnetic declination is  $2^\circ 50'$  west, then the true bearing of the line will be

- (A)  $64^\circ 70'$
- (B)  $59^\circ 70'$
- (C)  $65^\circ 10'$
- (D)  $59^\circ 30'$

83. If the forebearings of lines AB and BC are  $190^\circ$  and  $39^\circ$  respectively, the included  $\angle ABC$  is

- (A)  $29^\circ$
- (B)  $151^\circ$
- (C)  $49^\circ$
- (D)  $229^\circ$

84. A transition curve is introduced to gradually change the

- (A) superelevation
- (B) direction
- (C) gradient
- (D) camber

85. The axis about which the telescope and the vertical circle of a theodolite rotates in the vertical plane is called

- (A) vertical axis of telescope
- (B) bubble axis
- (C) trunnion axis
- (D) axis of level tube

86. In case of levelling, backsight is

- (A) the first staff reading taken after setting the instrument
- (B) the last staff reading taken before shifting the instrument
- (C) any staff reading taken on a point of unknown elevation
- (D) a fixed point of known elevation

87. For a tacheometer, the additive and multiplicative constants are respectively

- (A) zero and 100
- (B) 100 and zero
- (C) 100 and 100
- (D) zero and 1

88. Obstacle to ranging but not chaining is

- (A) river
- (B) hill
- (C) building
- (D) pond

89. Cross-hairs in a surveying telescope are fitted

- (A) at the centre of telescope
- (B) in the objective glass
- (C) in front of the eyepiece
- (D) anywhere between objective and eyepiece

90. A series of closely spaced contour lines represents a

- (A) steep slope
- (B) uniform slope
- (C) horizontal surface
- (D) gentle slope

91. The process of turning the telescope about the vertical axis in a horizontal plane is called

- (A) reversing
- (B) transiting
- (C) plunging
- (D) swinging

92. To determine the length of a bridge proposed to be built across a wide river, the survey method of choice would be

- (A) tacheometry
- (B) chain survey
- (C) hydrographic survey
- (D) triangulation

93. Mean sea level at any place is the average datum of hourly tide height observed over a period of nearly

- (A) 5 years
- (B) 10 years
- (C) 20 years
- (D) 50 years

94. Shift of a curve is equal to

- (A)  $\frac{L}{6R}$
- (B)  $\frac{L^2}{6R}$
- (C)  $\frac{L}{24R}$
- (D)  $\frac{L^2}{24R}$

95. Which of the following methods of plane table surveying is used to locate the position of an inaccessible point?

- (A) Radiation
- (B) Intersection
- (C) Traversing
- (D) Resection

96. If diameter of a long column is reduced by 20%, then percentage reduction in Euler's buckling load is

- (A) 4
- (B) 36
- (C) 48
- (D) 56

97. A 25 kN point load acts on the surface of an infinite elastic medium. The vertical pressure intensity in  $\text{kN/m}^2$  at a point 6.0 m below and 4.0 m away from the load will be

- (A) 132
- (B) 13.2
- (C) 1.32
- (D) 0.132

98. Negative skin friction is considered when the pile is constructed through a/an

- (A) fill material
- (B) dense coarse sand
- (C) overconsolidated stiff clay
- (D) dense fine sand

99. In a triaxial test carried out on a cohesionless soil sample with a cell pressure of 20 kPa, the observed value of applied stress at failure was 4 kPa. The angle of internal friction of the soil is

- (A)  $10^\circ$
- (B)  $20^\circ$
- (C)  $25^\circ$
- (D)  $30^\circ$

100. Water stored in a reservoir below the minimum pool level is called

- (A) valley storage
- (B) bank storage
- (C) surcharge storage
- (D) dead storage