

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

Test Booklet No. :

Series

04141

TEST BOOKLET

Paper—II

(CIVIL ENGINEERING)



Time Allowed : 2 Hours

Full Marks : 100

Read the following instructions carefully before you begin to answer the questions :

1. The name of the Subject, Roll Number as mentioned in the Admission Certificate, Test Booklet No. and Series are to be written legibly and correctly in the space provided on the Answer-Sheet with Black/Blue ballpoint pen.
2. Answer-Sheet without marking Series as mentioned above in the space provided for in the Answer-Sheet shall not be evaluated.
3. All questions carry equal marks.

The Answer-Sheet should be submitted to the Invigilator.

Directions for giving the answers : Directions for answering questions have already been issued to the respective candidates in the 'Instructions for marking in the OMR Answer-Sheet' along with the Admit Card and Specimen Copy of the OMR Answer-Sheet.

Example :

Suppose the following question is asked :

The capital of Bangladesh is

- (A) Chennai
- (B) London
- (C) Dhaka
- (D) Dhubri

You will have four alternatives in the Answer-Sheet for your response corresponding to each question of the Test Booklet as below :

(A) (B) (C) (D)

In the above illustration, if your chosen response is alternative (C), i.e., Dhaka, then the same should be marked on the Answer-Sheet by blackening the relevant circle with a Black/Blue ballpoint pen only as below :

(A) (B) (●) (D)

The example shown above is the only correct method of answering.

4. Use of eraser, blade, chemical whitener fluid to rectify any response is prohibited.
5. Please ensure that the Test Booklet has the required number of pages (16) and 100 questions immediately after opening the Booklet. In case of any discrepancy, please report the same to the Invigilator.
6. No candidate shall be admitted to the Examination Hall/Room 20 minutes after the commencement of the examination.
7. No candidate shall leave the Examination Hall/Room without prior permission of the Supervisor/ Invigilator. No candidate shall be permitted to hand over his/her Answer-Sheet and leave the Examination Hall/Room before expiry of the full time allotted for each paper.
8. No Mobile Phone, Electronic Communication Device, etc., are allowed to be carried inside the Examination Hall/Room by the candidates. Any Mobile Phone, Electronic Communication Device, etc., found in possession of the candidate inside the Examination Hall/Room, even if on off mode, shall be liable for confiscation.
9. No candidate shall have in his/her possession inside the Examination Hall/Room any book, notebook or loose paper, except his/her Admission Certificate and other connected papers permitted by the Commission.
10. Complete silence must be observed in the Examination Hall/Room. No candidate shall copy from the paper of any other candidate, or permit his/her own paper to be copied, or give, or attempt to give, or obtain, or attempt to obtain irregular assistance of any kind.
11. This Test Booklet can be carried with you after answering the questions in the prescribed Answer-Sheet.
12. Noncompliance with any of the above instructions will render a candidate liable to penalty as may be deemed fit.
13. No rough work is to be done on the OMR Answer-Sheet. You can do the rough work on the space provided in the Test Booklet.

N.B. : There will be negative marking @ 0.25 per 1 (one) mark against each wrong answer.

1. The point where the total volume of the body is assumed to be concentrated is

- (A) centre of area
- (B) centroid of volume
- (C) centroid of mass
- (D) All of the above

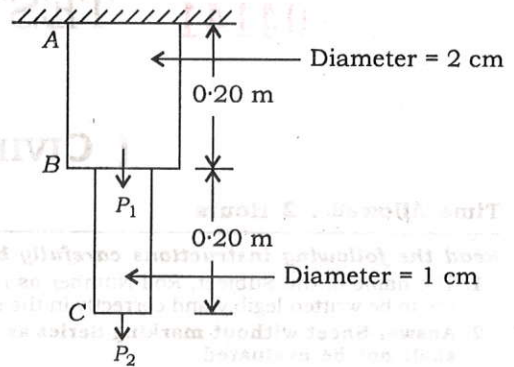
2. The moment of inertia (I_{xx} or I_{yy}) of a hollow circular section of external diameter D and internal diameter d is

- (A) $\frac{\pi}{32}(D-d)^4$
- (B) $\frac{\pi}{32}(D^4 - d^4)$
- (C) $\frac{\pi}{64}(D-d)^4$
- (D) $\frac{\pi}{64}(D^4 - d^4)$

3. In a perfect frame, if j = number of joints and n = number of members, then

- (A) $n = 2j + 3$
- (B) $n = 2j - 3$
- (C) $n > 2j + 3$
- (D) $n < 2j - 3$

4. A mild steel bar consisting of parts AB and BC is loaded as shown in the figure ($P_1 = P_2 = 10$ kN). The ratio of the stresses, σ_1 in part AB to σ_2 in part BC, is



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

5. The distance of the centroid of a semi-circle of radius r from its base is

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

6. A bar of uniform rectangular section of area A is subjected to an axial tensile load P . If E is the Young's modulus and $\frac{1}{m}$ is the Poisson's ratio, then the volumetric strain (e_v) is given by

(A) $\frac{P}{AE} \left(1 - \frac{2}{m}\right)$

(B) $\frac{P}{AE} \left(1 + \frac{2}{m}\right)$

(C) $\frac{P}{AE} \left(1 - \frac{1}{m}\right)$

(D) $\frac{P}{AE} \left(1 + \frac{1}{m}\right)$

7. The shear force on a simply supported beam is proportional to

(A) displacement of the neutral axis

(B) sum of the forces

(C) algebraic sum of the transverse forces of the section

(D) sum of the transverse forces

8. A three-hinged arch is said to be

(A) statically determinate structure

(B) statically indeterminate structure

(C) a bent beam

(D) None of the above

9. Principal planes are the planes on which the resultant stress is the

(A) shear stress

(B) normal stress

(C) tangential stress

(D) compressive stress

10. Hooke's law is applicable within

(A) elastic limit

(B) plastic limit

(C) fracture point

(D) ultimate strength

11. For a column whose one end is fixed and the other end is hinged, the crippling load for actual length l will be calculated by the formula

(A) $\frac{\pi^2 EI}{2l^2}$

(B) $\frac{\pi^2 EI}{4l^2}$

(C) $\frac{4\pi^2 EI}{l^2}$

(D) $\frac{2\pi^2 EI}{l^2}$

12. A fixed beam of 2 m length is subjected to a uniformly distributed load of 2 t/m over the entire length. The maximum hogging BM is equal to

(A) 1.0 t-m

(B) 2.0 t-m

(C) 0.33 t-m

(D) 0.67 t-m

13. A 100 mm diameter shaft is subjected to a torque of 3.14 kN-m. The maximum shear stress induced in the shaft is
- (A) 64 N/mm²
 (B) 32 N/mm²
 (C) 31.4 N/mm²
 (D) 16 N/mm²
14. The relationship among Young's modulus (E), bulk modulus (K) and Poisson's ratio (μ) is given by
- (A) $E = 2K(1 - 2\mu)$
 (B) $E = 3K(1 - 2\mu)$
 (C) $E = 2K(1 - 4\mu)$
 (D) $E = 2K(1 - 3\mu)$
15. The ability of the material to deform without breaking is called
- (A) elasticity
 (B) plasticity
 (C) creep
 (D) None of the above
16. When mild steel is subjected to a tensile load, its fracture will conform to
- (A) star shape
 (B) granular shape
 (C) cup and cone shape
 (D) fibrous shape
17. The ratio of average shear stress to the maximum shear stress for a solid circular section is
- (A) $\frac{3}{4}$
 (B) $\frac{2}{3}$
 (C) $\frac{1}{2}$
 (D) $\frac{3}{5}$
18. If a body is projected vertically upward with a velocity of 49 m/s, then the time taken to reach its original position is
- (A) 0.5 second
 (B) 5 seconds
 (C) 9.8 seconds
 (D) 10 seconds
19. The number of independent equations to be satisfied for static equilibrium of a plane structure is
- (A) 1
 (B) 2
 (C) 3
 (D) 6
20. The three-moment equation is applicable only when
- (A) the beam is prismatic
 (B) there is no settlement of supports
 (C) there is no discontinuity such as hinges within the span
 (D) the spans are equal

21. The minimum size of fillet weld should be
- not less than 3 mm
 - less than 3 mm
 - less than 2 mm
 - greater than the thickness of the thinner part joined
22. When one plate overlaps the other and the two plates are riveted together with two rows of rivets, the joint is known as
- single riveted lap joint
 - double riveted lap joint
 - double riveted single cover butt joint
 - double riveted double cover butt joint
23. Which of the following sections should preferably be used at places where torsion occurs?
- Angle section
 - Channel section
 - Box type section
 - Any of the above
24. Polar modulus of a shaft can be defined as the ratio of
- torsional moment of resistance to polar moment of inertia
 - polar moment of inertia to radius of the shaft
 - polar moment of inertia to moment of inertia
 - polar moment of inertia to torsional moment of resistance of the section of the shaft
25. The motion of the wheels of a bicycle is known as
- rotary
 - curvilinear
 - translatory
 - rotary and translatory
26. Which of the following is **not** the displacement method?
- Equilibrium method
 - Column analogy method
 - Moment distribution method
 - Kani's method
27. For a particular material, if the modulus of rigidity is equal to bulk modulus, then the Poisson's ratio will be
- $\frac{1}{2}$
 - $\frac{1}{4}$
 - $\frac{1}{8}$
 - 1
28. If the major and minor principal stresses acting on a rectangular block are 140 N/mm^2 (tensile) and 10 N/mm^2 (tensile) respectively, then the maximum shear stress will be
- 130 N/mm^2
 - 75 N/mm^2
 - 65 N/mm^2
 - 37.5 N/mm^2

29. As per IS : 1498, silt particles are smaller than
- (A) 425 micron
 - (B) 150 micron
 - (C) 75 micron
 - (D) 4.25 micron
30. In the plasticity chart of IS soil classification, the plasticity index of CL-MI soil varies between
- (A) 0-10
 - (B) 4-7
 - (C) 4-15
 - (D) 7-18
31. The angle of internal friction is least for
- (A) angular-grained loose sand
 - (B) angular-grained dense sand
 - (C) round-grained loose sand
 - (D) clays
32. For testing a saturated clay for shear strength, the test recommended is
- (A) direct shear test
 - (B) triaxial compression test
 - (C) unconfined compression test
 - (D) None of the above
33. The coefficient of permeability of soil
- (A) does not depend upon temperature
 - (B) increases with increase in temperature
 - (C) increases with decrease in temperature
 - (D) None of the above
34. The quantity of seepage of water through soils is proportional to
- (A) coefficient of permeability of the soil
 - (B) total head loss through the soil
 - (C) Neither (A) nor (B)
 - (D) Both (A) and (B)
35. The pressure distribution diagram for the earth pressure at rest is
- (A) circular
 - (B) triangular
 - (C) rectangular
 - (D) square
36. The China clay is which one of the following types of clay mineral?
- (A) Kaolinite
 - (B) Gibbsite
 - (C) Montmorillonite
 - (D) Illite

37. Piping in soil occurs

- (A) because of sudden change in permeability due to different soil layers
- (B) when the soil is highly porous
- (C) when the soil is highly stratified
- (D) when the upward seepage pressure is equal to the pressure due to submerged weight of the soil

38. The negative skin friction acting on pile is

- (A) the skin friction acting in upward direction due to compressible fill
- (B) the skin friction acting in upward direction due to stiff soil
- (C) the skin friction acting in downward direction due to compressible fill
- (D) None of the above

39. If q_s , q_{ns} and q_{nf} are the safe bearing capacity, net bearing capacity and net ultimate bearing capacity of a soil of average density γ at a depth D respectively and F = factor of safety, then

- (A) $q_s = \frac{q_{ns}}{F} + \gamma D$
- (B) $q_s = \frac{q_{nf}}{F} + \gamma D$
- (C) $q_{nf} = q_{ns} \cdot F - \gamma D$
- (D) $q_{nf} = q_{ns} \cdot F + \gamma D$

40. Swelling nature of black cotton soil is primarily due to the presence of

- (A) kaolinite
- (B) illite
- (C) vermiculite
- (D) montmorillonite

41. Grain size analysis of a soil indicates that

$$D_{10} = 0.0005 \text{ mm}$$

$$D_{30} = 0.003 \text{ mm}$$

$$D_{60} = 0.06 \text{ mm}$$

The uniformity coefficient of this soil is

- (A) 0.5
- (B) 2.0
- (C) 6.0
- (D) 12.0

42. With increase in compaction energy in compaction tests

- (A) MDD and OMC remain constant
- (B) MDD decreases and OMC increases
- (C) MDD increases and OMC decreases
- (D) MDD and OMC both increase

43. The ratio of settlement at any time to the final settlement is known as
- coefficient of consolidation
 - degree of consolidation
 - compression index
 - None of the above
44. The factor that is responsible for inclination of resultant pressure to the retaining wall is
- frictional force
 - surcharge
 - the earth pressure
 - weight of the wall
45. The difference between undisturbed shear strength and remoulded shear strength is known as
- activity
 - sensitivity
 - thixotropy
 - dilatancy
46. During consolidation process of a saturated soil, what happens to the degree of saturation of the soil?
- It increases
 - It decreases
 - It remains constant
 - It behaves randomly
47. Compaction of soil is done to
- remove water
 - remove air
 - remove soil particles
 - All of the above
48. During compaction, soil permeability
- increases
 - decreases
 - remains unchanged
 - None of the above
49. The maximum and minimum void ratios of a silty sand sample are 0.9 and 0.3 respectively. If at a certain state, the natural void ratio is 0.5, the relative density of the sample is
- 50%
 - 66.67%
 - 83.33%
 - 75%
50. If e = void ratio of a permeable soil, then the coefficient of permeability is proportional to
- $\frac{e^3}{1+e}$
 - $\frac{e}{1+e^3}$
 - $\frac{1}{e}$
 - $\frac{e}{1+e}$

51. According to Terzaghi, a foundation is shallow if
- (A) the depth is equal to or less than its width
 - (B) the depth is twice the width
 - (C) the width is thrice the depth
 - (D) the width is one-fourth of the depth
52. In standard penetration test, what is the dropping height as per IS : 2131-1981?
- (A) 450 mm
 - (B) 750 mm
 - (C) 650 mm
 - (D) 250 mm
53. The plasticity index of loose sand is about
- (A) 10-20
 - (B) 20-30
 - (C) 30-40
 - (D) None of the above
54. The decrease in void ratio per increase in effective stress is termed as
- (A) compression index
 - (B) swelling index
 - (C) coefficient of compressibility
 - (D) coefficient of consolidation
55. Bentonite is a clay formed by
- (A) organic soil
 - (B) fine inorganic silt
 - (C) calcareous clay
 - (D) decomposition of volcanic ash
56. The process by which a mass of saturated soil is caused by external forces to suddenly lose its shear strength and to behave as a fluid is called
- (A) piping
 - (B) sliding
 - (C) quick condition
 - (D) liquefaction
57. The tension in a string will be
- (A) maximum at support ends
 - (B) maximum at midway of the string
 - (C) maximum at quarter span
 - (D) uniform at each point along the string
58. In case of S_2 profile, the depth of flow (y) is
- (A) $y_n > y > y_c$
 - (B) $y_n < y < y_c$
 - (C) $y_n < y > y_c$
 - (D) $y_n > y < y_c$

59. For most economical rectangular channel, the hydraulic mean depth is equal to
- the depth of flow
 - half of the depth of flow
 - one-third of the depth of flow
 - None of the above
60. Normal depth in open channel flow is the depth of flow corresponding to
- steady flow
 - unsteady flow
 - laminar flow
 - uniform flow
61. Practical fluids
- are viscous
 - possess surface tension
 - are compressible
 - possess all of the above properties
62. The density of water is maximum at
- 0 °C
 - 4 °C
 - 100 °C
 - 20 °C
63. Bernoulli equation deals with the law of conservation of
- mass
 - momentum
 - energy
 - work
64. The property of a fluid, which offers resistance to the movement of one layer of fluid over another adjacent layer of fluid, is called
- surface tension
 - compressibility
 - capillarity
 - viscosity
65. When the flow parameters at any given instant remain same at every point, the flow is said to be
- quasistatic
 - steady state
 - laminar
 - uniform
66. Orifice meter is used to measure
- pressure at a point
 - discharge
 - average speed
 - velocity

67. The shear stress (τ) distribution across a section of a circular pipe of radius r having viscous flow is

(A) $\tau = \frac{\partial P}{\partial x} \cdot r^2$

(B) $\tau = \frac{\partial P}{\partial x} \cdot \frac{r}{2}$

(C) $\tau = \left(-\frac{\partial P}{\partial x}\right) \cdot \frac{r}{2}$

(D) $\tau = \left(-\frac{\partial P}{\partial x}\right) \cdot 2r$

68. Pitot tube is a device used in which fluid measuring?

(A) Discharge

(B) Pressure

(C) Velocity

(D) Kinetic energy + Pressure energy

69. If the critical depth in triangular channel is 0.60 m, the specific energy at critical depth is

(A) 1.00 m

(B) 0.80 m

(C) 0.75 m

(D) 0.60 m

70. Which of the following groups of GVF profiles does **not** exist?

(A) H_1, A_1, C_2

(B) H_1, A_2, C_2

(C) H_2, A_1, C_2

(D) H_1, A_1, C_1

71. At most economical section, a rectangular channel section has an area as 50 m². What is the bed width of the channel?

(A) 4 m

(B) 6 m

(C) 8 m

(D) 10 m

72. A channel is said to be of most economical cross-section, if

(A) it gives maximum discharge for a given cross-sectional area and bed slope

(B) it has minimum wetted perimeter

(C) it involves lesser excavation for the designed amount of discharge

(D) All of the above

73. In an open channel, the specific energy is the

(A) total energy per unit discharge

(B) total energy measured with respect to the datum passing through the bottom of the channel

(C) total energy measured above the horizontal datum

(D) kinetic energy plotted above the free surface of water

74. If the velocity potential of a fluid satisfies the Laplace equation, then the flow is

- (A) steady and uniform
- (B) steady and rotational
- (C) uniform, incompressible and irrotational
- (D) steady, incompressible and irrotational

75. Kinematic similarity between model and prototype means

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

76. Boundary layer on a flat plate is known as laminar boundary layer, if

- (A) Reynolds number < 2000
- (B) Reynolds number < 4000
- (C) Reynolds number < 5000
- (D) Reynolds number $< 5 \times 10^5$

77. The hydraulic mean depth or the hydraulic radius is the ratio of

- (A) area of flow and wetted perimeter
- (B) wetted perimeter and diameter of pipe
- (C) velocity of flow and area of flow
- (D) None of the above

78. The flow of water through the hole in the bottom of a wash basin is an example of

- (A) steady flow
- (B) uniform flow
- (C) free vortex
- (D) forced vortex

79. A flow in which the viscosity of fluid is dominating over the inertia force is called

- (A) steady flow
- (B) unsteady flow
- (C) laminar flow
- (D) turbulent flow

80. The ratio of inertia force to viscous force is called

- (A) Reynolds number
- (B) Froude number
- (C) Weber number
- (D) Euler number

81. The principle of surveying followed to prevent accumulation of errors is

- (A) to work from whole to part
- (B) to work from part to whole
- (C) Both (A) and (B)
- (D) None of the above

82. A triangle is said to be well-conditioned if none of its angles is

- (A) less than 20° and greater than 90°
- (B) less than 45° and greater than 90°
- (C) less than 30° and greater than 120°
- (D) less than 60° and greater than 60°

83. If the length of an arc or chord in a curve is 20 m, then the relation between radius of the curve and degree of the curve will be

- (A) $R = \frac{573}{D}$
- (B) $R = \frac{1146}{D}$
- (C) $R = 573 \times D^2$
- (D) $R = \frac{1718.9}{D}$

84. An imaginary line joining the points of equal elevation on the surface of the earth represents

- (A) contour surface
- (B) contour gradient
- (C) contour line
- (D) level line

85. Closed contours of decreasing values toward their centre represent

- (A) a hill
- (B) a depression
- (C) a saddle or pass
- (D) a river bed

86. The curvature of the earth is taken into consideration, if the limit of survey is

- (A) 50 km^2 to 100 km^2
- (B) 100 km^2 to 200 km^2
- (C) 200 km^2 to 250 km^2
- (D) more than 250 km^2

87. The angle between back tangent and forward tangent of a curve is known as
- (A) deflection angle
 - (B) central angle
 - (C) angle of intersection
 - (D) None of the above
88. Sag correction is
- (A) always positive
 - (B) sometime positive, sometime negative
 - (C) always negative
 - (D) zero
89. A series of closely spaced contour lines represents a
- (A) steep slope
 - (B) gentle slope
 - (C) uniform slope
 - (D) plane surface
90. If the magnetic bearing of a line is $61^{\circ}30'$ and the magnetic declination is $2^{\circ}50'$ West, then the true bearing of the line will be
- (A) $64^{\circ}20'$
 - (B) $58^{\circ}40'$
 - (C) $65^{\circ}20'$
 - (D) None of the above
91. A transition curve is introduced to gradually change the
- (A) direction
 - (B) superelevation
 - (C) gradient
 - (D) camber
92. The tacheometric method is more suitable method for preparing the contour map of a
- (A) valley
 - (B) hill
 - (C) ridge
 - (D) plane surface
93. The ratio in between centrifugal force and weight is designated as
- (A) equilibrium ratio
 - (B) centripetal ratio
 - (C) cant ratio
 - (D) centrifugal ratio
94. The vertical distance between any two consecutive contours is known as
- (A) contour line
 - (B) contour gradient
 - (C) contour interval
 - (D) horizontal equivalent

95. In a traverse, the deflection angle is the difference between
- (A) the included angle and 90°
 - (B) the included angle and 180°
 - (C) the included angle and 270°
 - (D) the included angle and 360°
96. Different grades are joined together by a
- (A) compound curve
 - (B) transition curve
 - (C) reverse curve
 - (D) vertical curve
97. A surface, which is normal to the direction of gravity at all points, as indicated by a plumb line, is known as
- (A) datum surface
 - (B) level surface
 - (C) horizontal surface
 - (D) vertical surface
98. In a prismatic compass, the zero of the graduated ring is located at
- (A) North end
 - (B) South end
 - (C) East end
 - (D) West end
99. Whole circle bearing varies from
- (A) 90° to 180°
 - (B) 180° to 270°
 - (C) 0° to 90°
 - (D) 0° to 360°
100. What is the least count of a levelling staff?
- (A) 0.5 mm
 - (B) 0.15 cm
 - (C) 5 mm
 - (D) 5 cm

SPACE FOR ROUGH WORK

97. In a traverse, the difference between the observed and the adjusted angles is called as

- (A) the included angle
- (B) the interior angle
- (C) the exterior angle
- (D) the included angle

98. When a line is drawn from a point to a line, the angle between them is called as

- (A) the included angle
- (B) the interior angle
- (C) the exterior angle
- (D) the included angle

99. When a line is drawn from a point to a line, the angle between them is called as

- (A) the included angle
- (B) the interior angle
- (C) the exterior angle
- (D) the included angle

SEAL