

QUESTION PAPER

1. The minimum and maximum eigen value of the matrix $\begin{pmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{pmatrix}$ are -2 and 6 respectively. What is the other eigen value?

- (a) 5
(b) 3
(c) 1
(d) -1

2. Evaluate $\lim_{x \rightarrow 1} \frac{x^x - x}{x - 1 - \log x}$

- (a) 2
(b) 0
(c) -2
(d) 8

3. If the rank of the matrix A is 2, the rank of $2A$ is

- (a) 1
(b) 2
(c) 4
(d) 6

4. The degree of the differential equation $\frac{d^2x}{dt^2} + 2x^3 = 0$ is

- (a) 0
(b) 2
(c) 1
(d) 3

5. $\int_0^{\pi/2} \sin^2 x \, dx$ equal to

- (a) $\frac{\pi}{4}$
(b) $\frac{\pi}{3}$
(c) $\frac{\pi}{2}$
(d) π

6. Two coins are simultaneously tossed. The probability of two heads simultaneously appearing is

- (a) $\frac{1}{8}$
(b) $\frac{1}{6}$
(c) $\frac{1}{4}$
(d) $\frac{1}{2}$

7. The $\lim_{x \rightarrow 0} \frac{\sin(2/3x)}{x}$ is

- (a) $\frac{2}{3}$
(b) 1
(c) $\frac{3}{2}$
(d) ∞

8. Evaluate $\int_0^{\pi/2} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}} \, dx$

- (a) $\frac{\pi}{4}$
(b) $\frac{\pi}{8}$
(c) $\frac{\pi}{2}$
(d) $\frac{\pi}{16}$

9. Evaluate $\lim_{x \rightarrow 0} \frac{e^x \sin x - x - x^2}{x^2 + x \log(1-x)}$

- (a) $\frac{-2}{3}$
(b) $\frac{2}{3}$
(c) $\frac{-3}{2}$
(d) $\frac{3}{2}$

10. The rank of $A = \begin{pmatrix} 0 & 0 & 0 & 0 \\ 4 & 2 & 3 & 0 \\ 1 & 0 & 0 & 0 \\ 4 & 0 & 3 & 0 \end{pmatrix}$ is

- (a) 0
- (b) 1
- (c) 2
- (d) 3

11. The modulus of rupture of concrete in terms of its characteristic cube compressive strength (f_{ck}) in Mpa according to IS 456-2000 is

- (a) $5000 f_{ck}$
- (b) $0.7 f_{ck}$
- (c) $5000 \sqrt{f_{ck}}$
- (d) $0.7 \sqrt{f_{ck}}$

12. For limit state of collapses, the partial safety factor recommended by IS 456-2000 for estimating the design strength of concrete and reinforcement steel are respectively

- (a) 1.15 and 1.5
- (b) 1.0 and 1.0
- (c) 1.5 and 1.15
- (d) 1.5 and 1.0

13. Creep Strain is

- (a) Caused due to live load only
- (b) Caused due to cyclic load only
- (c) Caused due to dead load only
- (d) Independent of load

14. Six columns of building are to be located within the plot size of 15×10 m. The expected load on each column is 600 kN. Allowable bearing capacity of soil is 120 kN/m^2 . The type of foundation to be used is

- (a) Isolated foundation
- (b) Pile foundation
- (c) Combined foundation
- (d) Raft foundation

15. A clay soil sample is tested in tri-axial apparatus in consolidated drained conditions at a cell pressure of 100 kN/m^2 . What will be the pore water pressure at a deviator stress of 40 kN/m^2 ?

- (a) 0 kN/m^2
- (b) 20 kN/m^2
- (c) 40 kN/m^2
- (d) 60 kN/m^2

16. The number of blows observed in a standard penetration test (SPT) for different depth are given below:

Penetration of Sample	Number of blows
0–150 mm	6
150–300 mm	8
300–450 mm	10

The observed ' N ' value is

- (a) 8
- (b) 14
- (c) 18
- (d) 24

17. A sampling tube has an inner diameter of 80 mm and outer diameter of 88 mm. The area ratio is

- (a) 0.21
- (b) 0.12
- (c) -0.21
- (d) -0.12

18. A compacted sample of soil with bulk density of 2.0 g/cm^3 has a water content of 15%. What is its dry density? Assume $G = 2.65$

- (a) 1.74 g/cm^3
- (b) 17.4 g/cm^3
- (c) 0.174 g/cm^3
- (d) 0.471 g/cm^3

19. A wet sample of sand weighing 415 g is taken for water content determination by a pycnometer. The mass of pycnometer, sand and water is 1667 g and mass of pycnometer full of water alone is 1440 g. Assume $G = 2.67$. Determine water content.

- (a) 41%
- (b) 14%
- (c) 0.14%
- (d) 0.41%

20. Match the dimensionless numbers in Group A to their definitions in Group B.

Group A	Group B
a. Reynolds's number	A. Ratio of inertia force to the surface tension force
b. Froude's number	B. Ratio of inertia force to the pressure force
c. Weber's number	C. Ratio of inertia force to the viscous force
d. Euler's number	D. Ratio of inertia force to the gravity force

- (a) a-B, b-A, c-D, d-C
 (b) a-C, b-D, c-A, d-B
 (c) a-D, b-C, c-A, d-B
 (d) a-A, b-B, c-C, d-D
21. When Mach number is less than unity, the flow is called
- (a) Sub-sonic flow
 (b) Sonic flow
 (c) Supersonic flow
 (d) Hypersonic flow
22. Coplanar concurrent force are those forces which
- (a) Meet at one point, but their lines of action do not lie in the same plane.
 (b) Do not meet at one point and their lines of action do not lie in the same plane.
 (c) Meet at one point and their lines of action also lie on the same plane.
 (d) Do not meet at one point, but their lines of action lie on the same plane.
23. The best hydraulic cross section for a open channel is the one
- (a) With a maximum hydraulic radius
 (b) With a maximum wetted perimeter
 (c) With a maximum hydraulic radius
 (d) With maximum resistance to flow
24. There is a free overall fall at the end of a long channel. For a given flow rate, the critical depth is less than normal depth. What gradually varied flow profile will occur in the channel for the flow rate?
- (a) M_1
 (b) M_2
 (c) M_3
 (d) S_1
25. For an isotropic material, the relationship between Young's modulus (E), Shear modulus (G), and Poisson's ratio (μ) is given by

$$(a) G = \frac{E}{2(1 + \mu)}$$

$$(b) E = \frac{G}{2(1 + \mu)}$$

$$(c) G = \frac{E}{(1 + 2\mu)}$$

$$(d) G = \frac{E}{2(1 - \mu)}$$

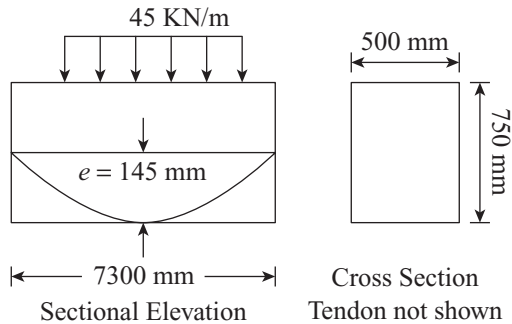
26. A standard measure of ductility of a material is
- (a) Percent elongation in length
 (b) Percent increase in the area
 (c) Percent decrease in the length
 (d) Percent decrease in length and increase in area
27. A rod of length $L = 500$ mm and cross sectional area $A = 60$ mm² is made of an elasto plastic material having a modular of elasticity $E = 200$ Gpa in its elastic range and yield point $\sigma_y = 300$ Mpa. The rod is subjected to an axial load until it is stretched 7 mm and the load is then removed. What is the resulting permanent set?
- (a) 6.25 mm
 (b) 6.50 mm
 (c) 6.00 mm
 (d) 5.95 mm
28. The change in the volume per unit volume occurs when normal stresses are applied on an element of isotropic material is called as
- (a) Bulk modulus of material
 (b) Shearing strain of material
 (c) Dilatation of material
 (d) Shearing stress of material
29. Determine the change in volume of a steel block of size 80 mm × 40 mm × 60 mm when it is subjected to the hydrostatic pressure $P = 180$ Mpa. Use $E = 200$ Gpa and $\nu = 0.29$
- (a) (-) 217.72 mm³
 (b) (-) 812 mm³
 (c) (-) 182 mm³
 (d) (-) 128 mm³
30. Whisper concrete is used
- (a) To increase the noise level of the road
 (b) To reduce the noise level of the road
 (c) To provide skid resistance and reduce noise level of the road
 (d) To increase the noise level and reduce the skid resistance of the road

31. The compound formed due to interaction of oxides present in the raw material of cement in the kiln at a high temperature are called
- Simple compound
 - Complicated compound
 - Bogue's compound
 - Joseph's compound
32. Transition zone represents
- The interfacial region between the particles of coarse aggregate and hard ended cement paste
 - The region between the paste phase and plane of weakness
 - The region between plane of weakness and the hardened paste
 - The region between aggregate phase and plane of weakness
33. The amount of water required for the complete chemical reaction of cement is
- 40% by weight of cement
 - 60% by weight of cement
 - 50% by weight of cement
 - 38% by weight of cement
34. High percentage of tricalcium silicate in cement results in
- No strength
 - High early strength
 - Slow setting
 - Slow hardening
35. Aggregate impact value indicates the following property of aggregate
- Durability
 - Toughness
 - Hardness
 - Strength
36. A bar of copper and bar of steel form a composite system, which is heated to a temp of 40°C. The stress in steel bar is
- Tensile
 - Compressive
 - Zero
 - Shear
37. A single bay single storey portal frame has hinged left support and fixed right support. It is loaded with uniformly distributed load on the beam. Which one of the following statement is true with regard to the deformation of the frame
- It would sway to the left side
 - It would sway to the right side
 - It would not sway at all
 - It would sway both ways
38. The permissible value of span/depth ratio will be the highest in the case of
- A simply supported beam
 - A cantilever beam
 - A continuous beam
 - It will be same for all cases
39. In the limit state design of a flexural bending, the maximum strain in the concrete at the outermost compression fibre is
- 0.0020
 - 0.0035
 - 0.0055
 - 0.0065
40. Under axial loading, a material will fail in shear, if the ratio of shear strength to tensile strength is less than
- 1
 - $\frac{3}{4}$
 - $\frac{1}{2}$
 - $\frac{1}{4}$
41. The important factor considered in the design of summit curve on highways is
- Comfort to passengers
 - Sight distance
 - Super elevation
 - Impact factor
42. The super elevation needed on a horizontal circular curve of 150 m radius for a design speed of 60 kmph with coefficient of friction of 0.15 is
- 38.8 cm
 - 3.88 cm
 - 0.388 cm
 - 388 cm

43. The rigid pavement are made of
- Bituminous binder
 - WBM
 - RCC
 - Plain concrete
44. California bearing ratio (CBR)
- Is a measure of soil strength.
 - Is a procedure of designing flexible pavement.
 - Is a method of soil identification.
 - Is a measure to indicate the relative strength of paving materials.
45. The contact pressure P_c , tyre pressure P and rigidity factor R are related by
- $\frac{P}{P_c} = R$
 - $\frac{P_c}{P} = R$
 - $P \cdot P_c = R$
 - $R = \sqrt{P \cdot P_c}$
46. Laterite is chemically classified as
- Calcareous rock
 - Argillaceous rock
 - Siliceous rock
 - Metamorphic rock
47. An assembled product made up of veneers and adhesives are called
- Board
 - Plank
 - Plywood
 - Batten
48. The purpose of seasoning of timber is to
- Change the direction of grains
 - Remove voids
 - Reduce moisture content
 - Increase the weight of timber
49. A first class brick should not absorb more than _____ of its own dry weight after 24 hrs of immersion in water
- 10%
 - 15%
 - 20%
 - 25%
50. A fixed point of reference of known elevation is called
- Change point
 - Station point
 - Bench mark
 - Datum
51. The vertical distance between two consecutive contours is called
- Vertical interval
 - Horizontal equivalent
 - Contour interval
 - Contour gradient
52. A benchmark has been established at the soffit of an ornamental arch at known elevation of 100.0 m above mean sea level. The back sight used to establish height of instrument is an inverted staff reading 2.105 m. A forward sight-reading with normally held staff of 1.105 m is taken on recently constructed plinth. The elevation of plinth is
- 103.21 m
 - 101.00 mm
 - 99.00 mm
 - 96.79 m
53. The method of leveling in which heights of mountain are found by observing the temperature at which the water boils is known as
- Barometric levelling
 - Reciprocal levelling
 - Longitudinal levelling
 - Hypometry
54. According to the Fuller's formula, the flood discharge (Q) in cumsec is given by
- $CA^{0.8}(1 + 0.80 \log T)(1 + 2.67A^{-0.3})$
 - $CA^{5/6}$
 - $CA \left(0.993 - \frac{1}{14 \log A} \right)$
 - $\frac{123 A}{\sqrt{A+10.4}}$
55. A deflecting Groyove in a river is
- Inclined towards upstream
 - Perpendicular to bank
 - Inclined towards downstream
 - Parallel to bank

56. A hydraulic jump is formed when
- A sub-critical flow strikes against super-critical flow
 - A super-critical flow strikes against sub-critical flow
 - The two flows of super-critical velocity meet each other
 - The two flows of sub-critical velocity meet each other
57. A convective precipitation is
- It results from lifting of air masses converging into low pressure area
 - It results from natural rising of warmer, lighter air in colder and dense surroundings
 - It results from lifting of warm moisture laden air masses due to topographic barrier
 - It results from lifting of air masses into high pressure area
58. A river meandering through an alluvial plain flows in a series of consecutive curve of reverse order (sinous curve), the transverse distance between the apex point of one curve and apex point on the reverse curve is called
- Meander length
 - Meandering width
 - Shoal
 - Meandering type
59. The maximum acidity in water will occur at a pH value of
- 0
 - 2
 - 7
 - 14
60. In the process of screening, the screen are inclined at 45° , the area of openings in screen should be such that the velocity of flow through them does not exceed,
- 0.75 to 1.0 m/s
 - 1.5 to 3.0 m/s
 - 3.0 to 5.0 m/s
 - 5.0 to 6.0 m/s
61. The most common coagulant is
- Magnesium sulphate
 - Alum
 - Chlorine
 - Bleaching powder
62. Self cleansing velocity is
- The maximum velocity of flow required to maintain certain amount of solids in the flow.
 - The minimum velocity of flow required to maintain certain amount of solids in the flow.
 - Such flow velocity as would be sufficient to flush out any deposited solids in the sewer.
 - Such flow of velocity as would be sufficient to ensure that sewage does not remain in the sewer.
63. When design imposed load does not exceed three-fourths of the design dead load, the load arrangement on structural frame as per IS 456-2000 is
- Design dead load and design imposed load on all the span.
 - Design dead load on all the span with full design imposed load on alternate span.
 - Design dead load on all span.
 - Design imposed load on all span.
64. A rectangular column section of 250×400 mm reinforced with 6 steel bars of F_{e500} , each of 25 mm diameter. Concrete mix is M_{30} . Axial load on column section with minimum eccentricity as per IS 456-2000 using limit state method can be applied upto:
- 1805.3 kN
 - 1707.37 kN
 - 2150.83 kN
 - 1903.7 kN
65. The effective length of circular electrical pole of length L and constant diameter erected on ground is
- $0.8 L$
 - $1.20 L$
 - $1.50 L$
 - $2.0 L$
66. If ϕ is the nominal diameter of reinforcing bar, f_x is compressive stress in the bar and f_{bd} is design bond stress of concrete, the anchorage length L_a of straight bar in compression is equal to:
- $L_a = \frac{\phi f_x}{f_{bd}}$
 - $L_a = \frac{\phi f_x}{2 f_{bd}}$
 - $L_a = \frac{\phi f_x}{\pi f_{bd}}$
 - $L_a = \frac{\phi f_x}{4 f_{bd}}$

67. A concrete beam prestressed with a parabolic tendon is shown in the sketch. The eccentricity of the tendon is measured from the centroid of the cross section. The applied prestressing force at service is 1620 kN. The uniformly distributed load of 45 kN/m includes self weight.



The stress (in N/mm²) in the bottom fibre at Mid Span is

- (a) Tension 2.94
 (b) Compression 2.94
 (c) Tensile 4.32
 (d) Compression 4.32
68. As per IS 456-2000; in the limit state design of a flexural member, the strain in reinforcing bar under tension at ultimate state should not be less than
- (a) $\frac{f_y}{E_x}$ (b) $\frac{f_y}{E_x} + 0.002$
 (c) $\frac{f_y}{1.15 E_x}$ (d) $\frac{f_y}{1.15 E_x} + 0.002$
69. As per Indian standard code of practice for prestressed concrete (IS 1343-1980), the minimum grade of concrete to be used for post tensioned and prestressed structural elements are respectively
- (a) M_{20} for both
 (b) M_{40} and M_{30}
 (c) M_{15} and M_{20}
 (d) M_{30} and M_{40}
70. The final deflection of a structure due to all loads including the effects of temperature, creep and shrinkage and measured from the as – cast level of support of floor, roofs and all other horizontal forces should not normally exceed
- (a) span/350
 (b) span/250
 (c) span/450
 (d) span/500

71. A square footing 2 m × 2 m is built in a homogeneous bed of sand of density 1.9 t/m³ and having an angle of shearing resistance of 38°. The depth of base of footing is 0.8 m below the ground surface. What is the safe load surrounding to Terzaghi analysis which can be carried by the footing with a factor of safety of 3 against complete shear failure? Assume $\phi = 38^\circ$; $N_q = 65$, $N_r = 80$
- (a) 298 t
 (b) 928 t
 (c) 892 t
 (d) 829 t
72. An elastic medium carries at its surface a uniform load of 10 t/m² (≈ 100 Kpa) covering a rectangular area of 4 m × 3 m. Find the vertical pressure at a depth of 5 m below the center and corner of the loaded area. Assume influence factor of equal quadrant is 0.0474 and influence factor for the point located at the corners of loaded area is 0.1247
- (a) 1.896 t/m²; 1.247 t/m²
 (b) 18.96 t/m²; 12.47 t/m²
 (c) 189.6 t/m²; 124.7 t/m²
 (d) 0.1896 t/m²; 0.1247 t/m²
73. A retaining wall, 4.5 m high has a smooth vertical back. The back fill has a horizontal surface in level with top of the wall. There is a uniformly distributed surcharge load of 2 t/m² intensity over the back fill. The density of the soil is 1.9 t/m³, its angle of shearing resistance is 30° and cohesion is zero. Determine the magnitude of the total active pressure per metre length of wall.
- (a) 94.1 t
 (b) 9.41 t
 (c) 941 t
 (d) 0.941 t
74. The shape factor of a rectangular section is
- (a) 1.00
 (b) 1.50
 (c) 2.00
 (d) 2.50
75. At two points 1 and 2 in a pipeline, the velocities of fluid are v and $3v$ respectively. Both points are at same elevation. The flow can be assumed to be incompressible, inviscid, steady and irrotational. The difference in pressure P_1 and P_2 at points 1 and 2 is
- (a) $0.5\rho v^2$
 (b) $2\rho v^2$
 (c) $3\rho v^2$
 (d) $4\rho v^2$

76. The top width and depth of flow in a rectangular channel were measured as 4 m and 1 m respectively. The measured velocities on the center line at the water surface, 0.2 m and 0.8 m below the surface are 0.7 m/s, 0.8 m/s, 0.6 m/s respectively. Using two point method of velocity measurement, the discharge (in m^3/s) in a channel is
- 1.4
 - 1.2
 - 1.0
 - 0.8
77. A rectangular open channel of width 5 m is carrying a discharge of $100 \text{ m}^3/\text{s}$. Froude number of flow is 0.8. The depth of flow in the channel is
- 4 m
 - 5 m
 - 6 m
 - 20 m
78. A concrete floor slab of 140 mm thick is reinforced by 16 mm dia steel rods placed 38 mm above the lower face of the slab and spaced 150 mm on center. The distance from the upper face of slab to steel is 100 mm. The modulus of elasticity is 25 Gpa for concrete and 200 Gpa for steel. Knowing that a bending moment of 4.5 kN m is applied to each 0.30 m width of slab, determine the maximum stress in the concrete and steel respectively
- 12.9 Mpa and 177.8 Mpa
 - 1.29 Mpa and 1.778 Mpa
 - 129 Mpa and 17.78 Mpa
 - 0.129 Mpa and 0.177 Mpa
79. The Poisson ratios of soil sample 1 and 2 are μ_1 and μ_2 respectively and the coefficient of earth pressure at rest for soil sample 1 and 2 are k_1 and k_2 respectively. If $\mu_2/\mu_1 = 1.5$ and $(1-\mu_1)/(1-\mu_2) = 0.875$, then k_1/k_2 will be
- 1.3125
 - 1.7143
 - 1.8213
 - 1.9687
80. Maximum cement content, maximum water cement ratio and minimum grade of concrete with normal weight of aggregate of 20 mm size for very severe exposure condition as per IS 456-2000 are respectively
- 340; 0.45; M_{35}
 - 400; 0.5; M_{40}
 - 360; 0.45; M_{40}
 - 320; 0.5; M_{35}