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UKPSC AE

Previous Year Paper
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Official Paper 1

1. In under-reamed pile construction, generally the ratio of shaft diameter to bulb diameter is
   (a) 1/1.5   (b) 1/2.0   (c) 1/2.5   (d) 1/4.0

2. The predominant mineral responsible for shrinkage and swelling in black cotton soil is
   (a) montmorillonite   (b) illite
   (c) kaolinite   (d) mica

3. A soil has a liquid limit of 35% and plastic index of 18%. The plastic limit of the soil will be
   (a) 18%   (b) 35%   (c) 53%   (d) 17%

4. An analysis of particle size distribution of a soil, it is found that $D_{10} = 0.12$ mm, $D_{30} = 0.36$ mm and $D_{60} = 0.72$ mm. The uniformity coefficient of soil is
   (a) 3.0   (b) 6.0   (c) 1.5   (d) 9.0

5. A soil has a discharge velocity of 5×10^{-7} m/s and a void ratio of 0.5. Its seepage velocity is
   (a) 15×10^{-7} m/s   (b) 10×10^{-7} m/s   (c) 5×10^{-7} m/s   (d) None of these

6. Reduction in volume of soil primarily due to squeezing out of water from the voids is called
   (a) Plastic flow   (b) Primary consolidation
   (c) Creep   (d) Secondary consolidation

7. Cohesion-less soils are formed due to
   (a) Oxidation   (b) Hydration
   (c) Physical disintegration   (d) Chemical decomposition

8. If instead of single drainage, the number of discharge faces is increased to two in responding soils, the rate of compression will be
   (a) 4 times slower (b) 2 times slower   (c) 4 times faster   (d) 2 times faster

9. Change in vertical stress in soil mass, estimated by Boussineq's equation when Poisson's ratio of soil changes from 0.3 to 0.5, will be
   (a) reduced by 30%   (b) increased by 20%
   (c) reduced by 20%   (d) No changes

10. In shear test on cohesionless soils, if the initial void ratio is less than critical void ratio, the sample will
    (a) increase in volume
    (b) decrease in volume
    (c) initially decrease and then increase in volume
    (d) initially increase in volume and then remains constant

11. If the sand is having an angle of internal friction of 30°, the ratio of passive to active lateral earth pressure will be
    (a) 1   (b) 9   (c) 3   (d) 6

12. If an infinite slope of clay at depth of 5.0 m has cohesion of 1.0 kN/m^2 and unit weight of 20.0 kN/m^3. The stability number will be
    (a) 0.01   (b) 0.02   (c) 0.03   (d) 0.04

13. A soil has the following properties :
$\phi = 30°$, Safe bearing capacity of soil p = 16 t/m² and unit weight of soil = 1.6 t/m³.
The minimum depth of foundation will be (as per Rankin's formula).
(a)   1.5 m   (b)   1.11 m   (c)   1.0 m   (d)   2.00 m

14. The hydraulic head that would produced a quick sand condition in a sand stratum of thickness 1.8 m, specific gravity 2.65 and void ratio 0.65, is equal to
(a)   1.2 m   (b)   1.6 m   (c)   1.0 m   (d)   1.8 m

15. Following are the two statements :
1.   Permeability of sand is more than clay.
2.   Void ratio of sand is always more than clay.
(a)   both 1 and 2 are true   (b)   1 is true and 2 is false
(c)   1 is false and 2 is true   (d)   both 1 and 2 are false

16. Inorganic soils with low compressibility and represented by
(a)   MH   (b)   SL   (c)   ML   (d)   CH

17. For a certain loading condition, a saturated clay layer undergoes 40% consolidation in a period of 178 days. What would be the additional time required for further 20% consolidation to occur ?
(a)   89 days   (b)   222.5 days   (c)   329.5 days   (d)   400.5 days

18. The stress taken up by the pore water in a soil mass is
(a)   effective stress   (b)   total stress
(c)   neutral stress   (d)   All of these

19. Sheep-foot rollers are recommended for compacting
(a)   hard rock   (b)   cohesive soil   (c)   grangular soil   (d)   any type of soil

20. If a soil is dried beyond its shrinkage limit, it will show
(a)   moderate volume change   (b)   large volume change
(c)   no change in volume   (d)   low volume change

21. The in-situ void ratio and specific gravity of a soil deposite are 0.5 and 2.50 respectively. The valve of critical hydraulic gradient is
(a)   0.9   (b)   1.0   (c)   1.5   (d)   1.25

22. Given that for a soil deposite
k_o = earth pressure coefficient at rest.
k_a = active earth pressure coefficient.
k_p = passive earth pressure coefficient.
μ = Poisson's ratio

The value of $\dfrac{1-\mu}{\mu}$ is given by

(a) $\dfrac{k_a}{k_p}$ (b) $\dfrac{k_o}{k_a}$ (c) $\dfrac{k_p}{k_a}$ (d) $\dfrac{1}{k_o}$

$\dfrac{2 \cdot 50 - 1}{1 + 5} = \dfrac{1 - 5}{1 \cdot 5} = 1$

$K_o = \dfrac{\mu}{}$

23. In the case of a counter fort retaining wall, the toe slab acts as a
    (a) Continuous slab
    (b) cantilever slab
    (c) simply supported slab
    (d) None of these

24. The piles used to transfer load through water or soft soil to a suitable bearing stratum is known as
    (a) Friction pile   (b) End bearing pile   (c) Compaction pile   (d) Anchor pile

25. In stroke's law, the terminal velocity of sinking particle is
    (a) Proportional to the square of radius of particle
    (b) Proportional to the radius of the particle
    (c) Inversely proportional to the square of radius of particle.
    (d) None of these

26. Poise is the unit of
    (a) Surface tension
    (b) Viscosity
    (c) Kinematic viscosity
    (d) None of these

27. The velocity components in x and y directions in terms of velocity potential (ϕ) are :
    (a) $\mu = -\dfrac{\partial \phi}{\partial x}, v = \dfrac{\partial \phi}{\partial y}$
    (b) $\mu = \dfrac{\partial \phi}{\partial y}, v = \dfrac{\partial \phi}{\partial x}$
    (c) $\mu = \dfrac{\partial \phi}{\partial x}, v = \dfrac{\partial \phi}{\partial y}$
    (d) $\mu = -\dfrac{\partial \phi}{\partial y}, v = \dfrac{\partial \phi}{\partial y}$

28. If H = total head at inlet, h_f = head lost due to friction, Efficiency of power transmission through pipe is given by
    (a) $\dfrac{(H - h_f)}{H}$
    (b) $\dfrac{H}{(H + h_f)}$
    (c) $\dfrac{(H - h_f)}{(H + h_f)}$
    (d) None of these

29. Cavitation in a pipe flow is caused by
    (a) negative pressure
    (b) low pressure
    (c) high pressure
    (d) moderate pressure

30. In a venturimeter, which of the following statement is correct ?
    (a) length of diverging cone is equal to length of converging cone.
    (b) length of diverging cone is more than converging cone.
    (c) length of diverging cone is less than length of converging cone.
    (d) None of these.

31. For saturated normal consolidated soil, Skempton's pore pressure. Coefficients are represented by
    (a) $A < 1, B = 1$ (b) $A > 1, B > 1$ (c) $A < 1, B < 1$ (d) $A = 1, B = 1$

32. Water is flowing under constant head of 40 cm in a soil sample 20 cm long and 10 cm^2 in sectional area. Quantity of flow in 4 minutes is 30 cm^3. Find k.
    (a) 3.750 cm/sec.   (b) 0.375 cm/sec.   (c) 3.75 cm/minutes   (d) 0.375 cm/minutes

33. The equation $\Delta H = \left(\dfrac{\Delta e}{1 + e_0}\right) H_0$ helps to calculate
    (a) change in head
    (b) compression of fill
    (c) consolidation of soil
    (d) All of these

34. When a fluid is flowing through a pipe, major loss in energy is due to
    (a) sudden expansion of pipe   (b) sudden contraction of pipe
    (c) bend in pipe   (d) friction

35. In case of a flow having Mach number equal to 1, it is called
    (a) Sonic flow   (b) Subsonic flow   (c) Transonic flow   (d) Supersonic flow

36. Formula $C\sqrt{RS}$ defines
    (a) Bazin's formula   (b) Chezy's formula
    (c) Manning's formula   (d) Kutter's formula

37. Water is flowing through a pipe of 70 mm diameter under a gauge pressure of 50 kPa and with a mean velocity of 2.0 m/s, neglecting friction. Determine the total head, if the pipe is 7.0 m above datum live.
    (a) 12.3 m   (b) 13.2 m   (c) 10.8 m   (d) 11.8 m

38. The equipotential line is one along which velocity potential (ϕ) is
    (a) Varying   (b) Constant
    (c) Varies with velocity   (d) Varies with potential

39. The type of flow, in which the velocity at any given time does not change with respect to space is called
    (a) Uniform flow   (b) Laminar flow
    (c) Smooth flow   (d) None of these

40. Determine the viscosity of a liquid having kinematic viscosity 6 strokes and specific gravity 1.9
    (a) 0.114 poise   (b) 1.140 poise   (c) 11.40 poise   (d) None of these

41. The momentum correction factor is expressed as

    (a) $\beta = \dfrac{1}{AV^2} \displaystyle\int_A v^2\, dA$

    (b) $\beta = \dfrac{1}{AV^2} \displaystyle\int_A v\, dA$

    (c) $\beta = \dfrac{1}{AV^3} \displaystyle\int_A v^2\, dA$

    (d) $\beta = \dfrac{1}{AV^2} \displaystyle\int_A v^3\, dA$

    (where symbols have their usual meaning)

42. If flow is irrotional, the relation that satisfies the flow condition is

    (a) $\dfrac{\partial U}{\partial x} - \dfrac{\partial V}{\partial y} = 0$

    (b) $\dfrac{\partial U}{\partial x} + \dfrac{\partial V}{\partial y} = 0$

    (c) $\dfrac{\partial V}{\partial x} - \dfrac{\partial U}{\partial y} = 0$

    (d) $\dfrac{\partial V}{\partial x} + \dfrac{\partial U}{\partial y} = 0$

43. For a pipe flow of diameter 'D' running full under action of gravity, the hydraulic mean depth will be

    (a) πD (b) $\dfrac{D}{4}$ (c) $\dfrac{D}{2}$ (d) D

44. The thickness of turbulent boundary layer a distance 'x' from the leading edge over a flat plate varies as
    (a) $x^{4/5}$ (b) $x^{1/2}$ (c) $x^{1/5}$ (d) $x^{3/5}$

45. Fluid statics deals with
    (a) Viscous and pressure forces
    (b) Viscous and Gravity forces
    (c) Gravity and pressure forces
    (d) Surface tension and gravity forces

46. Mach angle is denoted as
    (a) $\sin^{-1}(M)$
    (b) $\sin^{-1}\left(\dfrac{1}{M}\right)$
    (c) $\cos^{-1}\left(\dfrac{1}{M}\right)$
    (d) $\tan^{-1}\left(\dfrac{1}{M}\right)$

47. For oblique shock, the down stream Mach number ...... :
    (a) is always more than unity
    (b) is always less than unity
    (c) may be less or more than unity
    (d) can never be unity

48. Water is flowing in a converging pipe having inlet diameter of 10 cm and outlet diameter of 5 cm. If velocity of flow at the inlet 5 cm/s, what will be velocity of flow at the exit ?
    (a) 10 cm/s
    (b) 20 cm/s
    (c) 30 cm/s
    (d) 25 cm/s

49. The shear in turbulent flow is mainly due to
    (a) heat transfer
    (b) mass transfer
    (c) momentum transfer
    (d) All of these

50. A homogeneous earthen dam is 52 m high and has a free board of 2.0 m. The flownet drawn for a dam indicted the number of potential drops as 25 and the number of flow channels as 4. The coefficient of permeability of the dam is 3×10^{-6} m/s.. The discharge per m length of the dam will be
    (a) 2.4×10^{-6} m^3/sec/m
    (b) 24×10^{-6} m^3/sec/m
    (c) 2.5×10^{-6} m^3/sec/m
    (d) 25×10^{-6} m^3/sec/m

51. For a floating object, stable equilibrium will occur, if meta centre is
    (a) below the centre of gravity
    (b) coincide with centre of gravity
    (c) above the centre of gravity
    (d) None of these

52. Kaplan and Francis are
    (a) very high head and low discharge turbine
    (b) low head and low discharge turbines
    (c) high head and high discharge turbines
    (d) high discharge and low head turbines

53. Hydraulic jump occurs when
    (a) Super critical flows meets with subcritical flow.
    (b) Subcritical flows meets with subcritical flow.
    (c) Critical flows meets with super critical flow.
    (d) Critical flows meets with subcritical flow.

54. Velocity distribution profile for laminar flow between parallel plates is
    (a) Constant
    (b) Parabolic
    (c) Linear
    (d) Logarithmic

55. The effective length (Le) of ogee spillway crest represented by equation, where L = the net clear length of the spillway crest, k_p = Pier contraction coefficient, k_a = Abutment contraction coefficient, N = Number of piers, H_e = total design head on the crest including velocity head

   (a) $Le = L - 2[k_p \cdot N + ka] H_e$
   (b) $Le = L - [k_p \cdot N + k_a] H_e$
   (c) $Le = L - [k_p + k_a N] H_e$
   (d) None of these

56. The multipurpose Ngarjuna Sagar dam is located across river
   (a) Kaveri River
   (b) Krishna River
   (c) Sutlaj River
   (d) None of these

57. The maximum height of low gravity dam of elementary profile made of concrete of relative density 2.4 and safe allowable stress of foundation material 3.67 MPa without considering uplift force is about
   (a) 107.5 m
   (b) 112.5 m
   (c) 115.0 m
   (d) 110.0 m

58. If y_1 and y_2 are depth of flow before and after the hydraulic jump in a rectangular channel then the loss of energy is given by

   (a) $\dfrac{(y_2 - y_1)^2}{y_1 y_2}$
   (b) $\dfrac{(y_2 - y_1)^3}{y_1 y_2}$
   (c) $\dfrac{(y_2 - y_1)^3}{4 y_1 y_2}$
   (d) $\dfrac{(y_2 - y_1)^3}{8 y_1 y_2}$

59. Silt ejector is provided on
   (a) the river, just upstream of the under sluices.
   (b) the canal, just downstream of the canal head regulator.
   (c) the river, some distance downstream of the under sluice.
   (d) the canal, some distance downstream of the canal head regulator.

60. Khoslo's theory of independent variable is applicable to structure founded on
   (a) rock
   (b) clay soil
   (c) sandy soil
   (d) concrete

61. A core wall is provided in
   (a) A canal regulator
   (b) An aqueduct
   (c) A gravity dam
   (d) An earthen dam

62. A 2 km long pipe of 0.2 m diameter connects two reservoirs. The difference between the water levels in the reservoirs is 8.0 m. The Darcy weisback friction factor of pipe is 0.04. Accounting for frictional, entry and exit losses, the velocity in the pipe is m/sec
   (a) 0.35
   (b) 0.63
   (c) 2.52
   (d) 1.25

63. Euler number is defined as
   (a) Inertia force/Gravity force
   (b) Inertia force/Compressibility force
   (c) Inertia force/Pressure force
   (d) Gravity force/Inertia force

64. Generally a material is classified as uniform, if its uniformity coefficient 'Cu' is
   (a) ≤ 1
   (b) ≥ 1
   (c) ≥ 2
   (d) ≤ 2

65. The flow will be in the supercritical state in the following types of GVF profiles
   (a)   All S curves   (b) M_2 (c) S_2, M_2 and S_3 (d) A_3, M_3 and S_2

66. In the empty condition of reservoir and with the elementary profile of a dam, the vertical stress at heel and toe respectively are given by
Where W is the self weight of unit length of dam and B is the base width.
   (a)   0 and $\dfrac{W}{2B}$ (b)   0 and $\dfrac{2W}{B}$ (c) $\dfrac{2W}{B}$ and 0   (d) $\dfrac{W}{2B}$ and 0

67. If the level of canal bed and high flood level of river have the RL's of 110 m and 111.0 m respectively, then this type of cross drainage work is called
   (a)   Level crossing   (b)   Super passage
   (c)   Aqueduct   (d)   Siphon aqueduct

68. At a certain point in the floor of the weir, the uplift pressure head due to seepage is 3.75 m. If the relative density of the concrete is 2.5, the minimum thickness of the floor required at this point to counteract the uplift pressure.
   (a)   3.33 m   (b)   1.50 m   (c)   2.50 m   (d)   3.75 m

69. For a triangular channel of side slope m horizontal : 1 vertical, the froude number is given by Fr.
   (a) $\dfrac{V\sqrt{2}}{\sqrt{gy}}$ (b) $\dfrac{V}{\sqrt{2gy}}$ (c) $\dfrac{V\sqrt{2}}{gy}$ (d) $\dfrac{V}{\sqrt{gy}}$

70. Total force due to wave action on a gravity dam acts at a height of
Where h_w is the height of wave.
   (a) $\dfrac{2}{3}h_w$ above the reservoir surface   (b) $\dfrac{h_w}{2}$ above the reservoir surface
   (c) $\dfrac{3}{8}h_w$ above the reservoir surface   (d) $\dfrac{5}{4}h_w$ above the reservoir surface

71. A hydraulic jump formed in a horizontal rectangular channel corresponding to a froude no. of 10. The sequent depth ratio shall be nearly equal to
   (a)   8   (b)   12   (c)   10   (d)   14

72. In order to compute seepage loss through the foundation of cotter dam, Flow net study results gave $N_f = 6$ and $N_d = 16$, head of water loss during seepage was 6 m and $k = 4 \times 10^{-5}$ m/min. Seepage loss per meter of dam per minute is
   (a) 9×10^{-3} m³/sec.   (b) 9×10^{-4} m³/min.
   (c) 9×10^{-5} m³/min.   (d) 9×10^{-6} m³/min.

73. In unit hydrograph, the magnitude of effective rainfall is
   (a)   1.50 mm   (b)   1.05 inch   (c)   1.0 cm   (d)   0.5 cm

74. The Darcy-Weisback 'f' is related to Manning's 'n' as
   (a) $f = \dfrac{8gn^2}{R^{1/3}}$ (b) $f = \dfrac{gn^2}{8R^{1/3}}$ (c) $f = \dfrac{R^{1/3}}{8gn^2}$ (d) $f = \dfrac{64\,ng}{R^{1/3}}$

75. The rise in the maximum Flood Level (HFL) upstream of weir, caused due to construction of weir across the river is called
    (a) Pond level   (b) Afflux   (c) Flood   (d) Hydraulic jump

76. In a circular channel the ratio of the maximum discharge to pipe full discharge is about
    (a) 1.50   (b) 0.94   (c) 1.08   (d) 1.00

77. Following are the short comings of Kennedy's theory
    (a) Importance of $\frac{B}{D}$ ratio was neglected   (b) No equation for slope of channel was given
    (c) Both (a) and (b)   (d) None of these

78. Presence of tail water in a gravity dam
    (i) increase the principal stress   (ii) decrease the principal stress
    (iii) increase the shear stress   (iv) decrease the shear stress
    The correct gap answer is
    (a) (i) and (iii)   (b) (i) and (iv)   (c) (ii) and (iii)   (d) (ii) and (iv)

79. If 'D' is the depth of U/S pile, the horizontal length of launching apron is taken as
    (a) 1.0 D   (b) 1.5 D   (c) 2.0 D   (d) 2.5 D

80. Garrets diagrams are based on
    (a) Bligh's theory   (b) Khosla's theory
    (c) Lacey's theory   (d) Kennedy's theory

81. The critical depth of flow in a most economical triangular channel section for a discharge of 1.0 m^3/s is given by
    (a) $\left(\frac{1}{9.8}\right)^{1/5}$ m   (b) $\left(\frac{1}{9.8}\right)^{1/3}$ m   (c) $\left(\frac{1}{4.9}\right)^{1/5}$ m   (d) $\left(\frac{1}{4.9}\right)^{1/3}$ m

82. In a 2.0 m wide rectangular channel uniform flow occurs at a depth of 2.0 m, the velocity of flow being $\sqrt{2g}$. m/s. The height of hump, which can be raised, without causing afflux will be
    (a) zero   (b) 1.0 m   (c) 2.0 m   (d) 3.0 m

83. The hydraulic grade line is
    (a) always above the centre line of pipe.
    (b) never above the energy grade line.
    (c) always sloping down in the direction of flow.
    (d) All of these.

84. A canal is flowing with a discharge of 64 m^3/s. If the value of Lacy's silt factor is 1.0, what will be the bed slope of canal ?
    (a) $\frac{1}{6680}$ (b) $\frac{1}{6400}$ (c) $\frac{1}{7000}$ (d) None of these

85. For a V-shaped valley having strong side hills, which type of dam is most suited ?
    (a) Constant angle Arch Dam   (b) Constant Radius Arch Dam
    (c) Variable Radius Arch Dam   (d) None of these

86. The degree of freedom in an alluvial man made channel is
    (a) one   (b) two   (c) three   (d) four

87. Workability of concrete increases by
    (i)   increasing the water content
    (ii)   increasing the temperature
    (iii) increasing the use of flaky and elongated aggregates
    The correct answer is
    (a) only (i)   (b) (i) and (ii)   (c) (i) and (iii)   (d) (i), (ii) and (iii)

88. Prestressed concrete is more desirable in case of cylindrical pipe subjected to
    (a) internal fluid pressure
    (b) external fluid pressure
    (c) equal internal and external fluid pressure
    (d) None of these

89. To control cracking in beams, side face reinforcement is provided in RCC beam when the depth of beam exceeds :
    (a) 450 mm   (b) 750 mm   (c) 1000 mm   (d) 1250 mm,

90. As per IS : 456 – 2000, to design a concrete structure, modulus of elasticity of M25 grade concrete can be assumed as
    (a) 28,500 N/mm^2 (b) 25,000 N/mm^2
    (c) 30,000 N/mm^2 (d) None of these

91. As per IS : 456 – 2000, minimum longitudinal reinforcement in a rectangular column should be
    (a) 0.80% of cross sectional area   (b) 4 bars of 12 mm
    (c) Greater of (a) and (b)   (d) Lesser of (a) and (b)

92. In a design of shear reinforcement of a reinforced concrete beam, the design shear strength of concrete depends upon
    (a) grade of concrete only
    (b) grade of concrete and % of reinforcement in tension
    (c) grade of concrete and % of total reinforcement
    (d) grade of steel only

93. In a balance section at limit state of flexure, the maximum strains in extreme fibre of concrete and tension steel of grade Fe415 are respectively (Take E_s = 200 GPa)
    (a) 0.0035 and 0.0018   (b) 0.0020 and 0.0018
    (c) 0.0035 and 0.0038   (d) 0.0035 and 0.0048

94. The critical section for the calculation of maximum bending moment for footing supporting a concrete column is
    (a) at face of column.
    (b) halfway between the centre line of column and edge of column.
    (c) at a distance equal to half the effective depth of footing from face of column.
    (d) at a distance equal to the effective depth of footing from face of column.

95. Reinforced concrete slab act as
    (a) Rigid diaphragm   (b) flexible diaphragm
    (c) Brittle diaphragm   (d) None of these

96. For an RCC structure, 100 cu.m. concreting is done continuously. The minimum number of samples to be prepared for testing as per IS : 456 – 2000 will be
    (a) 7   (b) 6   (c) 5   (d) 4

97. For a footing M25 grade concrete with $k_s = 1$ was used as per IS : 456 – 2000, what is the maximum permissible shear stress in concrete ?
(a) 3.10 N/mm^2 (b) 0.80 N/mm^2 (c) 1.20 N/mm^2 (d) 1.25 N/mm^2

98. What is the minimum grade of design mix concrete for post tensioned prestressing system ?
(a) M-30 (b) M-35 (c) M-25 (d) M-40

99. What is the shrinkage strain in a post tensioned member after 8 days of prestressing ?
(a) 3×10^{-4} (b) 5×10^{-4} (c) 2×10^{-4} (d) 8×10^{-4}

100. If 'W' is the load per unit area on a circular slab of radius 'R', then the maximum radial moment per unit width of slab of a simply supported slab is equal to :
Assuming Poisson's ratio = 0.0
(a) $\dfrac{WR^2}{16}$ (b) $\dfrac{WR^2}{8}$ (c) $\dfrac{3WR^2}{16}$ (d) $\dfrac{5WR^3}{16}$

101. Design of a RC column subjected to biaxial bending depends on
(i) axial ultimate load.
(ii) ultimate bending moment about x-axis (M_{ux})
(iii) ultimate bending moment about y-axis (M_{uy})
(a) (i) is correct (b) (i) and (ii) are correct
(c) (i) and (iii) are correct (d) (i), (ii) and (iii) are correct

102. As per IS : 456 – 2000, in the design of RC foundation, the three critical sections (bending moments, one way and two way shear) are checked within the _____
(a) effective depth of footing (b) half of effective depth of footing
(c) two third of effective depth of footing (d) one-fourth of effective depth of footing

103. The maximum slenderness ratio of a concrete column should not exceed.
(a) 50 (b) 40 (c) 35 (d) 60

104. Loss of pre-stress in pre-tensioning as compared to post tensioning is
(a) more (b) less
(c) equal (d) some times more, some timesless

105. Column heads are provided in
(a) Combined footings (b) pile cap
(c) raft (d) flat-slab

106. What should be the minimum thickness of a flat slab in any case ?
(a) 120 mm (b) 125 mm (c) 130 mm (d) 140 mm

107. What is the relaxation loss in prestressing steel if the initial stress level is 50% of characteristic strength of prestressing steel.
(a) 20 MPa (b) 10 MPa (c) Zero (d) 35 MPa

108. How much portion of steel that should extend beyond the faces of support at discontinuous edges of two-way slab due to negative moments at discontinuous edges ? Where 'l' is effective span of slab.
(a) $0.10\,l$ (b) $0.15\,l$ (c) $0.25\,l$ (d) $0.30\,l$

109. Spacing of shear stirrups in a rectangular RC simply supported beam is
    (a) Decreased towards the centre of beam (b) Increased towards the centre of beam
    (c) Kept constant throughout the span (d) Increase towards the ends of beam

110. Sinking of an intermediate support of a continuous beam
    (i) reduces the negative moment at support
    (ii) increases the negative moment at support
    (iii) reduces the positive moment at the centre of span
    (iv) increases the positive moment at the centre of span
    The correct answer is
    (a) (ii) and (iii) (b) (iii) and (iv) (c) (i) and (iii) (d) (i) and (iv)

111. If long and short spans of a two way slab are L_y and L_x and load on the slab acting on strips parallel to L_x and L_y be W_x and W_y respectively, the Rankine – Grashoff theory suggests that :

    (a) $\left(\dfrac{L_y}{L_x}\right)^5 = \left(\dfrac{W_x}{W_y}\right)$ (b) $\left(\dfrac{W_x}{W_y}\right) = \left(\dfrac{L_y}{L_x}\right)^4$ (c) $\left(\dfrac{W_x}{W_y}\right) = \left(\dfrac{L_y}{L_x}\right)^3$ (d) $\left(\dfrac{W_x}{W_y}\right) = \left(\dfrac{L_y}{L_x}\right)^2$

112. To keep the intensity of bearing pressure between column base and concrete compressive throughout the length 'L' of column base, the ratio of moment (M) and the axial load 'P' should be _____

    (a) $< \dfrac{L}{3}$ (b) $> \dfrac{L}{3}$ (c) $< \dfrac{L}{6}$ (d) $> \dfrac{L}{6}$

113. The effect of creep on modular ratio is to
    (a) keep it unchanged (b) decrease it
    (c) increase it (d) either increase or decrease it

114. In limit state approach, spacing of main reinforcement controls primarily
    (a) cracking (b) Deflection (c) Durability (d) Collapse

115. In a doubly reinforced concrete beam, the maximum area of compression reinforcement shall be _____
    (b = width of beam, d = effective depth of beam, D = overall depth of beam, fy = strength of steel)

    (a) not exceed $\dfrac{0.85\,bd}{fy}$ (b) not exceed 0.04 bD

    (c) exceed 0.04 bD (d) exceed $\dfrac{0.85\,bd}{fy}$

116. If 'L' is unsupported length of column and D is the lateral dimension of the column in the direction under consideration, as per IS : 456-2000, a minimum eccentricity 'e_{min}' for the design of column as

    (a) $e_{min} = \dfrac{L}{500} + \dfrac{D}{30}$ subject to a minimum of 20 mm

    (b) $e_{min} = \dfrac{L}{500} + \dfrac{D}{30}$ subject to a minimum of 30 mm

    (c) $e_{min} = \dfrac{L}{500} + \dfrac{D}{20}$ subject to a minimum of 20 mm

    (d) $e_{min} = \dfrac{L}{500} + \dfrac{D}{20}$ subject to a minimum of 30 mm

117. As per IS : 456 – 2000, the range of grade of standard concrete is
    (a) M05 – M20 (b) M20 – M30 (c) M25 – M55 (d) M60 – M80

118. Which option is correct for the portal frame in equilibrium as shown in figure below :
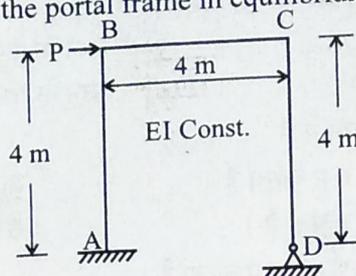
(a) $\left(\dfrac{M_{BC} + M_{CB}}{4}\right) + P = 0$

(b) $\left(\dfrac{M_{BA} + M_{AB}}{4}\right) + P = 0$

(c) $\left(\dfrac{M_{BA} + M_{AB}}{4}\right) + \left(\dfrac{M_{CD} + M_{DC}}{4}\right) + P = 0$

(d) $\left(\dfrac{M_{CD}}{4}\right) + P = 0$

119. The order of the flexibility matrix for a structure is
(a) equal to number of redundant forces
(b) more than the number of redundant forces
(c) less than the number of redundant forces
(d) equal to number of redundant forces plus 3

120. The point of contra flexure is a point where
(a) Shear force changes its sign
(b) Bending moment is maximum
(c) Shear force is maximum
(d) Bending moment changes its sign

121. Neglecting the axial changes in lengths, determine the kinematic indeterminacy of the frame as shown in figure below
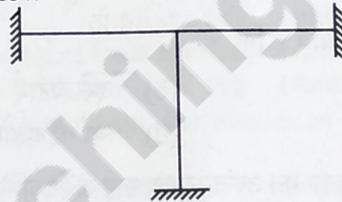
(a) 1 (b) 2 (c) 3 (d) 4

122. Two bars connected at their ends carry a force of 10 kN as shown in figure given below. Determine the vertical deflection of joint 'O'. Length of each bar is 2.0 m, area of bar 50 mm^2 and Modulus of Elasticity 2.0×10^5 N/mm^2
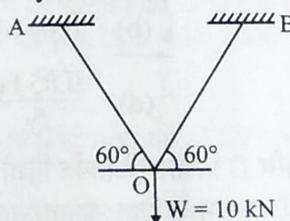
(a) 3.0 mm (b) 2.08 mm (c) 2.67 mm (d) 1.33 mm

123. Which one expression gives the relation between the load intensity (W) and the bending moment (M) at any section of the beam ?
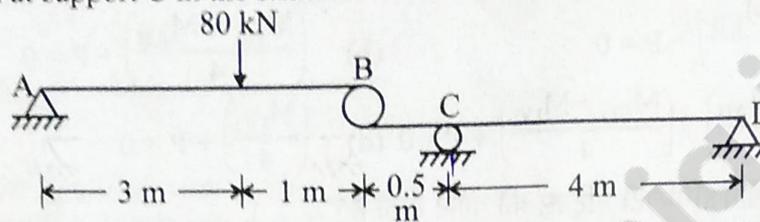
(a) $\dfrac{dM}{dx} = W$ (b) $\dfrac{d^3M}{dx^3} = W$ (c) $\dfrac{d^2M}{dx^2} = W$ (d) $\int \dfrac{dM}{dx} = W$

124. What is the ordinate of influence line at B for reaction R_D in figure below.
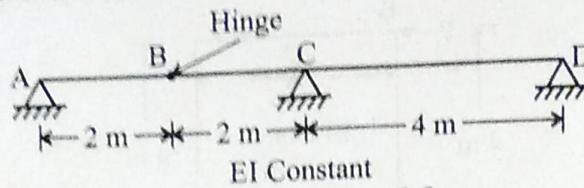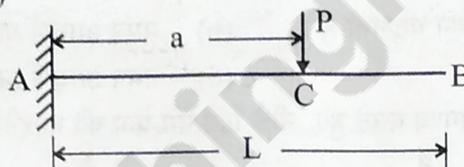

EI Constant

(a) 0.5   (b) 0.4   (c) 0.2   (d) Zero

125. The reaction at support C in the structure shown in figure below :

(a) 52.5 kN   (b) 60.0 kN   (c) 67.5 kN   (d) 75.0 kN

126. A cantilever carries a load 'P' at point C as shown in the figure below. The deflection at B is _____ (EI is constant)

(a) $\dfrac{Pa^2}{2EI}(L-a)$ (b) $\dfrac{Pa^2}{3EI}(L-a)$ (c) $\dfrac{Pa^2}{2EI}(L+a/3)$ (d) $\dfrac{Pa^2}{2EI}(L-a/3)$

127. A three hinged semi-circular arch of radius 'R' carries a uniformly distributed load 'W' per unit run over the whole span. The horizontal thrust will be

(a) W R   (b) $\dfrac{WR}{2}$ (c) $\dfrac{4WR}{3\pi}$ (d) $\dfrac{2WR}{3\pi}$

128. If in a propped cantilever, the supporting prop is removed and a unit deflection is induced at that point, the deflected shape of the beam represents the influence line for _____.

    (a) moment at fixed support   (b) moment at prop

    (c) reaction at fixed support   (d) reaction at prop

129. The strain energy stored in a bar of length 'l' cross-sectional area 'A', Modulus of elasticity 'E', subjected to an axial load 'W' is given by

(a) $\left(\dfrac{W^2 l}{AE}\right)$ (b) $\left(\dfrac{W^2 l}{2AE}\right)$ (c) $\left(\dfrac{W^2 l}{3AE}\right)$ (d) $\left(\dfrac{W^2 l}{4AE}\right)$

130. The displacement method is also referred to as which one of the following ?

    (a) minimum strain energy method   (b) flexibility matrix method

    (c) consistent deformation method   (d) stiffness matrix method

131. For a symmetrical two hinged parabolic arch, if one of the supports yields outward, then horizontal thrust
(a) is increased
(b) is decreased
(c) remain unchanged
(d) becomes zero

132. In the given figure below, what will be the propped reaction at point 'B' ? EI is constant
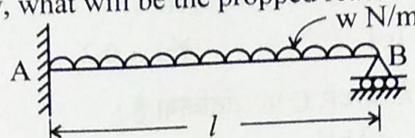
(a) $\frac{5}{8}\,w\,l$
(b) $\frac{2}{3}\,w\,l$
(c) $w\,l$
(d) $\frac{3}{8}\,w\,l$

133. A portal frame of indeterminate nature and uniform rigidity EI, is subjected to horizontal thrust, then the value of this thrust can be given as _____
(usual notations are used)

(a) $\int H\frac{\partial M}{\partial H}\cdot ds = 0$
(b) $\int M^2\frac{\partial M}{\partial H}\cdot ds = 0$
(c) $\int M\frac{\partial M}{\partial H}\cdot ds = 0$
(d) $\int H^2\frac{\partial^2 M}{\partial H^2}\cdot ds = 0$

134. A cantilever beam of rectangular cross-section is subjected to a load 'W' at its free end, causing deflection δ_1. If the load is increased to '2W' causing deflection δ_2, the ratio of value of $\left(\frac{\delta_1}{\delta_2}\right)$ will be

(a) 0.5
(b) 1.0
(c) 2.0
(d) 4.0

135. The shear force at the point of contraflexure in the beam shown below is
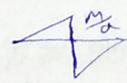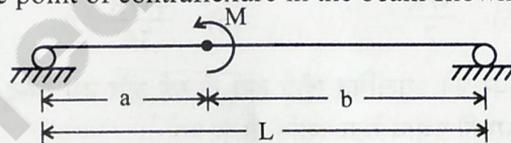
(a) $\frac{M}{a}$
(b) $\frac{M}{b}$
(c) $\frac{M}{L}$
(d) 0

136. In case of simply supported beam of I section having span 'L' and loaded with a central load 'W', the length of elastic-plastic zone of the plastic hinge is

(a) $\frac{L}{3}$
(b) $\frac{L}{5}$
(c) $\frac{L}{4}$
(d) $\frac{L}{2}$

137. If the stiffness matrix of beam element is given as $\frac{2EI}{L}\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$, then the flexibility matrix is

(a) $\frac{L}{3EI}\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$
(b) $\frac{L}{6EI}\begin{bmatrix} 1 & -2 \\ -2 & 1 \end{bmatrix}$
(c) $\frac{L}{3EI}\begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$
(d) $\frac{L}{6EI}\begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$

138. For ductile materials, the most appropriate failure theory is
    (a) maximum shear strain energy theory
    (b) maximum principal strain theory
    (c) maximum shear stress theory
    (d) maximum principal stress theory

139. The moment distribution method is best suited for
    (a) Pin jointed truss
    (b) Space frame
    (c) Rigid frame
    (d) Trussed beam

140. A uniformly distributed load of length 8 m passes over a simply supported beam of 20 m span. If maximum bending moment occurs at the left quarter point of the beam then the distance between the C.G. of load and centre of span will be
    (a) 2 m
    (b) 4 m
    (c) 3 m
    (d) 6 m

141. The collapse load for the portal frame shown below is :
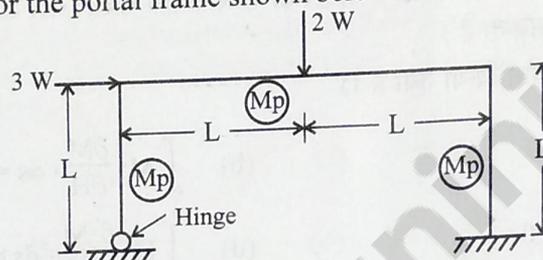
    (a) $\dfrac{Mp}{L}$
    (b) $\dfrac{2Mp}{L}$
   (c) $\dfrac{3Mp}{L}$
    (d) $\dfrac{2Mp}{3L}$

142. In a statically indeterminate pin jointed space frame, the relation between number of members 'm' and number of joints 'j' can be expressed as
    (a) $m > 2j - 3$
    (b) $m = 2j - 3$
    (c) $m > 3j - 6$
    (d) $m = 3j - 6$

143. When a uniformly distributed load longer than the span of the simply supported beam moves from left to right, the maximum bending moment at mid span exists if the load occupies
    (a) more than left half span
    (b) less than left half span
    (c) whole span
    (d) whole of left half span

144. A beam AB as shown below, is fixed at both ends and carries a uniformly distributed load of intensity 'W' per unit length over its entire length. The end B is changed to a simple support during construction. Percentage increase in Bending moment at A is
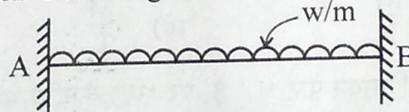
    (a) 75
    (b) 25
    (c) 100
    (d) 50

145. A cable carries a system of loads, the bending moment will be
    (a) maximum at the supports
    (b) maximum at the mid of span
    (c) maximum at the lowest point
    (d) zero at all the section

146. A simply supported beam of span 'L' and flexural rigidity 'EI' is carrying a concentrated load 'W' at the mid span. Strain energy stored in this beam is given by
    (a) $\dfrac{W^2L^2}{96EI}$
    (b) $\dfrac{W^2L^3}{96EI}$
    (c) $\dfrac{W^2L^3}{48EI}$
    (d) $\dfrac{W^2L^2}{48EI}$

147. According to Maxwell's reciprocal law, the deflection at point 'A' in a beam due to a unit force at point 'B' in the same beam is equal to deflection at point 'B' due to a unit _____.
   (a) Shear force at A
   (b) Bending moment at A
   (c) Couple at A
   (d) Force at A

148. When a load crosses through a Pratt truss in the direction left to right, the nature of force in any diagonal member in the left half of the span
   (a) changes from compression to tension
   (b) changes from tension to compression
   (c) always be in compression
   (d) always be in tension

149. What is the ratio of the shape factors for beam cross-sections having rectangular, circular and triangular shape and of same cross-section area.
   (a) 1.00 : 0.73 : 0.64
   (b) 1.00 : 0.88 : 1.38
   (c) 1.00 : 1.13 : 1.56
   (d) 1.00 : 1.56 : 1.13

150. In a roof truss, if pitch is $\frac{1}{2}$ and slope is 1, the angle of inclination with the horizontal would be
   (a) 30°
   (b) 45°
   (c) 60°
   (d) 75°

151. In a steel plate of 300 mm wide and 10 mm thick, a rivet of nominal diameter 16 mm is driven. The net sectional area of plate is
   (a) 2600 mm^2
   (b) 2760 mm^2
   (c) 2825 mm^2
   (d) 2840 mm^2

152. In the virtual work method of plastic analysis of steel structures, the virtual quantity is
   (a) slope
   (b) moment
   (c) load
   (d) displacement

153. In a diamond riveting for a plate of width 'b' and rivet diameter 'd', the efficiency of the joint is given by
   (a) $\frac{(b-d)}{b}$
   (b) $\frac{(b-2d)}{b}$
   (c) $\frac{(b-d)}{d}$
   (d) $\frac{(b-2d)}{d}$

154. A tension member consists of a pair of angles placed back to back on the same side of the gusset plate. The value of 'k' for calculating net area is given by (A_1 is the area of connecting leg, A_2 is the area of outstanding leg)
   (a) $\frac{3A_1}{(3A_1 + A_2)}$
   (b) $\frac{3A_1}{(A_1 + 3A_2)}$
   (c) $\frac{5A_1}{(A_1 + 5A_2)}$
   (d) $\frac{5A_1}{(5A_1 + A_2)}$

155. For a prismatic beam of length 'L' and flexural rigidity EI, the moment required to rotate the near end through unit angle, whose far end is fixed, will be
   (a) $\frac{6EI}{L}$
   (b) $\frac{3EI}{L}$
   (c) $\frac{2EI}{L}$
   (d) $\frac{4EI}{L}$

156. A simply supported beam of constant EI is subjected to end couple of 'M_o' at the left support. What is the moment required at the right support to prevent the rotation at the right support ?
   (a) $\frac{M_o}{3}$
   (b) $2M_o$
   (c) M_o
   (d) $\frac{M_o}{2}$

157. For a continuous beam, the number of influence lines for shear force would be
   (a) one
   (b) equal to number of supports
   (c) infinite
   (d) two

158. In the design of base plate of a steel column, the thickness of the base plate is selected from
    (a) bearing strength of the concrete pedestal
    (b) flexural strength of the plate
    (c) shearing strength of the plate
    (d) punching criterion

159. When any tension member is liable to reversal of stresses due to the action of earthquake and wind, the maximum permissible slenderness ratio should be less than
    (a) 400   (b) 300   (c) 425   (d) 350

160. Thickness of the Gusset plate in a tension member joint should not be less than
    (a) 6 mm   (b) 8 mm   (c) 12 mm   (d) 16 mm

161. For a built up beam, the maximum pitch of rivets intension flange of thickness 't' as per relevant IS code should not be more than
    (a) lesser of 250 mm and 16t   (b) lesser of 250 mm and 12t
    (c) lesser of 200 mm and 12t   (d) lesser of 200 mm and 16t

162. The minimum ratio of thickness of steel elements in compression, in terms of their outstanding length, has been specified to prevent
    (a) fracture   (b) bending failure   (c) local buckling   (d) tension failure

163. In a work shop, gantry girders are designed to resist
    (a) lateral loads   (b) lateral and longitudinal loads
    (c) longitudinal and vertical loads   (d) longitudinal, lateral and vertical loads

164. Splices for compression member are designed as
    (a) short column   (b) intermediate column
    (c) long column   (d) thickness based columns

165. Which of the following elements of a pitched roof industrial steel building primarily resists lateral load parallel to ridge ?
    (a) Purlins   (b) Trusses   (c) Columns   (d) Bracings

166. Maximum bending moment in roof purlins is taken as _____ (where W is the total distributed load and L is span)
    (a) $\frac{WL}{10}$ (b) $\frac{WL}{20}$ (c) $\frac{WL}{30}$ (d) $\frac{WL}{40}$

167. In plastic design of steel structures, the shape of the cross section that has maximum shape factor is
    (a) I - section   (b) diamond section
    (c) solid circular section   (d) rectangular section

168. In a built up column, 20 mm diameter rivets are used for lacing bars, the minimum width of lacing should be
    (a) 65 mm   (b) 55 mm   (c) 50 mm   (d) 60 mm

169. Proof stress for minimum bolt tension is given by
    (a) $0.5f_{ub}$ (b) $0.6f_{ub}$ (c) $0.7f_{ub}$ (d) $0.8f_{ub}$

170. IS : 800 – 2007 specifies the minimum thickness of steel section as
    (a) 5.0 mm if painted (b) 6.0 mm if painted
    (c) 8.0 mm if painted (d) it is silent

171. As per IS : 800, purlins are designed as :
    (a) simply supported beams (b) cantilever beams
    (c) continuous beams (d) compression members

172. The minimum and maximum spacing of vertical stiffness in terms of 'd' are
    (a) 0.25 d and 1.5 d (b) 0.33 d and 1.5 d
    (c) 0.5 d and 1.75 d (d) 0.33 d and 1.75 d

173. A frame has an indeterminacy of 2 and the number of possible plastic hinges is 3. The collapse will be
    (a) complete (b) partial
    (c) over complete (d) cannot be ascertained

174. The flange is classified as plastic, if the outstand element of compression flange of rolled section is less than......
    (where, ε is strain)
    (a) 8.4 ε (b) 9.4 ε (c) 10.5 ε (d) 15.7 ε

175. If M_{max} is maximum moment in the plate girder, p_b is allowable bending stress and t_w is thickness of web, then the economical depth of a plate girder is given by :
    (a) $(M_{max}/p_b t_w)^{1/2}$ (b) $1.1 (M_{max}/p_b \cdot t_w)^{1/2}$
    (c) $1.2 (M_{max}/p_b \cdot t_w)^{1/2}$ (d) $1.3 (M_{max}/p_b \cdot t_w)^{1/2}$

176. Westergard's analysis for stress distribution beneath loaded areas is applicable to
    (a) Sandy soils (b) Clayey soil (c) Silty soils (d) Stratified soils

177. Void ratio of an unstatrified sample of soil is 0.6. The value of maximum and minimum possible void ratio are found as 0.8 and 0.4 respectively. The relative density 'in percentage' for this soils sample will be
    (a) 25 (b) 50 (c) 75 (d) 90

178. IS MB 450 used as beam can be considered laterally restrained if
    (a) Compression flange is laterally restrained
    (b) Web is adequately stiffened
    (c) tension flange is laterally restrained
    (d) both (b) and (c)

179. A steel beam section is classified as low shear beam when the factored shear force is less than
    (a) $0.4 V_d$ (b) $0.6 V_d$ (c) $0.8 V_d$ (d) V_d

180. The web plate and flange plates are connected by a fillet weld. The size of the fillet weld depends upon
    (a) Vertical shear force at the section
    (b) Bending stress in the flange
    (c) buckling force in the web
    (d) Horizontal shear at the junction of flange and web