Answer Key of

OPSC 2019

ODISHA PUBLIC SERVICE COMMISSION

Astt. Executive Engineer

Civil Engineering
Paper-I

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Odisha Public Service Commission Exam, 2019

Civil Engineering : Paper-I

(Assistant Executive Engineer)

SET A

Q.1 Strain energy per unit volume that a material can absorb without exceeding its proportional limit is called:
(A) Strain hardening
(B) Shear modulus of material
(C) Bulk modulus of material
(D) Modulus of resilience

Ans. (D)

Q.2 The Lueders' Lines in a material indicate that:
(A) The material is failing in flexure
(B) The material is failing due to fatigue
(C) The material is failing due to its crushing
(D) The material is failing in shear

Ans. (D)

Q.3 For structural steel, experiment indicates, the value of Poison's ratio (μ) is
(A) 1.3 (B) 0.01
(C) 0.75 (D) 0.3

Ans. (D)

Q.4 A prismatic bar is subjected to axial tension. What is the aspect angle (ϕ) which defines an oblique section on which normal and shearing stresses are equal?
(A) 30° (B) 45°
(C) 60° (D) 90°

Ans. (B)

Q.5 What is the total elongation of a prismatic bar of length (L) and cross-sectional area (A) and Young's Modulus of its material (E) hangs vertically under its own weight (W)?

(A) $\frac{WL}{2AE}$ (B) $\frac{WL}{8AE}$

(C) $\frac{WL}{6AE}$ (D) $\frac{WL}{4AE}$

Ans. (A)

Q.6 Select in which case of the following biaxial stress, pure shear condition prevails:
(A) $\sigma_x = 2\sigma_y$ (B) $2\sigma_x = \sigma_y$
(C) $\sigma_x = \sigma_y$ (D) $\sigma_x = -\sigma_y$

Ans. (D)

Q.7 A steel wire of 20 mm diameter is bent into a circular shape of 10 m radius, then the maximum stress induced in the wire is
[Take $E = 2 \times 10^6$ kg/cm^2]
(A) 1×10^3 kg/cm^2 (B) 2×10^3 kg/cm^2
(C) 4×10^3 kg/cm^2 (D) 6×10^3 kg/cm^2

Ans. (B)

Q.8 The ratio of width to depth of a strongest beam that can be cut out of a cylindrical log of wood with homogeneous and isotropic properties is

(A) $\frac{1}{\sqrt{5}}$ (B) $\frac{1}{\sqrt{4}}$

(C) $\frac{1}{\sqrt{3}}$ (D) $\frac{1}{\sqrt{2}}$

Ans. (D)

Q.9 The maximum shear stress caused due to a shear force in a beam of rectangular cross-section is how much more is percentage than its average value?
(A) 200% (B) 150%
(C) 100% (D) 50%

Ans. (D)

Q.10 The diameter of the core of solid circular column of diameter "D", where stress induced due to a normal concentrated load of any eccentricity with respect to the centre of the column is:
(A) 0.20D (B) 0.25D
(C) 0.33D (D) 0.5D

Ans. (B)

Q.11 A beam of rectangular cross-section is 100 mm wide and 200 mm deep. If the section is subjected to a shear force of 20 kN, then the maximum shear stress in the section is:
(A) 1.25 N/mm^2 (B) 1.5 N/mm^2
(C) 1.6 N/mm^2 (D) 1.75 N/mm^2

Ans. (B)

Q.12 For no torsion, the plane of bending should
(A) Be parallel to one of the principal axes
(B) Pass through shear centre of section
(C) Pass through neutral axis of the section
(D) Pass through centre of gravity of the section

Ans. (B)

Q.13 Two beams, one of circular cross-section and other of square of cross-section, have equal areas of cross-section. If subjected to bending
(A) Circular section is more economical
(B) Square section is more economical
(C) Both sections are equally strong
(D) Both sections are equally stiff

Ans. (B)

Q.14 A simply supported beam with rectangular cross-section is subjected to a central concentrated load. If the width and depth of the beam are doubled, then the deflection at the centre of the beam will be reduced to:
(A) 50% (B) 25%
(C) 12.5% (D) 6.25%

Ans. (D)

Q.15 If the deflection at the free end of a uniformly loaded cantilever beam is 15 mm and the slope of the deflection curve at the free end is 0.02 radian, then the length of the beam is:
(A) 0.8 m (B) 1.0 m
(C) 1.2 m (D) 1.5 m

Ans. (B)

Q.16 Two ratio of maximum shear stress developed in a solid shaft of diameter D and a hollow shaft of external diameter D and internal diameter d for the same torque is given by

(A) $\frac{\left(D^2+d^2\right)}{D^2}$ (B) $\frac{\left(D^2-d^2\right)}{D^2}$

(C) $\frac{\left(D^4+d^4\right)}{D^4}$ (D) $\frac{\left(D^4-d^4\right)}{D^4}$

Ans. (D)

Q.17 Strain energy stored in a member is given by:
(A) 0.5 × stress × strain
(B) 0.5 × strain × volume
(C) 0.5 × stress × volume
(D) 0.5 × stress × strain × volume

Ans. (D)

Q.18 In plane stress problem there are normal tensile stresses σ_x and σ_y accompanied by shear stress τ_{xy} at a point along orthogonal Cartesian coordinates X and Y respectively, If it observed that the minimum principle stress on a certain plane is zero then:

(A) $\tau_{xy} = \sqrt{\left(\sigma_x + \sigma_y\right)}$

(B) $\tau_{xy} = \sqrt{\left(\sigma_x - \sigma_y\right)}$

(C) $\tau_{xy} = \sqrt{\left(\sigma_x \times \sigma_y\right)}$

(D) $\tau_{xy} = \sqrt{\left(\sigma_x / \sigma_y\right)}$

Ans. (C)

Q.19 If the depth of a rectangular section is reduced to half, strain energy stored in the beam becomes:

(A) $\frac{1}{4}$ times (B) $\frac{1}{8}$ times

(C) 4 times (D) 8 times

Ans. (D)

Q.20 The phenomenon of decreased resistance of a material to reversal of stress is called
(A) Creep (B) Fatigue
(C) Resilience (D) Plasticity

Ans. (B)

Q.21 The property of metal which allows it to deform continuously at slow rate without any further increase in stress is known as:
(A) Fatigue (B) Creep
(C) Plasticity (D) Resilience

Ans. (B)

Q.22 If a circular shaft is subjected to a torque T and bending moment M, the ratio of maximum bending stress to maximum shear stress is:
(A) $\frac{2M}{T}$ (B) $\frac{M}{2T}$
(C) $\frac{M}{T}$ (D) $\frac{2T}{M}$

Ans. (A)

Q.23 The identical bars, one simply supported and other fixed at ends, are acted upon by equal loads applied at the midpoints. The ratio of strain energy stored in the simply supported beam and the fixed ended beam is:
(A) 1 (B) 2
(C) 3 (D) 4

Ans. (*)

Q.24 For ductile materials, the most appropriate failure theory is:
(A) Maximum shear stress theory
(B) Maximum principal stress theory
(C) Maximum principal strain theory
(D) Shear strain energy theory

Ans. (D)

Q.25 The stress below which a material has a high probability of not failing under reversal of stress is known as:
(A) Tolerance limit
(B) Elastic limit
(C) Proportional limit
(D) Endurance limit

Ans. (D)

Q.26 In terms of bulk modulus (K) and modulus of rigidity (G), the Poisson's ratio can be expressed as:
(A) $\frac{(3K-4G)}{(6K+4G)}$ (B) $\frac{(3K+4G)}{(6K-4G)}$
(C) $\frac{(3K-2G)}{(6K+2G)}$ (D) $\frac{(3K+2G)}{(6K-2G)}$

Ans. (C)

Q.27 The deflection at the free end of a cantilever subjected to a couple of M at its free end having a uniform flexural rigidity EI throughout its length "L" is equal to
(A) $\frac{ML^2}{2EI}$ (B) $\frac{ML^2}{3EI}$
(C) $\frac{ML^2}{6EI}$ (D) $\frac{ML^2}{8EI}$

Ans. (A)

Q.28 The shear centre of a section is defined as that point:
(A) Through which load must be applied to produce zero twisting moment on the section
(B) At which shear force is zero
(C) At which shear force is maximum
(D) At which shear force is minimum

Ans. (A)

Q.29 If a three hinged parabolic arch carries a uniformly distributed load over the entire span, then any section of the arch is subjected to:
(A) Normal thrust only
(B) Normal thrust and shear force
(C) Normal thrust and bending moment
(D) Normal thrust, bending moment and shear force

Ans. (A)

Q.30 If the area under the shear force diagram for a beam between the two points C and D is "K", then the difference between the moments at the two points C and D will be equal to:
(A) K (B) 2K
(C) $\frac{K}{2}$ (D) K^2

Ans. (A)

Q.31 Given that for an element in a body of homogeneous isotropic material subjected to plane stress; ε_x, ε_y and ε_z are normal strains in x, y and z directions respectively and μ is the Poisson's ratio, the magnitude of unit volume change of the element is given by:

(A) $\varepsilon_x + \varepsilon_y + \varepsilon_z$

(B) $\varepsilon_x - \mu(\varepsilon_y + \varepsilon_z)$

(C) $\mu(\varepsilon_x + \varepsilon_y + \varepsilon_z)$

(D) $\mu(\varepsilon_y + \varepsilon_z) - \varepsilon_x$

Ans. (A)

Q.32 If a material has identical properties in all directions, it is said to be:

(A) Homogeneous (B) Orthotropic
(C) Elastic (D) Isotropic

Ans. (D)

Q.33 If the Young's modulus of elasticity of a material is twice its modulus of rigidity, then the Poisson's ratio of the material is:

(A) Zero (B) 0.5
(C) –0.5 (D) –1

Ans. (A)

Q.34 If a composite bar of steel and copper is heated, then the copper bar will be under:

(A) Tension (B) Compression
(C) Shear (D) Torsion

Ans. (B)

Q.35 Shear stress on principal planes is:

(A) Zero (B) Maximum
(C) Minimum (D) Depends on axial forces

Ans. (A)

Q.36 A simply supported beam of span L carries over its full span of load varying linearly from zero at either end to w/unit length at midspan. The maximum bending moment occurs at:

(A) Quarter points and is equal to $\frac{wL^2}{8}$

(B) Quarter points and is equal to $\frac{wL^2}{12}$

(C) Midspan and is equal to $\frac{wL^2}{8}$

(D) Midspan and is equal to $\frac{wL^2}{12}$

Ans. (A)

Q.37 Consider the following statements about flitched beams:

1. A flitched beam has a composite section made of two or more materials joined together in such a manner that they behave as a unit piece and each material bends to the same radius of curvature.
2. The total moment of resistance of a flitched beam is equal to the sum of the moments of resistance of individual sections.
3. Flitched beams are used when a beam of one material, if used alone, would require quite a large cross-sectional area.

(A) 1, 2 and 3 are correct
(B) 1 and 3 are correct
(C) 2 and 3 are correct
(D) 1 and 2 are correct

Ans. (A)

Q.38 Consider the following statements:
The theory of simple bending assumes that:

1. The material of the beam is homogeneous, isotropic and obeys Hooke's law.
2. The plane section remains plane after bending.
3. Each cross-section of the beam is symmetric about the loading plane.
4. Young's moduli are the same in tension and compression.

Of the above statements which are correct?

(A) 1 and 2 only (B) 1, 3 and 4 only
(C) 2, 3 and 4 only (D) 1, 2, 3 and 4

Ans. (A)

Q.39 If the diameter of a shaft, subjected to a torque alone, is doubled, then the horse power "P" can be increased to:

(A) 16P (B) 8P
(C) 4P (D) 2P

Ans. (B)

Q.40 A flitched beam consists of a wooden joist 150 mm wide and 300 mm deep strengthened by steel plates 10 mm thick and 300 mm deep one on either side of the joist. If modulus of elasticity of steel is 20 times that of wood, then the width of equivalent wooden section will be:
(A) 150 mm (B) 350 mm
(C) 500 mm (D) 550 mm

Ans. (D)

Q.41 Find out the wrong statement from the followings:
(A) The elastic section modulus of a section does not affect Shape Factor.
(B) The Shape Factor is a function of the cross-sectional shape.
(C) The Shape Factor represents the increase of strength due to plasticization.
(D) The Shape Factor of a section is a measure of reserve strength available in the section after initial yielding.

Ans. (A)

Q.42 Find the correct statement with regards to Plastic Hinge:
(A) Plastic Hinges are reached first at sections subjected to least curvature.
(B) The plastic hinge will not form at the point of zero shear in a span under distributed load.
(C) Where three structural members meets, plastic hinge will form in all members irrespective of their capacities of taking the moment.
(D) A plastic hinge is a zone of yielding due to shear in a structural member.

Ans. (C)

Q.43 Choose the correct statement:
(A) Through equilibrium condition will always be satisfied, a solution arrived at on the basis of an assumed mechanism will give a loading that is either correct or too high.
(B) The load obtained using the assumed moment diagram that does not violate the plastic moment condition will be either correct or too high.
(C) The strain at the onset of strain hardening is about 30 to 40 times the elastic strain in structural steel.
(D) The load factor of a rectangular steel section is 3.75, if the Factor of safety is 1.65.

Ans. (C)

Q.44 A fixed beam of 8 meters length is subjected to a single central concentrated load. If the plastic moment value is M_P, the ultimate load by mechanism method is:
(A) M_P (B) $2M_P$
(C) $1.5M_P$ (D) $4M_P$

Ans. (A)

Q.45 How many independent mechanism can be formed for a symmetrical portal frame of single bay and single storied, statically indeterminate to first degree and subjected to a concentrated load on the beam portion and one at the beam-column junction?
(A) 1 (B) 4
(C) 3 (D) 2

Ans. (D)

Q.46 What is the value of kinematic indeterminacy and statical indeterminacy of a fixed beam respectively?
(A) 3, 1 (B) 1, 2
(C) 2, 0 (D) 0, 3

Ans. (D)

Q.47 What is the value of Bending Moment in kN-m at 3 m from the left support of a three-hinged parabolic arch of span 10 m and rise 4 m which carries a uniformly distributed load of 5 kN/m over the whole span?
(A) 27.5 (B) 120
(C) 0 (D) 225

Ans. (C)

Q.48 Which method of structural analysis is a Force Method of analysis?
(A) Moment distribution method
(B) Slope deflection method

(C) None of these
(D) Both of these

Ans. (C)

Q.49 How many simultaneous equations, you have to solve to find the support moments for a continuous two spanned beams ABC of two consecutive spans AB and BC of equal length carrying uniformly distributed loads of 5 kN/m with end supports are simple supported?
(A) 4 (B) 6
(C) 1 (D) 3

Ans. (C)

Q.50 The stiffness of a member of length (L), moment of inertia of the section of the member is (I) and Young's Modulus of the material of the member is (E) is:
(A) $\frac{3EI}{L^2}$ (B) $\frac{4EI}{L}$
(C) $\frac{2EI}{L}$ (D) $\frac{4EI}{L^2}$

Ans. (B)

Q.51 What is the value of the bending moment at built-in ends of a prismatic beam of length L, carrying single concentrated load P at the middle?
(A) $\frac{PL}{4}$ (B) $\frac{PL}{8}$
(C) $\frac{3PL}{8}$ (D) $\frac{PL}{2}$

Ans. (B)

Q.52 The deflection at the free end of a cantilever of Length (L) and moment of inertia of its cross-section (I) and Young's modulus of the material is (E), subjected to uniformly distributed load of "w" is
(A) $\frac{wL^4}{30EI}$ (B) $\frac{wL^4}{8EI}$
(C) $\frac{wL^4}{2EI}$ (D) $\frac{wL^4}{48EI}$

Ans. (B)

Q.53 The slope at the end of a simple supported beam of length (L), subjected to concentrated load (P), moment of inertia of its cross-section (I) and Young's modulus of the material is (E) is
(A) $\frac{PL^2}{16EI}$ (B) $\frac{PL^2}{24EI}$
(C) $\frac{PL^2}{48EI}$ (D) $\frac{PL^2}{8EI}$

Ans. (A)

Q.54 A propped cantilever beam, AB, fixed at B is subjected to the action of a couple of moment M_A at the end A. What is the value of the reactive moment M_B will be induced at the built-in end B?
(A) $M_B = \frac{M_A}{4}$ (B) $M_B = M_A$
(C) $M_B = \frac{M_A}{8}$ (D) $M_B = \frac{M_A}{2}$

Ans. (D)

Q.55 Choose the correct statement:
(A) At the point of contra flexure, the shear force changes sign.
(B) At the point of contra flexure, the bending moment at not zero.
(C) At the point of contra flexure, the bending moment is maximum.
(D) At the point of contra flexure, the gradient of elastic line changes sign.

Ans. (D)

Q.56 The basic perfect frame is a:
(A) Triangle (B) Rectangle
(C) Square (D) Hexagon

Ans. (A)

Q.57 Method of joints is applicable only when the number of unknown forces at the joint under consideration is not more than:
(A) One (B) Two
(C) Three (D) Four

Ans. (B)

Q.58 The degree of static indeterminacy of a rigid-jointed space frame is where m, r and j are

unknown as member forces, r is unknown as reaction components and j is number of joints:
(A) $M + r - 2j$ (B) $M + r - 3j$
(C) $3m + r - 3j$ (D) $6m + r - 6j$

Ans. (D)

Q.59 Castigliano's first theorem is applicable
(A) For statically determinate structures only
(B) When the system behaves elastically
(C) Only when principle of superposition is valid
(D) For statically indeterminate structures only

Ans. (C)

Q.60 The carry over factor in a prismatic member whose far end is hinged is:
(A) 0 (B) $\frac{1}{2}$
(C) $\frac{3}{4}$ (D) 1

Ans. (A)

Q.61 The moment required to rotate the near end of a prismatic beam through a unit angle without translation, the far end being simply supported, is given by (where EI is the flexural rigidity and L is span of beam):
(A) $\frac{3EI}{L}$ (B) $\frac{4EI}{L}$
(C) $\frac{2EI}{L}$ (D) $\frac{EI}{L}$

Ans. (A)

Q.62 If the sinking of a support of a fixed beam causes the beam to rotate in the clockwise direction, then the moments induced at both the ends of the beam will be
(A) In anticlockwise direction and of equal magnitude
(B) In clockwise direction and of different magnitude
(C) In opposite directions and of equal magnitude
(D) In opposite directions and of different magnitude

Ans. (A)

Q.63 The Muller-Brealau principle can be used to
(A) Determine the shape of the influence line
(B) Indicates the parts of the structure to be loaded to obtain the maximum effect
(C) Calculate the ordinates of the influence lines
(D) All these are correct

Ans. (D)

Q.64 To generate the j^{th} column of the flexibility matrix:
(A) A unit force is applied at coordinate j and the displacements are calculated at all coordinates.
(B) A unit displacement is applied to coordinate j and the forces are calculated at all coordinates.
(C) A unit force is applied at coordinate j and the forces are calculated at all coordinates.
(D) A unit displacement is applied at coordinate j and the displacements are calculated at all co-ordinates.

Ans. (A)

Q.65 For stable structures, one of the important properties of flexibility and stiffness matrices is that the element of main diagonal:
(A) Of a stiffness and flexibility matrix must be negative.
(B) Of a stiffness matrix must be negative and flexibility matrix must be positive.
(C) Of a stiffness matrix must be positive and flexibility matrix must be negative.
(D) Of a stiffness and flexibility matrix must be positive.

Ans. (D)

Q.66 Due to some point load anywhere on a fixed beam, the maximum free bending moment is M. The sum of fixed end moment is
(A) M (B) 1.5 M
(C) 2.0 M (D) 3.0 M

Ans. (C)

Q.67 In the slope deflection equations, the deformations are considered to be caused by
(A) Shear force
(B) Bending moment

(C) Axial force
(D) Bending moment and shear force both

Ans. (B)

Q.68 An ordinate in a funicular polygon represents:
(A) Shear force
(B) Resultant force
(C) Bending moment
(D) Equilibrium

Ans. (C)

Q.69 The number of independent equations to be satisfied for static equilibrium of a space structure is:
(A) 1 (B) 2
(C) 3 (D) 6

Ans. (D)

Q.70 Independent displacement at each joint of a rigid-jointed plane frame are:
(A) Three linear movements
(B) Two linear movements and one rotation
(C) One linear movement and two rotations
(D) Three rotations

Ans. (B)

Q.71 Degree of kinematic indeterminacy of a pin-jointed plane frame is given by (where j is number of joints and r is unknown reactions):
(A) 2j – r (B) j – 2r
(C) 3j – r (D) 2j + r

Ans. (A)

Q.72 A beam of length "L", fixed at A and B of uniform flexural rigidity carries two loads "P" at one-third interval of span length C and D respectively. The maximum bending moment will occur:
(A) At C and D and will be equal to 2PL/9
(B) Between C and d and will be equal to PL/9
(C) At A and at B will be equal to 2PL/9
(D) Between A and C and also between B and D will be equal PL/9

Ans. (A)

Q.73 The strain energy stored in a simply supported beam of length "L" and flexural rigidity EI due to a central concentrated load "W" is:

(A) $\frac{W^2L^3}{48EI}$ (B) $\frac{W^3L^2}{48EI}$
(C) $\frac{W^2L^3}{96EI}$ (D) $\frac{W^3L^2}{96EI}$

Ans. (B)

Q.74 The strain energy of a structure due to bending is given by:

(A) $\int\left(\frac{M^2dx}{EI}\right)$ (B) $0.5\int\left(\frac{M^2dx}{EI}\right)$
(C) $\int 0.5\left(\frac{M^2dx}{EI}\right)$ (D) $0.33\int\left(\frac{M^2dx}{EI}\right)$

Ans. (B)

Q.75 A simple supported beam AB of length "L = 3 m". If the displacement at one-third length from the right hand support, at point D, due to load "W" at 1.0 m from left hand support, at point C is 5 mm, then the displacement at C due to a load of 0.2 W at D will be
(A) 1 mm (B) 2 mm
(C) 5 mm (D) 25 mm

Ans. (A)

Q.76 A propped cantilever AB is fixed at A and simply supported at B. If a 1 kN concentrated load is acting at B, what is the vertical reaction at support A?
(A) 0 kN (B) 1 kN
(C) 0.5 kN (D) 2 kN

Ans. (A)

Q.77 The principle of virtual work can be applied to elastic system by considering the virtual work of:
(A) Internal force only
(B) External force only
(C) Internal as well as external forces
(D) None of these

Ans. (C)

Q.78 If one end of a prismatic beam AB of length "L" with flexural rigidity "EI" with fixed ends is given a transverse displacement Δ without any rotation,

then the transverse reactions at A and B due to displacement is:

(A) $\frac{6EI\Delta}{L^2}$ (B) $\frac{6EI\Delta}{L^3}$

(C) $\frac{12EI\Delta}{L^2}$ (D) $\frac{121EI\Delta}{L^3}$

Ans. (D)

Q.79 A simply supported beam of length L over hanged to the right by $\frac{L}{2}$ at support B. The maximum reaction at support B will be when the uniformly distributed load is loaded:

(A) Only in AB (B) Only in BC
(C) Entire span (D) None of these

Ans. (C)

Q.80 The element of flexibility matrix of a structure:

(A) Are dependent on the choice of coordinates
(B) Are independent on the choice of coordinates
(C) Are always dimensionally homogeneous
(D) Both (A) and (C) are correct

Ans. (D)

Q.81 In limit state design of concrete for flexure, the area of stress block diagram is taken as 9 where f_{ck} is characteristic compressive strength of concrete and X_u is depth of neutral axis from top of the section:

(A) 0.36 $f_{ck} X_u$ (B) 0.42 $f_{ck} X_u$
(C) 0.446 $f_{ck} X_u$ (D) 0.56 $f_{ck} X_u$

Ans. (A)

Q.82 In limit state method, balanced design of a reinforced concrete beam gives:

(A) Smallest concrete section and maximum area of reinforcement.
(B) Largest concrete section and maximum area of reinforcement.
(C) Smallest concrete section and minimum area of reinforcement.
(D) Largest concrete section and minimum area of reinforcement.

Ans. (A)

Q.83 The development length of bars of diameter ϕ, as per IS:456-2000 is given by

(A) $\frac{4\phi\sigma_s}{\tau_{bd}}$ (B) $\frac{\phi\sigma_s}{\tau_{bd}}$

(C) $\frac{2\phi\sigma_s}{3\tau_{bd}}$ (D) $\frac{\phi\sigma_s}{3\tau_{bd}}$

Ans. (*)

No option is correct. Answer should be $\frac{\phi\sigma_s}{4\tau_{bd}}$.

Q.84 In prestressed concrete:

(A) Forces of tension and compression change but lever arm remains unchanged.
(B) Forces of tension and compression remain unchanged but lever arm changes with the moment.
(C) Both forces of tension and compression and lever arm change.
(D) Both forces of tension and compression and lever arm remain unchanged

Ans. (B)

Q.85 Modulus of rupture of concrete is a measure of:

(A) Flexural tensile strength
(B) Direct tensile strength
(C) Compressive strength
(D) Split tensile strength

Ans. (A)

Q.86 According to **IS:456-2000**, the maximum strain in concrete at the outermost compression fibre in the limit state design of flexural member is:

(A) 0.0020 (B) 0.0035
(C) 0.0050 (D) 0.0065

Ans. (B)

Q.87 Concordant profile represents for a certain set of external loads to some scale, the :

(A) Bending moment diagram
(B) Williot-Mohr diagram
(C) Shear force diagram
(D) Influence line diagram

Ans. (A)

Q.88 For prestressed structural elements, high strength concrete is used primarily because:
(A) Both shrinkage and creep are more
(B) Shrinkage is less but creep is more
(C) Modulus of elasticity and creep values are higher
(D) Of high modulus of elasticity and low creep

Ans. (A)

Q.89 For bars in tension, a standard hook has an anchorage value equivalent to a straight length of (where ϕ is diameter of hook):
(A) 8ϕ (B) 12ϕ
(C) 16ϕ (D) 24ϕ

Ans. (C)

Q.90 The relation between modulus of rupture f_cr, splitting strength f_{cs} and direct tensile strength f_{ct} is given by:
(A) $f_{cr} = f_{cs} = f_{ct}$ (B) $f_{cr} > f_{cs} > f_{ct}$
(C) $f_{cr} < f_{cs} < f_{ct}$ (D) $f_{cs} > f_{cr} > f_{ct}$

Ans. (B)

Q.91 Yield line theory results in:
(A) Elastic solution
(B) Lower bound solution
(C) Upper bound solution
(D) Unique solution

Ans. (C)

Q.92 A reduction factor C_r to load carrying capacity of a long column is given by:

(A) $C_r = \left(1.25 - \frac{L_e}{24b}\right)$

(B) $C_r = \left(1.00 - \frac{L_e}{48b}\right)$

(C) $C_r = \left(1.25 - \frac{L_e}{48b}\right)$

(D) $C_r = \left(1.5 - \frac{L_e}{48b}\right)$

Ans. (C)

Q.93 The effect of creep on modular ratio is:
(A) To decrease it
(B) To increase it
(C) Either to decrease or to increase it
(D) To keep it unchanged

Ans. (B)

Q.94 For walls, columns and vertical faces of all structural members, the form work is generally removed after:
(A) 24 to 48 hours (B) 3 days
(C) 7 days (D) 14 days

Ans. (A)

Q.95 The maximum compressive stress in concrete for design purposes is based on a partial safety factor of:
(A) 1.15 (B) 1.50
(C) 1.85 (D) 2.20

Ans. (B)

Q.96 In the design of prestressed concrete structures, which of the following limit state will come under the limit state of serviceability?
1. Flexure 2. Shear
3. Deflection 4. Cracking
(A) 1 and 4 (B) 3 and 4
(C) 2, 3 and 4 (D) 2 and 3

Ans. (B)

Q.97 For the deflection of simply supported beam to be within permissible limits the ratio of its span to effective depth as per **IS:456:1978** should not exceed:
(A) 7 (B) 20
(C) 26 (D) 35

Ans. (B)

Q.98 Most common method of prestressing used for factory production is:
(A) Long line method
(B) Freyssinet system
(C) Magnel-Blaton system
(D) Lee-Macall system

Ans. (A)

Q.99 Shrinkage deflection in case of rectangular beams and slabs can be eliminated by putting:

(A) Compression steel equal to tensile steel
(B) Compression steel more than tensile steel
(C) Compression steel less than tensile steel
(D) Compression steel 25% more than tensile steel

Ans. (A)

Q.100 In the limit state method of design, the failure criterion for reinforced concrete beams and columns is:
(A) Maximum principal theory
(B) Maximum principal strain theory
(C) Maximum shear theory
(D) Maximum strain energy theory

Ans. (A)

Q.101 The design yield stress of steel according to **IS:456-1978** is:

(A) $0.37\sqrt{f_y}$ (B) $0.57\sqrt{f_y}$

(C) $0.67\sqrt{f_y}$ (D) $0.87\sqrt{f_y}$

Ans. (D)

Q.102 Pre-stressing losses in post-tensioned and pre-tensioned beams are respectively:
(A) 15% and 20% (B) 20% and 15%
(C) 15% and 15% (D) 20% and 20%

Ans. (A)

Q.103 In limit state of design, the maximum limit imposed by **IS:456-1978** on the redistribution of moments in statically indeterminate beams is
(A) 10% (B) 15%
(C) 20% (D) 30%

Ans. (D)

Q.104 At limit state of collapse in shear, in case of web shear cracks, it is assumed that the concrete cracks when the maximum principal tensile stress exceeds a value of f_t equal to:

(A) $0.24\sqrt{f_{ck}}$ (B) $0.20\sqrt{f_{ck}}$

(C) $0.16\sqrt{f_{ck}}$ (D) $0.30\sqrt{f_{ck}}$

Ans. (A)

Q.105 Minimum clear cover (in mm) to the main steel bars in slab beam column and footing respectively are:
(A) 10, 15, 20, 25 (B) 15, 25, 40, 75
(C) 20, 25, 30, 40 (D) 20, 35, 40, 75

Ans. (B)

Q.106 Which one of the following statements is correct?
(A) Maximum longitudinal reinforcement in an axially loaded short column is 6% of gross sectional area.
(B) Columns with circular section are provided transverse reinforcement helical type only.
(C) Spacing of lateral ties can not be more than 16 times the diameter of the bar.
(D) Longitudinal reinforcement bar need not be contact with lateral ties.

Ans. (A)

Q.107 Limit state of serviceability for deflection including the effects due to creep, shrinkage and temperature occurring after erection of partitions and application of finishes as applicable to floors and roofs is restricted to:

(A) $\frac{\text{Span}}{150}$ (B) $\frac{\text{Span}}{200}$

(C) $\frac{\text{Span}}{250}$ (D) $\frac{\text{Span}}{350}$

Ans. (D)

Q.108 Flexural collapse in over reinforced beams is due to:
(A) Primary compression failure
(B) Secondary compression failure
(C) Primary tension failure
(D) Bond failure

Ans. (A)

Q.109 Approximate value of shrinkage strain in concrete is:
(A) 0.003 (B) 0.0003
(C) 0.00003 (D) 0.03

Ans. (B)

Q.110 According to **IS:456-1978**, the modulus of elasticity of concrete E_c (in N/mm^2) can be taken as:

(A) $E_c = 5000\sqrt{f_{ck}}$

(B) $E_c = 570\sqrt{f_{ck}}$

(C) $E_c = 5700 f_{ck}$

(D) $E_c = 700\sqrt{f_{ck}}$

Ans. (A)

Q.111 The lacing bars in a steel column should be designed to resist:

(A) Bending moment due to 2.5% of the column load.

(B) Shear force due to 2.5% of the column load

(C) 2.5% of the column load only

(D) Both (A) and (B)

Ans. (B)

Q.112 As per **IS:800**, the maximum bending moment for design of purlins can be taken as (where W is total distributed load on the purlins and L is centre distance of support):

(A) $\frac{WL}{6}$ (B) $\frac{WL}{8}$

(C) $\frac{WL}{10}$ (D) $\frac{WL}{12}$

Ans. (C)

Q.113 The number of seismic zones in which the country has been divided are:

(A) 3 (B) 5

(C) 6 (D) 7

Ans. (B)

Q.114 As per **IS:875**, for the purposes of specifying basic wind velocity, the country has been divided into:

(A) 4 zones (B) 5 zones

(C) 6 zones (D) 7 zones

Ans. (C)

Q.115 The thickness of web for unstiffened plate girder with clear distance "d" between the flanges shall not be less than:

(A) $\frac{d}{200}$ (B) $\frac{d}{85}$

(C) $\frac{d}{100}$ (D) $\frac{d}{160}$

Ans. (B)

Q.116 At a section along the span of a welded plate girder, where the web is sliced, the bending moment is M. If the girder has top flange, web and bottom flange plates of equal area, then the share of the bending moment which would be taken by the splice plates would be

(A) M (B) $\frac{M}{3}$

(C) $\frac{M}{7}$ (D) $\frac{M}{13}$

Ans. (C)

Q.117 Given that the effective area of a tension member is A_e and the yield stress is σ_y. In order to obtain the ultimate strength of the tension member, as per the plastic design concept A_e σ_y is to be multiplied by

(A) 1.1 (B) 0.95

(C) 0.85 (D) 0.75

Ans. (C)

Q.118 For a compression member with double angle section, which of the following section will give larger value of minimum radius of gyration?

(A) Equal angles back to back.

(B) Unequal legged angles with long legs back to back.

(C) Unequal legged angles with short legs back to back.

(D) Both (B) and (C)

Ans. (C)

Q.119 Battens provided for a compression member shall be designed to carry a transverse shear equal to

(A) 2.5% of axial force in member

(B) 5% of axial force in member

(C) 10% of axial force in member

(D) 20% of axial force in member

Ans. (A)

Q.120 The channels or angles in the compression chords of the steel truss girder bridges are turned outward in order to increase:
(A) Cross-section area
(B) Section modulus
(C) Torsional constant
(D) Radius of gyration

Ans. (D)

Q.121 The effective length of a structural steel compression of length "L" effective held in position and restrained against rotation at one end but neither held in position nor restrained against rotation at the other end is member:
(A) L (B) 1.2L
(C) 1.5L (D) 2.0L

Ans. (D)

Q.122 A column, base is subjected to moment. If the intensity of bearing pressure due to axial load is equal to stress due to the moment, then the bearing pressure between the base and concrete is
(A) Uniform compression throughout.
(B) Zero at one end and compression at the other end.
(C) Tension at one end and compression at the other end.
(D) Uniform tension throughout

Ans. (B)

Q.123 Economical depth of a plate girder is given by:
(A) $\sqrt{\left(\frac{M}{\sigma t_w}\right)}$ (B) $1.1\sqrt{\left(\frac{M}{\sigma t_w}\right)}$
(C) $1.2\sqrt{\left(\frac{M}{\sigma t_w}\right)}$ (D) $1.3\sqrt{\left(\frac{M}{\sigma t_w}\right)}$

Ans. (B)

Q.124 Shear buckling of web in a plate girder is prevented by using:
(A) Vertical intermediate stiffener
(B) Horizontal stiffener along the neutral axis
(C) Bearing stiffener
(D) None of these

Ans. (A)

Q.125 Intermediate vertical stiffeners in a plate girder need to be provided, if the depth of web exceeds ("t" is thickness of web):
(A) 50t (B) 85t
(C) 200t (D) 250t

Ans. (B)

Q.126 The range of economical spacing of trusses varies from (where L is span):
(A) $\frac{L}{3}$ to $\frac{L}{5}$ (B) $\frac{L}{4}$ to $\frac{2L}{5}$
(C) $\frac{L}{3}$ to $\frac{L}{2}$ (D) $\frac{2L}{5}$ to $\frac{3L}{5}$

Ans. (A)

Q.127 In case of plastic design, the calculated maximum shear capacity of a beam as per **IS:800** shall be (where A_w effective cross-sectional area resisting shear and f_y is the yield stress of the steel):
(A) $0.55\, A_w f_y$ (B) $0.65\, A_w f_y$
(C) $0.75\, A_w f_y$ (D) $0.85\, A_w f_y$

Ans. (A)

Q.128 Bearing stiffener in a plate girder is used to:
(A) Transfer the load from the top flange to the bottom one.
(B) Prevent buckling of web
(C) Decrease the effective depth of web
(D) Prevent excessive deflection

Ans. (B)

Q.129 As per **IS:800**, for compression flange, the outstand of flange plates should not exceed, if "t" is thickness of thinnest flange plate:
(A) 12t (B) 16t
(C) 20t (D) 25t

Ans. (B)

Q.130 Horizontal stiffener in a plate girder is provided to safeguard against:
(A) Shear buckling of web plate
(B) Compression buckling of web plate
(C) Yielding
(D) All of these

Ans. (B)

Q.131 The most common admixture which is used to retarder in cement is:
(A) Gypsum
(B) Calcium chloride
(C) Calcium carbonate
(D) None of these

Ans. (A)

Q.132 Which of the following test is used to determine the rate of wear of stones?
(A) Crushing test (B) Abrasion test
(C) Attrition test (D) Impact test

Ans. (C)

Q.133 According the IS specification, the compressive strength of ordinary Portland cement after three days should not be less than:
(A) 7 MPa (B) 11.5 MPa
(C) 16 MPa (D) 21 MPa

Ans. (B)

Q.134 Which of the following cements is suitable for use in massive concrete structures such as large dams?
(A) Ordinary Portland Cement
(B) Low Heat Cement
(C) Rapid Hardening Cement
(D) Sulphate Resisting Cement

Ans. (B)

Q.135 The slump recommended for mass concrete is about:
(A) 25 mm to 50 mm
(B) 50 mm to 100 mm
(C) 100 mm to 125 mm
(D) 125 mm to 150 mm

Ans. (A)

Q.136 The most common admixture which is used to accelerate the initial set of concrete:
(A) Gypsum
(B) Calcium Chloride
(C) Calcium Carbonate
(D) None of these

Ans. (B)

Q.137 Which of the following cements contains maximum percentage of dicalcium silicate?
(A) Ordinary Portland Cement
(B) Low Heat Cement
(C) Rapid Hardening Cement
(D) Sulphate Resisting Cement

Ans. (B)

Q.138 Number of bricks required for one cubic meter of brick meter of brick masonry is:
(A) 400 (B) 450
(C) 500 (D) 550

Ans. (C)

Q.139 Distemper is used to coat:
(A) Compound wall
(B) Wood work
(C) External concrete surface
(D) Interior surfaces not exposed to weather

Ans. (D)

Q.140 Neoprene is suitable for use in:
(A) Bearings of bridge
(B) Floors of dance hall
(C) Joinery work
(D) Coating of floor

Ans. (A)

Q.141 Minimum width of landing should be:
(A) Equal to width of stairs
(B) Half the width of stairs
(C) Twice the width of stairs
(D) One-fourth the width of stairs

Ans. (C)

Q.142 Doglegged stairs are:
(A) Half turn stairs
(B) Quarter turn stairs
(C) Straight stairs
(D) Three quarter turn stairs

Ans. (A)

Q.143 The type of windows provided on the sloping side of a pitched roof is called:
(A) Dormer window
(B) Gable window

(C) Lantern
(D) None of these

Ans. (A)

Q.144 Sum of tread and rise must lie between:
(A) 300 mm to 350 mm
(B) 400 mm to 450 mm
(C) 500 mm to 550 mm
(D) 600 mm to 650 mm

Ans. (B)

Q.145 The function of king post in a king post roof truss is
(A) To support the framework of the roof
(B) To receive the ends of principal rafter
(C) To prevent the walls from spreading outward
(D) To prevent the tie beam from sagging at its centre

Ans. (D)

Q.146 The pitched and sloping roofs are suitable for:
(A) Coastal regions
(B) Pain regions
(C) Covering large areas
(D) All of these

Ans. (A)

Q.147 The lintels are preferred to arches because:
(A) Arches require more head-room to span the opening like doors and windows.
(B) Arches require strong abutments to withstand arch thrust.
(C) Arches are difficult to construct.
(D) All of these

Ans. (D)

Q.148 The type of footing which is used to transmit heavy loads through steel columns is:
(A) Raft foundation
(B) Grillage foundation
(C) Well foundation
(D) Isolated footing

Ans. (B)

Q.149 In case of foundation on black cotton soils, the most suitable method to increase the bearing capacity of the soil is:
(A) Increase the depth of foundation
(B) Drain the soil
(C) Compact the soil
(D) Replace the poor soil

Ans. (D)

Q.150 A queen closer is a
(A) Brick laid with its length parallel to the face or direction of wall.
(B) Brick laid with its breadth parallel to the face or direction of wall.
(C) Brick having the same length and depth as the other bricks but half the breadth.
(D) Brick with half the width at one end and full width at the other.

Ans. (C)

Q.151 Le Chatelier's device is used for determining the:
(A) Setting time of cement
(B) Soundness of system
(C) Tensile strength of cement
(D) Compressive strength of cement

Ans. (B)

Q.152 The ultimate tensile strength of structural mild steel is about:
(A) 130 N/mm^2 (B) 260 N/mm^2
(C) 420 N/mm^2 (D) 840 N/mm^2

Ans. (C)

Q.153 The type of bond provided in brick masonry for carrying heavy load is
(A) English bond
(B) Single Flemish bond
(C) Double Flemish bond
(D) Zigzag bond

Ans. (A)

Q.154 Paints with white lead base are suitable for painting of:
(A) Wood work
(B) Iron work
(C) Both wood work and iron work
(D) None of these

Ans. (A)

Q.155 The role of super plasticizer in a cement paste is to:
(A) Disperse the particle
(B) Disperse the particle and to remove the air bubbles
(C) Retard setting
(D) Disperse the particle and to remove the air bubbles and to retard setting

Ans. (A)

Q.156 For a given environment, the most significant factor that influences the total shrinkage of concrete is
(A) Cement content of mix
(B) Total amount of water added at the time of mixing
(C) Size of the member concreted
(D) Maximum size of the coarse aggregate used

Ans. (B)

Q.157 A good brick, when immersed in water for 24 hours, should not absorb more than
(A) 20% of its dry weight
(B) 30% of its saturated weight
(C) 10% of its dry weight
(D) 20% of its saturated weight

Ans. (A)

Q.158 The approximate ratio between the strength of cement concrete at 7 days and 28 days is
(A) $\frac{3}{4}$ (B) $\frac{2}{3}$
(C) $\frac{1}{2}$ (D) $\frac{1}{3}$

Ans. (B)

Q.159 If X is the standard consistency of cement, the amount of water used in conducting the initial setting time test on cement is:
(A) 0.65X (B) 0.85X
(C) 0.6X (D) 0.8X

Ans. (B)

Q.160 For complete hydration of cement the water/cement ratio needed is:
(A) Less than 0.25
(B) More than 0.25 but less than 0.35
(C) More than 0.35 but less than 0.45
(D) More than 0.45 but less than 0.55

Ans. (A)

Q.161 Approximate cost of building commonly estimated by
(A) Service unit method
(B) Comparison of costs at relative dates
(C) Rough grouped quantities or elemental bill method
(D) All of these methods

Ans. (D)

Q.162 In estimation of earthwork the measurements shall be taken separately for what lead and height?
(A) 30 m, 1.5 m
(B) 25 m, 2.0 m
(C) 20 m, 1.0 m
(D) 40 m, 3.0 m

Ans. (A)

Q.163 In long wall and short wall method of estimation which one of the following is correct?
(A) Short wall length in-to-in = centre to centre length – one breadth
(B) Short wall length in-to-in = centre to centre length + one breadth
(C) Long wall length out-to-out = centre to centre length + one breadth
(D) Long wall length out-to-out = centre to centre length – two breadth

Ans. (A)

Q.164 Revised estimate is a detailed estimate and is required to be prepared under the condition when:
(A) The original estimate exceeds or likely to exceed by more than specified in OPWD manual.
(B) The expenditure on a work exceeds or likely to exceed the amount of adminis-trative sanction as specified in OPWD manual.

(C) There are material deviation from the original proposal even through the cost may be met from the sanctioned strength.
(D) Any or all such case prevails.

Ans. (B)

Q.165 The Schedule of Rates is prepared based on:
(A) Analysis of rates
(B) Experience
(C) General abstract of cost
(D) Building cost index

Ans. (A)

Q.166 In analysis of rates which is/are included from the following?
(A) Cost of quantities of materials.
(B) Cost of labour and other miscellaneous expenditures.
(C) Contractor's profit
(D) All of these

Ans. (D)

Q.167 In 1.0 cubic meter of 1 : 2 : 4 cement concrete, how many bags of cement (approximately) is required?
(A) 6.6 (B) 16.6
(C) 26.6 (D) 36.6

Ans. (A)

Q.168 In case of approximate estimation, which one is correct?
(A) It gives a rough idea of the probable expenditure for project financing.
(B) It is used for administrative approval for the project.
(C) It is used for valuation and rent fixation.
(D) All of these

Ans. (D)

Q.169 The earthwork quantities are calculated:
(A) By mid-sectional method
(B) By mean-sectional method
(C) By Prismoidal method
(D) All of these

Ans. (D)

Q.170 The detailed estimated of the cost of the project is done by
(A) Unit-quantity method
(B) Total-quantity method
(C) BOOQ method
(D) By first two methods

Ans. (A)

Q.171 Which of the following is a weakness of bar chart?
(A) Interdependencies of activities
(B) Project progress
(C) Uncertainties
(D) All of these

Ans. (D)

Q.172 Cost slope:

(A) $\frac{(\text{Crash cost} - \text{Normal cost})}{\text{Crash time}}$

(B) $\frac{(\text{Crash cost})}{(\text{Normal time} - \text{Crash time})}$

(C) $\frac{(\text{Crash cost} - \text{Normal cost})}{\text{Normal time}}$

(D) $\frac{(\text{Crash cost} - \text{Normal cost})}{(\text{Normal time} - \text{Crash time})}$

Ans. (D)

Q.173 The PERT calculations yield a project length of 50 weeks, with a variance of 9. Within how many weeks would you expect the project to be completed with probability of 95%, take probability factor Z equal to 1.65 for 95% probability:
(A) 54.95 (B) 56.6
(C) 60 (D) 70

Ans. (A)

Q.174 The probability of competition of any activity within its expected time is:
(A) 50% (B) 84.1%
(C) 99.9% (D) 100%

Ans. (A)

Q.175 The direct cost of a project with respect to normal time is
(A) Minimum (B) Maximum
(C) Zero (D) Infinite

Ans. (A)

Q.176 Slack time refers to
(A) An activity
(B) An event
(C) Both event and activity
(D) Critical event only

Ans. (D)

Q.177 If the optimistic time, most likely time and pessimistic time for activity A are 4, 6 and 8 respectively and for activity B are 5, 5.5 and 9 respectively, then:
(A) Expected time for activity A is greater than the expected time of activity B
(B) Expected time of activity B is greater than the expected time of activity A
(C) Expected time of activity A is same as that of the expected time of activity B
(D) None of these is correct

Ans. (C)

Q.178 Free float is mainly used to:
(A) Identify the activities which can be delayed without affecting the total float of preceding activity.
(B) Identify the activities which can be delayed without affecting the total float of succeeding activity.
(C) Establish priorities.
(D) Identify the activities which can be delayed without affecting the total float of either of preceding or succeeding activities.

Ans. (B)

Q.179 There are three parallel paths in a part of a network between a bursting node and the next merging node with only one activity in each path. The minimum number of dummy arrows needed will be
(A) 0 (B) 1
(C) 2 (D) 3

Ans. (C)

Q.180 In the time-cost optimization, using CPM method for network analysis, the crashing of the activities along the critical path is done starting with the activity having:
(A) Shortest duration
(B) Least cost slope
(C) Longest duration
(D) Highest cost slope

Ans. (B)

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