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**T.B.C. : B-HUF-P-EEA**

**Test Booklet Series**

Serial 1035761

# A

## TEST BOOKLET

## CIVIL ENGINEERING

## Paper I

*Time Allowed : Two Hours*                                   *Maximum Marks : 200*

### INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET *DOES NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.

2. Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series Code A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.

3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. *DO NOT* write *anything else* on the Test Booklet.

4. This Test Booklet contains 120 items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case, you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose *ONLY ONE* response for each item.

5. You have to mark all your responses *ONLY* on the separate Answer Sheet provided. See directions in the Answer Sheet.

6. All items carry equal marks.

7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.

8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator *only the Answer Sheet*. You are permitted to take away with you the Test Booklet.

9. Sheets for rough work are appended in the Test Booklet at the end.

10. **Penalty for wrong answers :**

    **THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE.**

    (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third (0·33)** of the marks assigned to that question will be deducted as penalty.

    (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.

    (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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1. Consider the following statements :

1. There will be no defects in select grade timbers.

2. The codal values for strength of grade-II timber without defects may be reduced by 37·5%.

3. For timber used as columns, the permissible stress in ungraded timbers is adopted with a multiplying factor of 0·50.

4. In case of wind force and earthquakes, a modification factor of 1·33 is adopted.

Which of the above statements are correct ?

(a) 1 and 3 only

(b) 1 and 4 only

(c) 2 and 4 only

(d) 2 and 3 only

2. Consider the following statements regarding timber :

1. The strength of timber increases by Kiln seasoning.

2. Cutting of wood is to be done prior to treatment.

3. Water seasoning is good for prevention of warping.

4. ASCU treatment enhances the strength of wood.

Which of the above statements are correct ?

(a) 1, 2 and 3 only

(b) 2, 3 and 4 only

(c) 1, 3 and 4 only

(d) 1, 2, 3 and 4

3. Gase(s) emitted during rotting or decomposition of timber is/are mainly

(a) Methane and Hydrogen

(b) Hydrogen Sulphide

(c) Carbonic acid and Hydrogen

(d) Ammonia

4. Efflorescence of bricks is due to

(a) Excessive burning of bricks

(b) High silt content in brick clay

(c) High porosity of bricks

(d) Soluble salts present in parent clay

5. Disintegration of brick masonry walls is primarily due to

1. Efflorescence

2. Magnesium sulphate in bricks

3. Calcined clay admixtures

4. Kankar nodules

Which of the above statements are correct ?

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 3 and 4 only

(d) 1, 2, 3 and 4

6. Consider the following tests :

1. Transverse strength test

2. Water absorption test

3. Impact test

4. Breaking strength test

Which of the above are relevant to testing of tiles ?

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 3 and 4 only

(d) 1, 2, 3 and 4

7. Which of the following statements is/are correct regarding the strength of cement ?

   1. Particle sizes less than 3 μm increase the viscous nature of the cement.

   2. Finer particles in cement can be replaced by fly-ash to improve the strength.

   (a) 1 only

   (b) 2 only

   (c) Both 1 and 2

   (d) Neither 1 nor 2

8. The constituent compound in Portland cement which reacts immediately with water, and also sets earliest, is

   (a) Tricalcium silicate

   (b) Dicalcium silicate

   (c) Tricalcium aluminate

   (d) Tetracalcium aluminoferrite

9. Which of the following statements are correct with regard to cement mortar ?

   1. Workability of cement mortar can be improved by addition of lime.

   2. Fly-ash cement is economical in plastering jobs.

   3. Addition of saw dust improves workability.

   4. Sand in mortar can be replaced by finely crushed fire bricks.

   (a) 1, 2, 3 and 4

   (b) 1, 2 and 3 only

   (c) 3 and 4 only

   (d) 1, 2 and 4 only

10. In a concrete mix of proportion 1 : 3 : 6, the actual quantity of sand, which is judged to have undergone 15% bulking, per unit volume of cement, will be

   (a) 3·00

   (b) 3·45

   (c) 4·50

   (d) 6·00

11. The Rheological behaviour of concrete, when represented by shear stress vs rate of shear, is characterized as

   (a) $\tau = \tau_0 + \mu \cdot \dot{\gamma}$

   (b) $\tau_0 = \tau + \mu \cdot \dot{\gamma}$

   (c) $\dfrac{\tau}{\tau_0} = \mu \cdot \dot{\gamma}$

   (d) $\tau = \mu \cdot \dot{\gamma}$

   where : $\tau$ = shear stress,

              $\tau_0$ = (initial) yield value,

              $\mu$ = at-point plastic viscocity,

              $\dot{\gamma}$ = at-point rate of shear.

12. Which method of curing of concrete is recommendable for rapid gain of strength of concrete ?

   (a) Sprinkling water

   (b) Membrane curing

   (c) High-pressure steam curing

   (d) Infrared radiation curing

**13.** Which of the following is appropriate as a simple field method for assessing consistency of concrete ?

(a) Compacting factor

(b) Slump test

(c) Vee-Bee test

(d) Kelly Ball test

**14.** Which of the following are relatable to Autoclaved Aerated Concrete ?

1. Light weight

2. Strong

3. Inorganic

4. Non-toxic

(a) 1, 2 and 3 only

(b) 1, 2 and 4 only

(c) 3 and 4 only

(d) 1, 2, 3 and 4

**15.** The workability of concrete becomes more reliable depending on

1. Aggregate-cement ratio

2. Time of transit

3. Grading of the aggregate

(a) 1 only

(b) 2 only

(c) 3 only

(d) 1, 2 and 3

**16.** The longitudinal strain of a cylindrical bar of 25 mm diameter and 1·5 m length is found to be 3 times its lateral strain in a tensile test. What is the value of Bulk Modulus by assuming $E = 1 \times 10^5$ N/mm$^2$ ?

(a) $2 \times 10^5$ N/mm$^2$

(b) $1·1 \times 10^5$ N/mm$^2$

(c) $1 \times 10^5$ N/mm$^2$

(d) $2·1 \times 10^5$ N/mm$^2$

**17.** For an elastic material, Poisson's ratio is $\mu$, Modulus of Elasticity is E, Modulus of Rigidity is C and Bulk Modulus is K. $\mu$ is expressible in terms of K and C as

(a) $\dfrac{6K - 2C}{3K - 2C}$

(b) $\dfrac{6K + 2C}{3K - 2C}$

(c) $\dfrac{3K - 2C}{6K + 2C}$

(d) $\dfrac{3K + 2C}{6K + 2C}$

**18.** A mild steel bar of length 450 mm tapers uniformly. The diameters at the ends are 36 mm and 18 mm, respectively. An axial load of 12 kN is applied on the bar. $E = 2 \times 10^5$ N/mm$^2$. The elongation of the bar will be

(a) $\dfrac{1}{3\pi}$ mm

(b) $\dfrac{1}{6\pi}$ mm

(c) $\dfrac{3\pi}{2}$ mm

(d) $\dfrac{2}{3\pi}$ mm

**19.** Which of the following statements are correct for stresses acting on mutually perpendicular faces of a plane element ?

1. The sum of the normal stresses in mutually perpendicular planes is equal to the sum of the principal stresses.

2. The shearing stresses in two mutually perpendicular planes are equal in magnitude and direction.

3. Maximum shear stress is half of the difference between principal stresses.

(a) 1, 2 and 3

(b) 1 and 2 only

(c) 2 and 3 only

(d) 1 and 3 only

**20.** Which of the following statements are correct ?

1. Strain in the direction of applied stress is known as longitudinal strain.

2. Tensile stress results in tensile strain in linear and lateral directions.

3. Strains in all directions perpendicular to the applied stress are known as lateral strain.

4. Ratio of change in volume to original volume is known as volumetric strain.

(a) 1, 2 and 3 only

(b) 1, 3 and 4 only

(c) 3 and 4 only

(d) 1, 2, 3 and 4

**21.** The state of stress on an element is as shown in the figure. If $E = 2 \times 10^5$ N/mm$^2$ and Poisson's ratio = 0·3, the magnitude of the stress σ for no strain in BC is
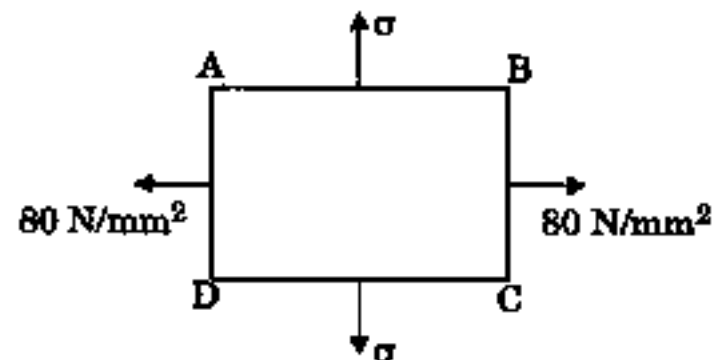


(a) 84 N/mm$^2$

(b) 64 N/mm$^2$

(c) 34 N/mm$^2$

(d) 24 N/mm$^2$

**22.** In the cross-section of a timber, cambium layer can occur in

(a) Inner Bark and Sap Wood

(b) Pith and Heart Wood

(c) Sap Wood and Heart Wood

(d) Outer Bark and Sap Wood

**23.** Consider the following statements :

1. In the infinitesimal strain theory, dilatation is taken as an invariant.

2. Dilatation is not proportional to the algebraic sum of all normal stresses.

3. The shearing modulus is always less than the elastic modulus.

Which of the above statements is/are correct ?

(a) 1 only

(b) 1 and 2 only

(c) 2 only

(d) 1, 2 and 3

24. Which one of the following represents 'constitutive relationship' ?

   (a) Vertical displacements in a structure

   (b) Rotational displacements in a structure

   (c) System of forces in equilibrium

   (d) Stress – strain behaviour of a material

25. A square element of a structural part is subjected to biaxial stresses as shown in the figure. On a plane along BD, the intensity of the resultant stress due to these conditions will be
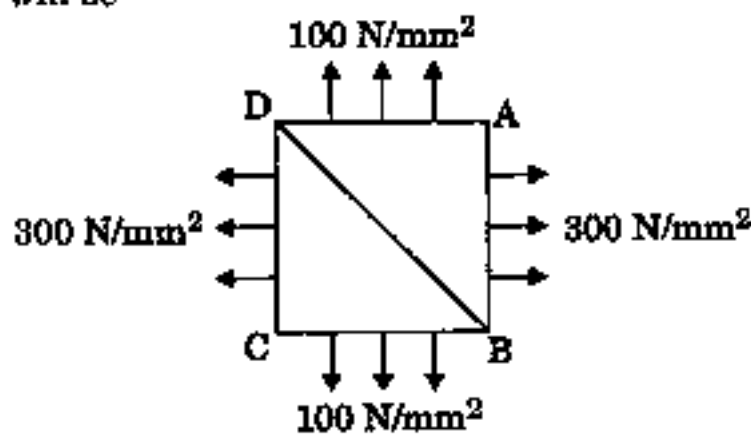


   (a) $25\sqrt{5}$ N/mm$^2$

   (b) $50\sqrt{5}$ N/mm$^2$

   (c) $75\sqrt{5}$ N/mm$^2$

   (d) $100\sqrt{5}$ N/mm$^2$

26. A structural element is subjected to pure shear of 80 N/mm$^2$, as shown in the figure. The yield stresses both in tension and in compression are 240 N/mm$^2$. According to the maximum normal stress theory, the factors of safety in tension and compression are, respectively,
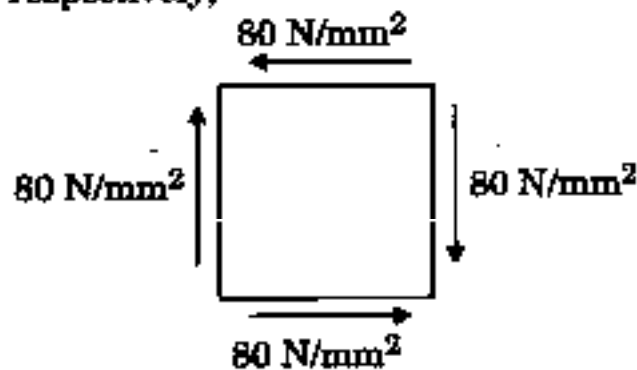


   (a) 2 and 2
   (b) 2·5 and 2·5
   (c) 3 and 3
   (d) 4 and 4

27. Principal stresses at a point are 80 N/mm$^2$ and 40 N/mm$^2$, both tensile. The yield stress in simple tension for this material is 200 N/mm$^2$. The values of factors of safety according to maximum principal stress theory and maximum shear stress theory, respectively, are

   (a) 2·5 and 2·5

   (b) 2·5 and 5

   (c) 5 and 5

   (d) 5 and 1·67

28. The principal stresses at a point are $2\sigma$ (tensile) and $\sigma$ (compressive), and the stress at elastic limit for the material in simple tension is 210 N/mm$^2$. According to maximum shear strain theory, the value of $\sigma$ at failure is

   (a) 70 N/mm$^2$

   (b) 105 N/mm$^2$

   (c) 140 N/mm$^2$

   (d) 210 N/mm$^2$

29. A thin steel ruler having its cross-section of 0·0625 cm × 2·5 cm is bent by couples applied at its ends so that its length $l$ equal to 25 cm, when bent, as a circular arc, subtends a central angle $\theta = 60°$. Take $E = 2 \times 10^6$ kg/cm$^2$. The maximum stress induced in the ruler and the magnitude is

   (a) 2618 kg/cm$^2$

   (b) 2512 kg/cm$^2$

   (c) 2406 kg/cm$^2$

   (d) 2301 kg/cm$^2$

**30.** Which of the following statements are correct ?

1. Cranes are employable in moving and/or hoisting loads.

2. With the use of dipper and stick, power shovels can be used as hoes.

3. Overdrive for higher speeds is a facility often used comfortably in the working of a tractor.

4. Clam shells are less desirable than draglines if the material is water-saturated.

(a) 1 and 4 only

(b) 1 and 2 only

(c) 2 and 3 only

(d) 3 and 4 only

**31.** Two similar bars of Steel and Aluminium are heated to a same temperature. Forces are applied at the ends of the bars to maintain their lengths unaltered. If the ratio of Young's modulii of Steel and Aluminium is 3, and the ratio of the coefficients of thermal expansion of Steel to that of Aluminium is 0·5, what is the stress on the Aluminium bar if the stress on the Steel bar is 100 MPa ?

(a) 16·7 MPa

(b) 66·7 MPa

(c) 136·7 MPa

(d) 150·0 MPa

**32.** In order that the extreme fibre stresses in bending will be in the ratio 4 : 3 in the beam shown in the following figure, the width b of the upper flange (b < 10 cm) of the beam section is to be
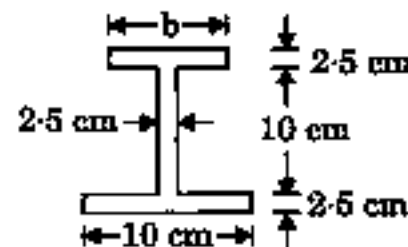


(a) 6·1 cm

(b) 6·6 cm

(c) 5·1 cm

(d) 5·6 cm

**33.** A structural steel beam has an unsymmetrical I-cross-section. The overall depth of the beam is 200 mm. The flange stresses at the top and bottom are 120 $N/mm^2$ and 80 $N/mm^2$, respectively. The depth of the neutral axis from the top of the beam will be
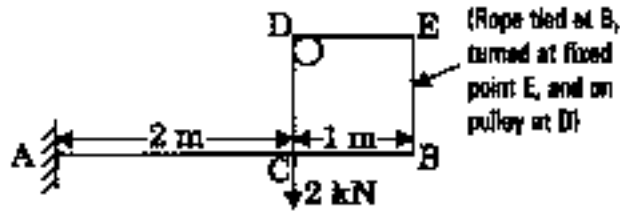
(a) 120 mm

(b) 100 mm

(c) 80 mm

(d) 60 mm

**34.** The bending moment at A for the beam shown below (with BD being a rigid bar) is
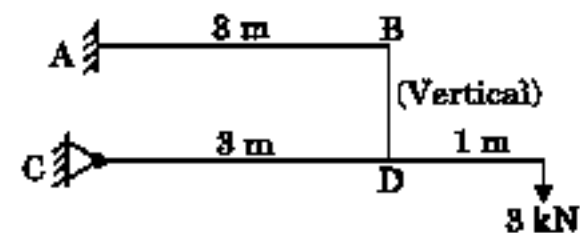


(a) Zero

(b) 12 kN-m

(c) 8 kN-m

(d) 6 kN-m

**35.** The bending moment diagram for the beam shown below is



(a)


(b)


(c)


(d)


**36.** A circular shaft rotates at 200 rpm and is subject to a torque of 1500 Nm. The power transmitted would be
 (a)   $10 \pi$ kW
 (b)   $15 \pi$ kW
 (c)   $20 \pi$ kW
 (d)   $30 \pi$ kW

**37.** Torques are transmitted to the solid circular shaft as shown in the figure below. If the corresponding permissible stress in the shaft is 60 N/mm$^2$, the diameter of the shaft is nearly
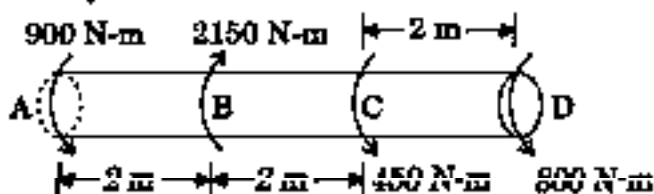


 (a)   57·3 mm
 (b)   47·5 mm
 (c)   37·3 mm
 (d)   27·3 mm

**38.** A solid circular shaft has a diameter d. Its polar modulus will be

 (a)   $\dfrac{\pi}{16} d^2$

 (b)   $\dfrac{\pi}{64} d^3$

 (c)   $\dfrac{\pi}{16} d^3$

 (d)   $\dfrac{\pi}{32} d^2$

**39.** A hollow steel shaft has outside diameter d and inside diameter $\dfrac{d}{2}$. The value of d for the shaft, if it has to transmit 200 hp at 105 rpm with a working shear stress of 420 kg/cm$^2$, is
 (a)   5·6 cm
 (b)   2·6 cm
 (c)   12·1 cm
 (d)   15·5 cm

**40.** Two thin-walled tubular members made of the same material have the same length, same wall thickness and same total weight and are both subjected to the same torque of magnitude T. If the individual cross-sections are circular and square, respectively, as in the figures, then the ratios of the shear stress $\tau$, reckoned for the circular member in relation to the square member will be

*Figures not to scale*
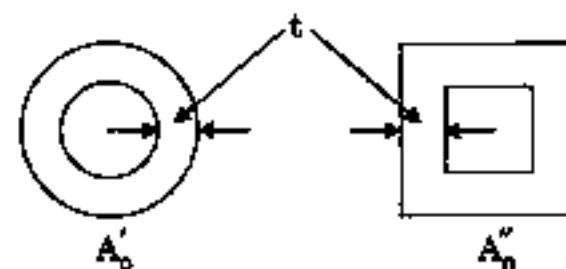


 (a)   0·785
 (b)   0·905
 (c)   0·616
 (d)   0·513

41. In the analysis of beams subjected to loads, the point with Nil Bending Moment can be a

1. Point of Contraflexure
2. Point of Maximum Shear Force
3. Point of Inflexion

Which of the above statements is/are correct ?

(a) 1 only
(b) 2 only
(c) 3 only
(d) 1, 2 and 3

42. A mild steel bar, 1·5 m long, has a square section 40 mm × 40 mm. The bar is subjected to a two-dimensional stress, $\sigma_x$ = 310 N/mm$^2$ (tensile) and $\sigma_y$ = 300 N/mm$^2$ (compressive). E = 2 × 10$^5$ N/mm$^2$, Poisson's ratio $\mu$ = 0·3. The elongation of the bar in the direction of $\sigma_x$ will be

(a) 1·25 mm
(b) 1·75 mm
(c) 2·25 mm
(d) 3 mm

43. A tractor has a permissible loaded speed of 200 m/minute, which can increase by 25% when the load is removed/deposited. Generally, it is operated at 80% of the permissible speed (loaded or unloaded). It works at a location where haul distance is 120 m. Rest allowance per round-trip is taken as 50 seconds on an average. Fixed time per trip, for loading and unloading and turnaround, etc., is 30 seconds. What is its effective cycle time ?

(a) 157 seconds
(b) 161 seconds
(c) 173 seconds
(d) 182 seconds

44. The bending moment at A for the beam shown below (not to scale) is
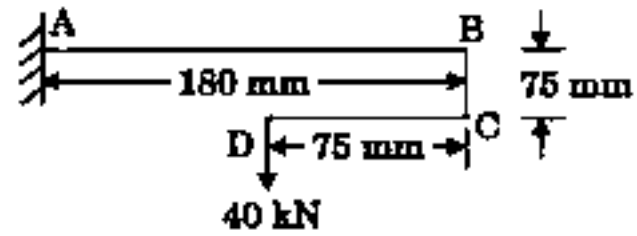


(a) 3200 kN.mm
(b) 3600 kN.mm
(c) 4200 kN.mm
(d) 4800 kN.mm

45. In the pin-end cantilever truss shown below, member FG had been fabricated 10 mm longer than required. How much will point E deflect vertically ?



(a) 10 mm
(b) 20 mm
(c) 30 mm
(d) 40 mm

46. The purpose of lateral ties in a short RC column is to

(a) Avoid buckling of longitudinal bars
(b) Facilitate compaction of concrete
(c) Increase the load carrying capacity of the column
(d) Facilitate construction

47. When a two-hinged parabolic arch is subjected to a rise in ambient temperature, the horizontal thrust at the support will

(a) Increase
(b) Decrease
(c) Remain same
(d) Increase or decrease depending on the span

**48.** The degree of static indeterminacy for a rigid frame as shown below is
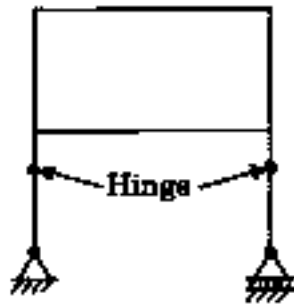


(a)   0
(b)   1
(c)   2
(d)   3

**49.** In the slope-deflection equations, deformations are considered to be caused by
(a)   Shear forces and bending moments only
(b)   Axial forces, shear forces and bending moments
(c)   Axial forces and bending moments only
(d)   Bending moments only

**50.** The maximum bending moment caused by a set of concentrated moving loads is
(a)   Always at the mid-point of span
(b)   Between the mid-point and concentrated load next to the mid-point of the span
(c)   Not definable
(d)   Always under a load close to the centroid of the set of loads

**51.** Force method of analysis of a structure is particularly preferred when
1.   The degrees of freedom of the structure become large
2.   The structure has less numbers of static, and more numbers of kinematic, indeterminacies
3.   The structure has more numbers of static, and less numbers of kinematic, indeterminacies
(a)   1 only
(b)   2 only
(c)   3 only
(d)   1, 2 and 3

**52.** Stiffness matrix method is in the category of
1.   Compatibility method
2.   Displacement method
3.   Force method
4.   Equilibrium method
(a)   1 and 3 only
(b)   1 and 4 only
(c)   2 and 3 only
(d)   2 and 4 only

**53.** Müller-Breslau Principle for obtaining influence lines is applicable to
1.   Statically determinate beams and frame
2.   Statically indeterminate structures, the material of which is elastic, and follows Hooke's law
3.   Any statically indeterminate structure
(a)   1 and 2 only
(b)   1 only
(c)   2 only
(d)   1 and 3 only

**54.** The plastic neutral axis
1.   Divides the given section into two equal halves
2.   Divides the given section into two unequal parts
3.   Lies on the centroidal axis of the section
(a)   1 only
(b)   2 only
(c)   3 only
(d)   2 and 3 only

**55.** The plastic moment capacity $M_p$ is
(a)   Less than the yield moment
(b)   Equal to the yield moment
(c)   Greater than the yield moment
(d)   Dependent on section dimensions

56. Web crippling is caused by
   (a) Excessive bending moment
   (b) Failure of web under point loads
   (c) Width of flanges
   (d) Column action of web

57. The block shear failure of a bolted joint in tension occurs because of
   1. Use of high shear strength bolts
   2. Use of plates with higher bearing strength
   (a) 1 only
   (b) 2 only
   (c) Both 1 and 2
   (d) Neither 1 nor 2

58. As per IS code, the maximum longitudinal pitch allowed in bolted joints of tension members is nominally
   (a) 12 times the thickness of the plate
   (b) 12 times the diameter of the bolt
   (c) 16 times the thickness of the plate
   (d) 16 times the diameter of the bolt

59. ISMB 100 ($r_z$ = 40 mm, $r_y$ = 10 mm) has been used as a column in an industrial shed. Along the minor axis, the column has restraints in the form of purlins at 1·0 m intervals. Effective length factor along major and minor axes are 1·2 and 1·0, respectively. If the slenderness ratio is restricted to 120, the maximum column height will be
   (a) 1·0 m
   (b) 2·4 m
   (c) 4·0 m
   (d) 4·8 m

60. As per IS 800 – 2007, the permitted slenderness ratio for a bracing member in case of hangers shall be
   (a) 140
   (b) 145
   (c) 150
   (d) 160

61. A rectangular beam of depth d is under bending. Load has been gradually increased when the top fibre has obtained five times the strain at the first yield. What depth of the beam will still respond by elastic conditions ?
   (a) 0·16 d
   (b) 0·20 d
   (c) 0·25 d
   (d) 0·40 d

62. The ultimate moment capacity of a mild steel section is usually
   (a) Equal to the plastic moment capacity
   (b) More than the yield moment capacity
   (c) Less than the plastic moment capacity but more than the yield moment capacity
   (d) More than the plastic moment capacity

63. The portal bracing in a truss-bridge is used to
   (a) Transfer load from top of end posts to bearings
   (b) Maintain the rectangular shape of the bridge cross-section
   (c) Stiffen the structure laterally
   (d) Prevent the buckling of top chord under side sway

64. Consider the following cases in the design of reinforced concrete members in flexure :
   1. Over-reinforced section
   2. Tension failure
   3. Compression failure
   4. Under-reinforced section
   Which of the above cases are considered for safe design of R.C. members in flexure ?
   (a) 1 and 2 only
   (b) 2 and 4 only
   (c) 3 and 4 only
   (d) 1 and 3 only

65. The bond between steel and concrete is mainly due to
    1. Mechanical resistance
    2. Pure adhesive resistance
    3. Frictional resistance
    (a) 1 and 2 only
    (b) 1 and 3 only
    (c) 2 and 3 only
    (d) 1, 2 and 3

66. The carbonation process is demonstrated more by
    (a) Atmospheric corrosion
    (b) Chloride corrosion
    (c) Stress corrosion
    (d) Hydrogen embrittlement

67. When a spirally reinforced short column is loaded axially, the concrete inside the core is subjected to
    (a) Bending and compression
    (b) Biaxial compression
    (c) Triaxial compression
    (d) Uniaxial compression

68. In a reinforced concrete section, shear stress distribution is diagrammatically
    (a) Wholly Parabolic
    (b) Wholly Rectangular
    (c) Parabolic above NA and Rectangular below NA
    (d) Rectangular above NA and Parabolic below NA

69. As per IS 456 – 2000, the maximum permissible shear stress, $\tau_{C\,max}$, is based on
    (a) Diagonal tension failure
    (b) Diagonal compression failure
    (c) Flexural tension failure
    (d) Flexural compression failure

70. Footings shall be designed to sustain the
    1. Applied loads
    2. Moments and forces under relatable loading conditions
    3. Induced reactions
    (a) 1 and 2 only
    (b) 1 and 3 only
    (c) 2 and 3 only
    (d) 1, 2 and 3

71. Reinforced concrete slabs are designed for
    1. Shear
    2. Flexure
    3. Positive bending moment
    4. Negative bending moment
    (a) 1, 2 and 3 only
    (b) 1 and 4 only
    (c) 2, 3 and 4 only
    (d) 1, 2, 3 and 4

72. As compared to the working stress method of design, the limit state method of design premises that the concrete can admit
    (a) A lower stress level
    (b) A higher stress level
    (c) Occasionally higher, but usually lower, stress level
    (d) Only the same stress level

73. The bending stress in a T-beam section is maximum
    1. At top fibre
    2. At centroidal fibre
    3. At bottom fibre
    (a) 1 only
    (b) 2 only
    (c) 3 only
    (d) At a level which is dependent on the loading condition

74. If the loading on a simply supported pre-stressed concrete beam is uniformly distributed, the centriod of the pre-stressing tendon should be as

   (a) A straight profile along the lower edge of the kern

   (b) A parabolic profile with convexity downward

   (c) A straight profile along the centriodal axis

   (d) A circular profile with convexity upward

75. In a post-tension pre-stressed concrete beam, the end block zone is in between the end of the beam and the section where

   (a) The shear stresses are maximum

   (b) Only shear stresses exist

   (c) No lateral stresses exist

   (d) Only longitudinal stresses exist

76. In the pre-tensioning method

   1. Tension in concrete is induced directly by external force

   2. Tension is induced in the tendons before concreting

   3. Concrete continues to be in tension after pre-stressing

   (a) 1 only

   (b) 2 only

   (c) 3 only

   (d) 1 and 3 only

77. Flexural collapse in over-reinforced beams is due to

   (a) Primary compression failure

   (b) Secondary compression failure

   (c) Primary tension failure

   (d) Bond failure

78. If a beam is likely to fail due to high bonding stresses, then its bond strength can be increased most economically by

   (a) Providing vertical stirrups

   (b) Increasing the depth of the beam

   (c) Using smaller diameter bars in correspondingly more numbers

   (d) Using higher diameter bars by reducing their numbers

79. A single-acting reciprocating pump has a stroke of 25 cm, speed of 135 rpm, and a piston of 30 cm diameter. If its slip has been estimated as 4% at a particular operating condition, what is the corresponding realized discharge through a height of 14 m ?

   (a) 33·2 lps

   (b) 35·6 lps

   (c) 37·0 lps

   (d) 38·2 lps

80. In the design of pre-stressed concrete structures, which of the following limit states will qualify as the limit states of serviceability ?

   1. Flexural

   2. Shear

   3. Deflection

   4. Cracking

   (a) 1 and 2 only

   (b) 3 and 4 only

   (c) 1 and 4 only

   (d) 2 and 3 only

**81.** Consider the following statements :

1. Pumps used in series are generally of the centrifugal type.

2. Centrifugal pumps, though yielding comparatively smaller discharges than axial flow pumps, yield higher heads (at each stage) compared to axial flow pumps.

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

**82.** When steel reinforcing bars are provided in masonry, the bars shall have an embedment with adequate cover in cement-sand mortar not leaner than

(a) $1:3$

(b) $1:4$

(c) $1:5$

(d) $1:6$

**83.** The efficacy of pumpcrete is based primarily on

1. The capacity of pump

2. The aggregate size, which should not exceed 8 cm

3. The diameter of pipe being large, with more than 30 cm being desirable

4. The performance of the agitator

(a) 1 and 4 only

(b) 1 and 2 only

(c) 3 and 4 only

(d) 2 and 3 only

**84.** In a non-tilting type drum mixer,

1. Large size aggregate up to 20 – 25 cm can be handled

2. Mixing time is less than 2 minutes

3. Discharge is through buckets onto the platform

4. For large-size mixers, the mixing time should be slightly increased if handling more than 800 litres of the mix

Which of the above statements are correct ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1, 2 and 4 only

(d) 3 and 4 only

**85.** How many impellers are required for a multi-stage pump to lift 4000 $lpm$ against a total head of 80 m at a speed of 750 rpm; given that $N_s$ for each impeller should be between 720 to 780 units ?

(a) 6

(b) 5

(c) 4

(d) 3

**86.** A 15 cm centrifugal pump delivers 6 $lps$ at a head of 26 m running at a speed of 1350 rpm. A similarly designed pump of 20 cm size runs at the same speed. What are the most likely nearest magnitudes of discharge and delivery head provided by the latter pump ?

(a) 11 $lps$ and 46 m

(b) 14 $lps$ and 52 m

(c) 11 $lps$ and 52 m

(d) 14 $lps$ and 46 m

87. Which of the following statements are correct as operating characteristics of a centrifugal pump?

   1. As discharge increases from zero value, head slightly increases; then the head declines gently; and beyond a certain discharge, the head falls steeply.

   2. As discharge increases, efficiency increases from zero, rising fast to a maximum value and then falls rapidly, more rapidly than the head-discharge curve.

   3. BHP increases from a non-zero (positive) value at zero discharge, the increase being only moderate before it starts falling beyond a certain discharge.

   (a) 1, 2 and 3

   (b) 1 and 2 only

   (c) 1 and 3 only

   (d) 2 and 3 only

88. Engines used in earthwork equipment are qualified by the power developed under specified conditions. As operating conditions change, the power developed will increase with local ambience, if

   1. Ambient temperature increases

   2. Ambient temperature decreases

   3. Ambient pressure increases

   4. Ambient pressure decreases

Which of the above statements are correct?

   (a) 1 and 3 only

   (b) 1 and 4 only

   (c) 2 and 3 only

   (d) 2 and 4 only

89. Manometric head developed $h_m$ in m, and discharge Q in lps in respect of two pumps, 1 and 2, are tabulated. The pumps are connected in series against a static head of 100 m. Total head losses for a discharge of Q are as $\frac{Q^2}{100}$ (m). What is the delivered discharge?

| Q in lps | 15 | 18 | 20 | 22 | 25 |
|---|---|---|---|---|---|
| $h_{m1}$ in m | 60·6 | 61·2 | 62·0 | 55·0 | 48·0 |
| $h_{m2}$ in m | 50·8 | 51·0 | 48·8 | 45·8 | 40·0 |

   (a) 20·15 lps

   (b) 21·25 lps

   (c) 21·95 lps

   (d) 22·20 lps

90. A reciprocating pump has a stroke of 30 cm, speed of 100 rpm, and a piston of 22·5 cm diameter. It discharges 18·9 lps. What is the slip of the pump?

   (a) 3·12%

   (b) 3·54%

   (c) 4·15%

   (d) 4·95%

91. The following data were recorded when a centrifugal pump worked at its maximum efficiency : Q = 40 lps; Manometric head developed = 25 m; Input shaft horse power = 11·9 W. What is the non-dimensional specific speed of the pump if it was running at 1500 rpm? (May adopt the following (all in S.I. units) :

$g^{1/4} = 1·77, g^{1/2} = 3·132, g^{3/4} = 5·544,$

$\sqrt{2} = 1·414, \sqrt{5} = 2·236$ and $\sqrt{10} = 3·162$)

   (a) 165

   (b) 155

   (c) 145

   (d) 135

**92.** The total head to be developed by a centrifugal pump is expected to be up to 50 m. The normal ratio of radii of impeller rim and impeller eye of 2 is maintained. The design is for a speed of 1300 rpm. What is the nominal diameter of the impeller ? Take $\sqrt{g}$ = 3·13 and $\frac{1}{\pi}$ = 0·318.

(a) 53 cm

(b) 57 cm

(c) 60 cm

(d) 64 cm

**93.** Activities A, B, C and D constitute a small project; their interrelationship, expected duration and standard deviation of this expected duration are shown in the figure, respectively.
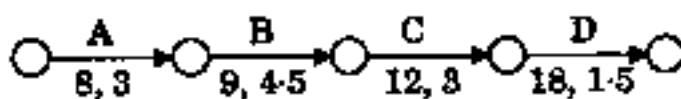


With a view to improving the speed of implementation, each of B, C and D are split into three equal segments, maintaining appropriate inter-relationships between A and each of these nine segments. What will be the standard deviation of the modified project duration after segmentation (to the nearest $\frac{1}{10}$ unit) ?

(a) 6·2

(b) 5·6

(c) 5·2

(d) 4·6

**94.** Which of the following is/are the main drawback(s) in adopting bar charts ?

1. All the activities are shown as being independent of each other

2. The sequence of activities is not defined at all

3. It is difficult to judge whether an activity is completed or not

(a) 1 only

(b) 2 only

(c) 3 only

(d) 1, 2 and 3

**95.** The purpose of work-break-down structure in project planning is mainly to

1. Facilitate and improve the decision-making on procurement of resources

2. Relate activities under particular trade specializations to help in organizing for project staff

3. Co-ordinate regarding milestone events across trade specializations to improve the synergy between the trades

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

**96.** Which of the following statements is/are correct ?

1. An activity is in between two node numbers, which need not be in an increasing order in the activity progress sequence.

2. The length of the arrow in a network has certain significance.

3. Concurrent activities are mutually independent and can possibly be taken up simultaneously.

(a) 1 only

(b) 3 only

(c) 2 only

(d) 1, 2 and 3

**97.** Which of the following statements are implicit in developing the critical path network ?

1. Only one time estimate is required for any activity

2. Time only is the controlling factor at this stage

3. Time and cost both are controlling factors at this stage

4. Critical events may have positive, negative, or zero float

(a) 1 and 2 only

(b) 1 and 3 only

(c) 1 and 4 only

(d) 2 and 4 only

**98.** In the Critical Path Method of project planning, free float can be

(a) Greater than independent float

(b) Greater than total float

(c) Less than independent float

(d) Equal to total float

**99.** Slack time in PERT analysis

(a) Can never be greater than zero

(b) Is always zero for critical activities

(c) Can never be less than zero

(d) Is minimum for critical events

**100.** A small project consists of 3 activities P, Q and R to be executed in that sequence. The relationship between Time Duration (in 'Units' of time-T) and corresponding total direct cost (C units) for each of the activities, for alternate mutually exclusive possible durations for each activity, are tabulated herewith :

| P | | Q | | R | |
|---|---|---|---|---|---|
| T | C | T | C | T | C |
| 8 | 250 | 6 | 340 | 8 | 400 |
| 9 | 235 | 7 | 320 | 10 | 375 |
| 10 | 225 | 8 | 295 | 12 | 350 |
| 11 | 215 | 9 | 275 | | |

For a total duration of 25 units of time, the least total direct cost for the complete project will be

(a) 965 units

(b) 950 units

(c) 940 units

(d) 925 units

*Directions :* *Each of the next twenty (20) items consists of two statements, one labelled as the 'Statement (I)' and the other as 'Statement (II)'. Examine these two statements carefully and select the answers to these items using the codes given below :*

**Codes :**

(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)

(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is *not* the correct explanation of Statement (I)

(c) Statement (I) is true but Statement (II) is false

(d) Statement (I) is false but Statement (II) is true

**101.** *Statement (I) :*

Splitting of fibres is a type of seasoning defect in wood.

*Statement (II) :*

Seasoning of timber is a general requirement for structural purposes.

**102.** *Statement (I) :*

Hardwoods are used in special purpose heavy constructions.

*Statement (II) :*

Hardwoods too are porous in nature.

**103.** *Statement (I) :*

In general, bricks cannot be used in industrial foundations.

*Statement (II) :*

Heavy duty bricks can withstand higher temperatures.

**104.** *Statement (I) :*

In multistoried constructions, burnt clay perforated bricks are used to reduce the cost of construction.

*Statement (II) :*

Perforated bricks are economical and they also provide thermal insulation.

**105.** *Statement (I) :*

Positive displacement pumps can be used for pumping of ready-mixed concrete.

*Statement (II) :*

The coarse aggregate in the mix is unlikely to be crushed during positive displacement.

**106.** *Statement (I) :*

Fire resistance of plastering can be achieved by mixing surkhi to the cement mortar.

*Statement (II) :*

Insulation against sound and fire can be achieved by adding sufficient water in-situ just before applying the mortar.

**107.** *Statement (I) :*

Water containing less than 2000 ppm of dissolved solids can generally be used satisfactorily for making concrete.

*Statement (II) :*

The presence of any of zinc, manganese, tin, copper or lead reduces the strength of concrete considerably.

**108.** *Statement (I) :*

Though a non-elastic material, yet concrete exhibits a linear relationship between stress and strain at low values of stress.

*Statement (II) :*

The modulus of elasticity of concrete is dependent on the elastic properties of aggregate and on curing.

**109.** *Statement (I) :*

Finer the cement, greater is the need for water for hydration and workability.

*Statement (II) :*

Bleeding of a mix occurs due to low water-cement ratio.

**110.** *Statement (I) :*

The failure of a mild steel specimen of circular cross-section, subjected to a torque occurs along its cross-section.

*Statement (II) :*

The failure occurs on a plane of the specimen subjected to maximum shear stress; and mild steel is relatively weak in shear.

**111.** *Statement (I) :*

In elastic analysis of structures, the Neutral Axis is the intersection between the plane of bending and the neutral plane.

*Statement (II) :*

Neutral Axis in the context of plastic analysis of structures is always the Equal Area Axis of the cross-section.

**112.** *Statement (I) :*

Whereas shutter vibrators are preferred for use with pre-stressed beams, needle vibrators are preferred in foundation concreting.

*Statement (II) :*

Needle vibrators are susceptible to get dysfunctional with leaking-in of cement slurry — which is not the case with the shutter vibrator.

**113.** *Statement (I) :*

The forward edge of wheels or outriggers acts as a fulcrum in determining the lifting capacity of a mobile crane.

*Statement (II) :*

There is in-built security and safety against sudden dropping of load, as well as against abrupt swinging, in the working of a mobile crane.

**114.** *Statement (I) :*

Hand-operated chain-hoists include differential screw-geared types within their range.

*Statement (II) :*

In case of a hoist-winch, the capacity of the hoist is increased by a number of gear reductions.

**115.** *Statement (I) :*

When employing weigh-batching for mix preparation, bulking of sand has to be accounted for.

*Statement (II) :*

Bulked sand will affect the proportional composition of the ingredients to be used in making wet concrete of the desired eventual strength.

**116.** *Statement (I) :*

Critical path(s) through a CPM network can be identified even without working out the backward pass computations by a competent user.

*Statement (II) ;*

Critical path is the progressive chain of activities from start to finish (not excluding between splitting and merging nodes) through the network where Total Float is absent throughout (including through dummy arrows, if appropriate).

**117.** *Statement (I) :*

For implementing weigh-batching, separate compartments are made for storing large quantities of the aggregates. Besides lifting and loading equipments, there must be regular assessment of grading and also of moisture content.

*Statement (II) :*

Whereas eventual strength of the mix depends also on the grading of the ingredients, the water needs too must be properly computed and implemented.

**118.** *Statement (I) :*

Resources Optimization is largely a pre-implementation pursuit whereas Resources Allocation is a through-implementation dynamic process.

*Statement (II) :*

Resources Allocation has a larger bearing on Inventory Management than Resources Optimization.

**119.** *Statement (I) :*

Crashing of project duration always increases the cost of the project on its completion, no matter what the indirect, or overhead, costs are.

*Statement (II) :*

The critical path along the project activities network diagram is compressed in the process of investigating the crashing of the project duration, and not the non-critical activities, up to a certain stage of crashing.

**120.** *Statement (I) :*

In the operation of reciprocating pumps, slip can sometimes be negative.

*Statement (II) :*

Under conditions of high speed, long suction pipes (without capitation) and short delivery pipes, inertia pressure can be relatively rather high, causing the delivery valve to open before the discharge stroke begins.

**SPACE FOR ROUGH WORK**

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