

ESE Exam -> 2012

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T.B.C. : R-FTF-M-DFA

Test Booklet Series

Serial No.



TEST BOOKLET
CIVIL ENGINEERING
(OBJECTIVE-TYPE)

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. ENCODE CLEARLY THE TEST BOOKLET SERIES **A, B, C** OR **D** AS THE CASE MAY BE IN THE APPROPRIATE PLACE IN THE ANSWER SHEET.
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 IN THE OBJECTIVE TYPE QUESTION PAPERS.
 - (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. The radial splits which are wider on the outside of the log and narrower towards the pith are known as

- (a) star shakes
- (b) annular rings
- (c) cup shakes
- (d) heart shakes

2. Consider the following distinguishing characteristics of hardwood :

1. They have distinct annular rings.
2. They are not resinous.

Which of these characteristics of hardwood is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

3. Consider the following statements on the specific gravity of wood :

1. It is always greater than 2.
2. It is less than 1.
3. It is not dependent upon temperature and equilibrium moisture content.
4. It is dependent upon type of species.

Which of these statements are correct?

- (a) 1, 2, 3 and 4
- (b) 1 and 3 only
- (c) 2 and 3 only
- (d) 2 and 4 only

4. The age of a log of timber can be estimated by

- (a) diameter of pith
- (b) thickness of bark
- (c) number of annular rings
- (d) number of medullary rays

5. Consider the following statements :

Seasoning of timber results in

1. increased strength
2. increased durability
3. reduced resilience
4. increased dimensional stability

Which of these statements are correct?

- (a) 1, 2 and 4
- (b) 1, 2 and 3
- (c) 1, 3 and 4
- (d) 2, 3 and 4

6. Match List-I with List-II and select the correct answer using the code given below the Lists :

<i>List-I</i>	<i>List-II</i>
A. Plywood	1. Furniture
B. Fiberboard	2. Cantilever arches
C. Laminated lumber	3. Insulation
D. Commercial block-board	4. Lining of form-work in concrete

Code :

(a) A B C D
1 2 3 4

(b) A B C D
4 3 2 1

(c) A B C D
1 3 2 4

(d) A B C D
4 2 3 1

7. Consider the following statements :

Perforated bricks are preferred in construction since

1. they are lighter
2. they are stronger than class I bricks
3. they have heat-insulating properties
4. they are cheaper and need less mortar

Which of these statements are correct?

- (a) 1, 2, 3 and 4
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 3 and 4 only

8. The standard size of a brick is

- (a) 20 cm × 10 cm × 10 cm
- (b) 19 cm × 9 cm × 9 cm
- (c) 18 cm × 9 cm × 9 cm
- (d) 18 cm × 10 cm × 10 cm

9. Consider the following statements :

More than 6% magnesium oxide by weight in cement results in

1. high early strength and high heat generation
2. less tendency towards volume change and formation of cracks

Which of these statements is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Neither 1 nor 2
- (d) Both 1 and 2

10. Fineness of cement is measured in the units of

- (a) volume / mass
- (b) mass / volume
- (c) area / mass
- (d) mass / area

11. The initial setting time of cement depends most on

- (a) tricalcium aluminate
- (b) tricalcium silicate
- (c) tricalcium aluminoferrite
- (d) dicalcium silicate

12. Consider the following statements :

Sand in cement mortar is used for

- 1. increasing the strength
- 2. reducing the shrinkage
- 3. decreasing the surface area of the binding material
- 4. decreasing the quantity of cement

Which of these statements are correct?

- (a) 1, 2 and 4
- (b) 1, 2 and 3
- (c) 1, 3 and 4
- (d) 2, 3 and 4

13. Consider the following statements :

- 1. The compressive strength of concrete decreases with increase in water-cement ratio of the concrete mix.
- 2. Water is added to the concrete mix for hydration of cement and workability.
- 3. Creep and shrinkage of concrete are independent of the water-cement ratio in the concrete mix.

Which of these statements are correct?

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

14. According to the Indian Standard Specifications, concrete should be cured under a humidity of

- (a) 90%
- (b) 80%
- (c) 70%
- (d) 60%

15. Consider the following statements :

In a typical compression test with a cylindrical concrete specimen, failure is initiated by

- 1. crushing in compression
- 2. inclined shear failure
- 3. longitudinal tensile cracks

Which of these statements is/are correct?

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

16. If one intends to obtain the best workability of concrete, the preferred shape of aggregate is

- (a) round
- (b) annular
- (c) triangular
- (d) flinty

17. Consider the following statements as regards rheology of concrete :

1. It deals with strength of concrete.
2. It deals with deformation in concrete.
3. It is the study of deformation and flow of concrete.
4. It deals with rate of shear and shear stress in concrete.

Which of these statements are correct?

- (a) 1, 2, 3 and 4
- (b) 3 and 4 only
- (c) 2 and 3 only
- (d) 1 and 2 only

18. Consider the following for durability of well-graded concrete :

1. The environment
2. Cover to embedded reinforcement
3. Shape and size of concrete member

Which of these are correct?

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

19. Consider the common methods related to testing of concrete :

1. Consistency
2. Compacting factor
3. Vee-Bee
4. Setting time
5. Slump

Which of these methods refer to measuring workability of concrete?

- (a) 1, 2 and 3
- (b) 1, 2 and 5
- (c) 2, 3 and 4
- (d) 2, 3 and 5

20. Gypsum is added into the raw materials during manufacture of cement so that the final product exhibits

- (a) retarded initial setting time
- (b) improved mouldability for cornices, etc.
- (c) increased compressive strength
- (d) augmented bond strength

21. Consider the following constituents of a high performance concrete (HPC) :

1. Cement
2. Fine aggregate
3. Coarse aggregate
4. Water
5. Mineral admixture
6. Chemical admixture

Which of these constituents are relevant for HPC?

- (a) 1, 2, 3, 4, 5 and 6
- (b) 1, 2, 3, 4 and 5 only
- (c) 2, 3, 4, 5 and 6 only
- (d) 1, 2, 3, 5 and 6 only

22. If

- A = Cross-sectional area
 E = Young's modulus of elasticity
 G = Modulus of rigidity
 I = Moment of inertia
 J = Polar moment of inertia

then torsional rigidity is given by

- (a) AE
- (b) GE
- (c) EI
- (d) GJ

23. If a material has identical elastic properties in all directions, it is said to be

- (a) elastic
- (b) isotropic
- (c) orthotropic
- (d) homogeneous

24. Two circular mild steel bars A and B of equal lengths l have diameters $d_A = 2$ cm and $d_B = 3$ cm. Each is subjected to a tensile load of magnitude P . The ratio of the elongations of the bars l_A / l_B is

- (a) $2/3$
- (b) $3/4$
- (c) $4/9$
- (d) $9/4$

25. In a two-dimensional stress system, the radius of the Mohr's circle represents

- (a) maximum normal stress
- (b) minimum normal stress
- (c) minimum shear stress
- (d) maximum shear stress

26. In a plane stress problem, there are normal tensile stresses σ_x and σ_y , with $\sigma_x > \sigma_y$, accompanied by shear stress τ_{xy} at a point in the x - y plane. If it is observed that the minimum principal stress on a certain section is zero, then

(a) $\tau_{xy} = \sqrt{\sigma_x \cdot \sigma_y}$

(b) $\tau_{xy} = \sqrt{\frac{\sigma_x}{\sigma_y}}$

(c) $\tau_{xy} = \sqrt{\sigma_x - \sigma_y}$

(d) $\tau_{xy} = \sqrt{\sigma_x + \sigma_y}$

27. Steel has proportionality limit of 300 MPa in simple tension. It is subjected to principal stresses of 120 MPa (tensile), 60 MPa (tensile) and 30 MPa (compressive). What is the factor of safety according to maximum stress theory?

(a) 1.5

(b) 1.75

(c) 1.8

(d) 2.0

28. The polar moment of inertia of the cross-section of the member is required to assess the strength of the member in

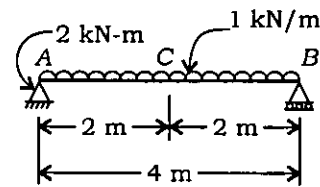
(a) bending

(b) torsion

(c) axial force

(d) shear

29.



A freely supported beam AB of span 4 m is subjected to a UDL of 1 kN/m over the full span and a moment of 2 kN-m at support A as shown in the figure. The resulting BM at mid-span C of the beam will be

(a) 1 kN-m (sagging)

(b) 1 kN-m (hogging)

(c) 2 kN-m (sagging)

(d) 2 kN-m (hogging)

30. A cylindrical shell of 100 cm diameter made of mild steel plate is to be subjected to an internal pressure of 10 kg/cm². If the material yields at a stress of 200 kg/cm², assuming factor of safety as 4 and using maximum principal stress theory, the requisite thickness of the plate will be

(a) 8 mm

(b) 10 mm

(c) 12 mm

(d) 15 mm

31. According to maximum shear stress failure theory, yielding occurs in the material when

(a) maximum shear stress
= yield stress

(b) maximum shear stress
= 2 times yield stress

(c) maximum shear stress
= $\frac{1}{2}$ of yield stress

(d) maximum shear stress
= $\sqrt{2}$ times yield stress

32. For the design of a cast iron member, the most appropriate theory of failure is

(a) Mohr's theory

(b) Rankine's theory

(c) maximum stress theory

(d) maximum shear energy theory

33. A simply supported beam of span L carries a concentrated load W at its mid-span. If the width b of the beam is constant throughout the span, then, with permissible stress as σ , the depth of the beam at mid-span will be

(a) $\frac{3WL}{2b\sigma}$

(b) $\sqrt{\frac{3WL}{2b\sigma}}$

(c) $\frac{6WL}{b\sigma}$

(d) $\sqrt{\frac{6WL}{b\sigma}}$

34. Out of the two beams of the same material and same cross-sectional area, one is of circular cross-section and the other is of square cross-section. If each of these is subjected to bending moment of the same magnitude, then

(a) both sections would be equally strong

(b) both sections would be equally economical

(c) square section would be more economical than circular section

(d) square section would be less economical than circular section

35. A rectangular beam of width 100 mm is subjected to a maximum shear force of 60 kN. The corresponding maximum shear stress in the cross-section is 4 N/mm^2 . The depth of the beam should be

(a) 200 mm

(b) 150 mm

(c) 100 mm

(d) 225 mm

36. In a circular shaft of diameter d , subjected to a torque T , the maximum shear stress induced is

- (a) proportional to d^3
- (b) proportional to d^4
- (c) inversely proportional to d^3
- (d) inversely proportional to d^4

37. Which of the following terms represents the torque corresponding to a twist of one radian in a shaft over its unit length?

- (a) Torsional stress
- (b) Torsional rigidity
- (c) Flexural rigidity
- (d) Moment of resistance

38. If a shaft is turning at N r.p.m. and the mean torque to which the shaft is subjected is T N-m, the power transmitted by the shaft in kW would be

- (a) $\frac{2\pi NT}{45000}$
- (b) $\frac{2\pi NT}{60000}$
- (c) $\frac{2\pi NT}{30000}$
- (d) $\frac{2\pi NT}{33000}$

39. The polar modulus of a circular shaft of diameter d is

(a) $\frac{\pi}{16} \cdot d^3$

(b) $\frac{\pi}{32} \cdot d^3$

(c) $\frac{\pi}{64} \cdot d^3$

(d) $\frac{\pi}{32} \cdot d^2$

40. If a shaft rotates at 100 r.p.m. and is subjected to a torque of 3000 N-m, the power transmitted in kW would be

(a) 30π

(b) 15π

(c) 20π

(d) 10π

41. The ratio of torsional moments of resistance of a solid circular shaft of diameter D to that of a hollow shaft with external diameter D and internal diameter d is

(a) $\frac{D^4}{D^4 - d^4}$

(b) $\frac{D^4 - d^4}{D^4}$

(c) $\frac{D^3}{D^3 - d^3}$

(d) $\frac{D^3 - d^3}{D^3}$

Both the shafts are of the same material.

42. A bar AB of diameter 40 mm and 4 m long is rigidly fixed at its ends. A torque 600 N-m is applied at a section of the bar, 1 m from end A . The fixing couples T_A and T_B at the supports A and B , respectively are

(a) 200 N-m and 400 N-m

(b) 300 N-m and 150 N-m

(c) 450 N-m and 150 N-m

(d) 300 N-m and 100 N-m

43. A solid shaft of circular cross-section is subjected to torque T which produces a maximum shear stress τ in the shaft. The diameter of the shaft will be

(a) $\sqrt[3]{\frac{16T}{\pi\tau}}$

(b) $\sqrt{\frac{\pi\tau}{16T}}$

(c) $\sqrt[3]{\frac{\pi\tau}{16T}}$

(d) $\sqrt{\frac{16T}{\pi\tau}}$

44. A cantilever carries a uniformly distributed total load W over its whole length and a concentrated upward load W at its free end. The net vertical deflection at the free end is

(a) zero

(b) $\frac{5}{24} \cdot \frac{Wl^3}{EI}$ downwards

(c) $\frac{5}{24} \cdot \frac{Wl^3}{EI}$ upwards

(d) $\frac{5}{48} \cdot \frac{Wl^3}{EI}$ upwards

45. The maximum number of unknown forces that can be determined in a concurrent coplanar force system under equilibrium is

(a) 2

(b) 3

(c) 6

(d) 1

46. If a cantilever beam of span L and flexural rigidity EI carries a moment M at the free end, the deflection at that end is

- (a) $\frac{ML}{24EI}$
- (b) $\frac{ML^2}{12EI}$
- (c) $\frac{ML}{6EI}$
- (d) $\frac{ML^2}{2EI}$

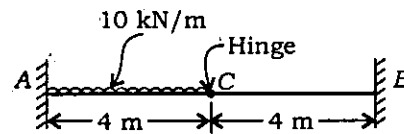
47. The maximum bending moment under a particular point load among a train of point loads crossing a simply supported girder occurs when that load is

- (a) at mid-span
- (b) at one-third span
- (c) at one-quarter span
- (d) so placed that the load point and the point of CG of the train of loads are equidistant from the mid-span

48. A uniformly distributed load of length 8 m crosses a simply supported girder of span 20 m. The maximum bending moment at the left quarter-span point occurs when the distance between the point of CG of the total load and mid-span is

- (a) 0
- (b) 2 m
- (c) 3 m
- (d) 4 m

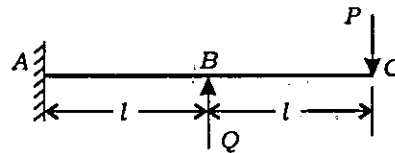
49.



The reaction of the beam at C is

- (a) 5.5 kN
- (b) 6.5 kN
- (c) 7.5 kN
- (d) 8.5 kN

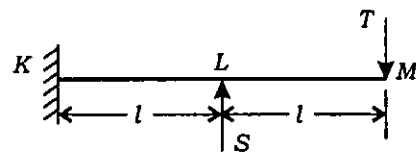
50.



For the beam-system as shown, if the deflection at C is zero, then the ratio $\frac{P}{Q}$ is

- (a) $\frac{3}{8}$
- (b) $\frac{5}{8}$
- (c) $\frac{3}{16}$
- (d) $\frac{5}{16}$

51.



For the beam-system as shown, if the slope at M is zero, then the ratio $\frac{T}{S}$ is

- (a) $\frac{1}{2}$
- (b) $\frac{1}{3}$
- (c) $\frac{1}{4}$
- (d) $\frac{1}{8}$

52. Consider the following statements :

1. The principle of superposition will hold good for the analysis of linear structural systems only.
2. The stress in a structural member due to several applied forces is the sum of the effects due to each of such forces, applied one at a time, only if the Hooke's law holds good.
3. Internal stresses may not be caused resulting from lack of fit of a structural member.

Which of these statements are correct?

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

53. Consider the following statements :

1. A properly constrained rigid system has several degrees of freedom.
2. The number of degrees of freedom of a locomotive moving on a railway track is only two.
3. A floating ship has six degrees of freedom.

Which of these statements is/are correct?

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

54. A suspension bridge with a two-hinged stiffening girder is statically

- (a) determinate
- (b) indeterminate to 1 degree
- (c) indeterminate to 2 degrees
- (d) indeterminate to 3 degrees

55. Match List-I with List-II and select the correct answer using the code given below the Lists :

List-I

List-II

- | | |
|------------------|--|
| A. Axel Bëndixen | 1. The mathematical theory of elasticity |
| B. Hardy Cross | 2. Theory of curved bars |
| C. Winkler | 3. Slope-deflection method |
| D. St. Venant | 4. Moment distribution |

Code :

- (a)

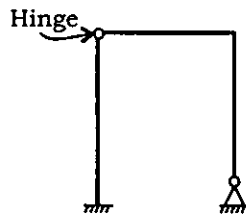
A	B	C	D
1	4	2	3
- (b)

A	B	C	D
3	4	2	1
- (c)

A	B	C	D
1	2	4	3
- (d)

A	B	C	D
3	2	4	1

56.



The kinematic indeterminacy of the frame is

- (a) 4
- (b) 6
- (c) 8
- (d) 10

57.



The kinematic indeterminacy of the beam is

- (a) 5
- (b) 9
- (c) 14
- (d) 15

58. The moment required to rotate the near end of a prismatic beam through unit angle without translation, when the far end is fixed, is

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

59. The Müller-Breslau principle in structural analysis is used for

- (a) drawing influence line diagram for any force function
- (b) superimposition of load effects
- (c) writing virtual work equation
- (d) None of the above

60. Match List-I with List-II and select the correct answer using the code given below the Lists :

List-I

List-II

- | | |
|------------------------------|---------------------|
| A. Upper bound theorem | 1. Undeformed state |
| B. Lower bound theorem | 2. Large rotation |
| C. Equilibrium of forces | 3. Statical method |
| D. Ductility of the material | 4. Mechanism method |

Code :

- (a) A B C D
2 1 3 4
- (b) A B C D
4 1 3 2
- (c) A B C D
2 3 1 4
- (d) A B C D
4 3 1 2

61. Consider the following parameters with regards to slenderness ratio of a compression member :

1. Material
2. Sectional configuration
3. Length of member
4. Support end conditions

On which of these parameters does the slenderness ratio of a compression member depend?

- (a) 1, 2 and 3 only
- (b) 1, 3 and 4 only
- (c) 2, 3 and 4 only
- (d) 1, 2, 3 and 4

62. Two equal angles, each being ISA 100 mm × 100 mm of thickness 10 mm, are placed back-to-back and connected to either side of a gusset plate through a single row of 16 mm diameter rivets in double shear. The effective areas of the connected and unconnected legs of each of these angles are 775 mm^2 and 950 mm^2 respectively. If these angles are not tack-riveted, the net effective area of this pair of angles is

- (a) 3650 mm^2
- (b) 3450 mm^2
- (c) 3076 mm^2
- (d) 2899 mm^2

63. When the effect of wind or earthquake load is taken into account in the design of a riveted connection, the permissible stresses in rivets may be exceeded by

- (a) 16.66%
- (b) 33.33%
- (c) 25%
- (d) 50%

64. A mild steel flat subjected to a tensile force of 840 kN is connected to a gusset plate using rivets. If the permissible forces required per pitch length (i) to shear a single rivet, (ii) to crush the rivet and (iii) to tear the plate are 50 kN, 80 kN and 60 kN respectively, then the number of rivets required is

- (a) 12
- (b) 14
- (c) 16
- (d) 17

65. The effective throat thickness of a fillet weld depends upon

- (a) angle between fusion faces
- (b) length of weld
- (c) permissible shear stress
- (d) type of weld

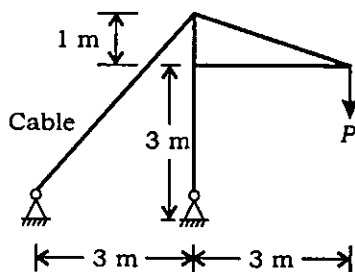
66. When the load line coincides with the centroid of the rivet group, the rivets are subjected to

- (a) shear only
- (b) tension only
- (c) bending only
- (d) shear as well as tension

67. A column member of length l which cannot sway has a rigid foundation at its bottom. Its top is held with heavy beams. The effective length of the column is

- (a) $1.5 l$
- (b) $1.0 l$
- (c) $0.8 l$
- (d) $0.65 l$

68.



In the simple system shown in the figure, the load P is equal to 4 tonnes. What is the tension in the cable?

- (a) 4 t
- (b) 5 t
- (c) 6 t
- (d) 7 t

69. Through which of the following responses may a steel tubular hinged strut fail?

1. Compression
2. Bending
3. Overall buckling
4. Torsion
5. Skin buckling

(a) 2, 4 and 5

(b) 1, 2 and 3

(c) 3, 4 and 5

(d) 1, 3 and 5

70. An ISMB 500 is used as a beam in a multistorey construction. From the viewpoint of structural design, it can be considered to be 'laterally restrained' when

(a) the tension flange is laterally restrained

(b) the compression flange is laterally restrained

(c) the web is adequately stiffened

(d) the conditions in both (a) and (c) are met

71. A steel column pinned at both ends has a buckling load of 200 kN. If the column is restrained against lateral movement at its mid-height, its buckling load will be

- (a) 200 kN
- (b) 283 kN
- (c) 400 kN
- (d) 800 kN

72. Consider the following provisions to possibly improve the shear capacity of a steel girder :

1. Horizontal stiffeners
2. Vertical stiffeners
3. Column splice
4. Bearing stiffeners

Which of these are correct?

- (a) 1, 2, 3 and 4
- (b) 3 and 4 only
- (c) 1 and 2 only
- (d) 2 and 3 only

73. In a steel plate girder, the web plate is connected to the flange plates by fillet welding. The size of fillet welds is designed to safely resist

- (a) the bending stresses in the flanges
- (b) the vertical shear force at the section
- (c) the horizontal shear forces between the flanges and the web plate
- (d) the forces causing buckling in the web

74. Deflection limitations over beams are imposed because excessive deflection may cause

- (a) undesirable twisting and distortion of end connections
- (b) problems in drainage system
- (c) psychological effect on users
- (d) All of the above

75. In laced columns, end tie-plates are provided to

- (a) check the buckling of column
- (b) keep the column components in position
- (c) check the distortion of column sections at ends because of unbalanced horizontal force from lacings
- (d) prevent rotation of elements

76. For heavy vibrating loads in industrial buildings, the roof trusses are provided with

- (a) diagonal bracing in the plane of lower chord members
- (b) diagonal bracing in the plane of upper chord members
- (c) knee bracing
- (d) sway bracing

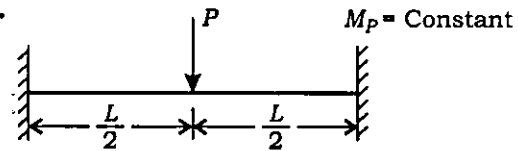
77. Which of the following elements of a pitched roof industrial steel building primarily resists lateral load parallel to the ridge?

- (a) Bracing
- (b) Purlin
- (c) Truss
- (d) Column

78. Purlins are to be chosen for a roof truss of 20 m span, 4 m rise. Trusses are spaced at 4.5 m centre-to-centre. A most efficient design results from the use of

- (a) angle sections
- (b) channel sections
- (c) circular hollow sections
- (d) square hollow sections

79.



The plastic moment at collapse is

- (a) $\frac{PL}{6}$
- (b) $\frac{PL}{8}$
- (c) $\frac{PL}{12}$
- (d) $\frac{PL}{16}$

80. A column is effectively held in position and restrained in direction at one end but is free at the other end. If the actual length is L , the effective length is

- (a) $0.67L$
- (b) L
- (c) $1.5L$
- (d) $2L$

81. Consider the following statements :

1. Modulus of elasticity of concrete increases with the increase in compressive strength of concrete.
2. Shear strength of concrete increases with the increase in compressive strength of concrete.

Which of these statements is/are correct?

- (a) Neither 1 nor 2
- (b) Both 1 and 2
- (c) 1 only
- (d) 2 only

82. Grade of steel is designated as Fe 415, if

- (a) the upper yield stress of the steel is 415 N/mm^2
- (b) the ultimate stress of the steel is 415 N/mm^2
- (c) the partial safety factor is 1.15
- (d) the characteristic strength is 415 N/mm^2

83. The maximum safe permissible limit of sulphates in domestic water supply is

- (a) 100 mg/L
- (b) 200 mg/L
- (c) 500 mg/L
- (d) 600 mg/L

84. If a two-way slab is found to be unsafe in shear, then the preferred remedy is

- (a) to provide shear stirrups
- (b) to increase the flexural reinforcement by 15%
- (c) to increase the thickness of the slab adequately
- (d) to increase the distribution reinforcement in edge strips

85. A reinforced concrete column of size bD is carrying an axial load P and a bending moment M about an axis parallel to its width. The magnitude of bending moment is such that the neutral axis lies outside the section. Over which extent of depth from the highly compressed edge will the compressive stress have a constant value $0.45f_{ck}$?

- (a) $\frac{3}{7}D$
- (b) $\frac{4}{7}D$
- (c) $\frac{D}{2}$
- (d) D

86. The development length in compression for a 20 mm diameter deformed bar of grade Fe 415 embedded in concrete of grade M 25, whose design bond stress is 1.40 N/mm^2 , is

- (a) 1489 mm
- (b) 1289 mm
- (c) 806 mm
- (d) 645 mm

87. Magnitudes of minimum reinforcement recommended for reinforced concrete using mild steel in slabs/columns are

- (a) 0.15% / 0.60%
- (b) 0.25% / 0.80%
- (c) 0.50% / 1.00%
- (d) 0.15% / 0.80%

88. Which of the following assumptions is/are implied in the table listing moment coefficients for continuous slabs?

1. Load is distributed uniformly along supports.
2. Mid-span deflections in orthogonal directions are the same.
3. Load distribution along each support is triangular.
4. Support moment is about 1.5 times the span moment.

- (a) 1, 2, 3 and 4
- (b) 2 only
- (c) 3 only
- (d) 4 only

89. In an isolated reinforced concrete column footing of effective depth d , the stress in punching shear is checked

- (a) at the centre of the column
- (b) at the face of the column
- (c) at a distance $d/2$ away from the face of the column
- (d) at a distance $d/2$ away from the centre of the column

90. The additional cover thickness to be provided in reinforced concrete members that are totally immersed in seawater is

- (a) 25 mm
- (b) 30 mm
- (c) 35 mm
- (d) 40 mm

91. A simply supported beam has an effective span of 16 m. What shall be the limiting ratio of span to effective depth as per IS 456-2000 ?

- (a) 26
- (b) 20
- (c) 12.5
- (d) 7

92. A simply supported beam is considered as a deep beam if the ratio of effective span to overall depth is less than

- (a) 1
- (b) 2
- (c) 3
- (d) 4

93. The minimum grade of reinforced concrete in seawater as per IS 456-2000 is

- (a) M 15
- (b) M 20
- (c) M 30
- (d) M 40

94. Torsion reinforcement provided at the corners of a two-way slab

- (a) distributes bending moment uniformly
- (b) prevents corners from lifting
- (c) controls cracking at corners
- (d) does not allow any twist at corners

95. Which one of the following represents the ratio of volume of helical reinforcement to volume of core?

- (a) $0.36 \left(\frac{A_g}{A_c} - 1 \right) \frac{f_{ck}}{f_y}$
- (b) $0.36 \left(\frac{A_g}{A_s} - 1 \right) \frac{f_{ck}}{f_y}$
- (c) $0.36 \left(\frac{A_s}{A_c} - 1 \right) \frac{f_{ck}}{f_y}$
- (d) $0.36 \left(\frac{A_c}{A_s} - 1 \right) \frac{f_{ck}}{f_y}$

where A_g , A_s and A_c are gross cross-sectional area of the member, area of steel and core area; and f_{ck} and f_y are characteristic strength of concrete and steel respectively.

96. The appropriate expression in assessing development length is

- (a) $L_d = \frac{\phi \sigma_s}{4 \tau_{bd}}$
- (b) $L_d = \frac{\phi \sigma_{bc}}{\tau_{bd}}$
- (c) $L_d = \frac{\sigma_s}{4 \tau_{bd}}$
- (d) $L_d = \frac{\phi \sigma_s}{8 \tau_{bd}}$

97. A concrete beam of rectangular cross-section of 200 mm × 400 mm is prestressed with a force of 400 kN at an eccentricity of 100 mm. The maximum compressive stress in the concrete is

(a) 12.5 N/mm²

(b) 7.5 N/mm²

(c) 5.0 N/mm²

(d) 2.5 N/mm²

98. Consider the following statements :

Prestressing in concrete can be done

1. by means of hydraulic jacks
2. by means of thermal methods
3. by means of support displacement
4. by the use of expanding cement

Which of these statements are correct?

(a) 1, 2 and 3 only

(b) 1, 3 and 4 only

(c) 2, 3 and 4 only

(d) 1, 2, 3 and 4

99. A pretensioned (assume no losses) concrete rectangular ($b \times d$) beam is designed on the basis of no tension. Concrete strength is σ_c . The maximum moment that the beam can carry is

(a) $\sigma_c \cdot \frac{bd^2}{2}$

(b) $\sigma_c \cdot \frac{bd^2}{3}$

(c) $\sigma_c \cdot \frac{bd^2}{4}$

(d) $\sigma_c \cdot \frac{bd^2}{6}$

100. The percentage loss of prestress due to anchorage slip of 3 mm in a concrete beam of length 30 m which is posttensioned by a tendon with an initial stress of 1200 N/mm² and modulus of elasticity equal to 2.1×10^5 N/mm², is

(a) 0.0175

(b) 0.175

(c) 1.75

(d) 17.5

101. Consider the following statements for longitudinal reinforcement in a RC member to resist earthquake force :

1. The tension steel ratio on any section shall not be less than $0.24 \sqrt{\frac{f_{ck}}{f_y}}$.
2. There shall be two bars at top as well as bottom of the member throughout.
3. The 'positive' steel at a joint face must be at least equal to half the 'negative' steel at that face.

Which of these statements are correct?

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

102. The most suitable type of equipment for compaction of cohesive soils is

- (a) smooth-wheeled roller
- (b) vibratory roller
- (c) sheepsfoot roller
- (d) tamper

103. For excavating rocks, the most suitable equipment is

- (a) dragline
- (b) power shovel
- (c) clamshell
- (d) hoe

104. When a pump primes and works but not up to its capacity and pressure, the attributable reasons are as follows :

1. Speed may be too low.
2. Suction lift is too high.
3. Total static head is much higher than as designed.
4. Foot valve has been removed.

Which of these reasons can be valid?

- (a) 1, 2, 3 and 4
- (b) 1, 2 and 4 only
- (c) 2, 3 and 4 only
- (d) 1, 2 and 3 only

105. Determine the number of impellers required for a multistage pump to lift 3840 liters per minute against a total head of 80 m at a speed of 700 r.p.m., given that the limiting N_s for each impeller is 700 units.

- (a) 6
- (b) 5
- (c) 4
- (d) 3

106. A 20 cm centrifugal pump delivers 13.2 lps at a head of 45 m when running at a speed of 1350 r.p.m. A similarly designed pump of 15 cm size runs at the same speed. What are the most likely values of discharge and delivery head serviced by this second pump?

- (a) 5.57 lps and 25.3 m
- (b) 7.20 lps and 25.3 m
- (c) 8.27 lps and 27.8 m
- (d) 8.27 lps and 29.4 m

107. A linked bar chart is an improvement over a conventional bar chart, because

1. resources for individual activities can be planned
2. floats will be available for utilization as needed
3. milestone events need not be specifically monitored

Which of these is/are correct?

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

108. In PERT analysis, the time estimates of activities and probability of their occurrence follow

- (a) beta distribution
- (b) gamma distribution
- (c) normal distribution
- (d) Poisson's distribution

109. Two parallel paths A and B extending from start to finish comprise a project network. Along A, the expected duration is 40 days with a standard deviation of 8 days; along B, these are 45 days and 12 days, respectively. What is the probability of the complete project being finished in 42 days? The table of normal probability curve is given :

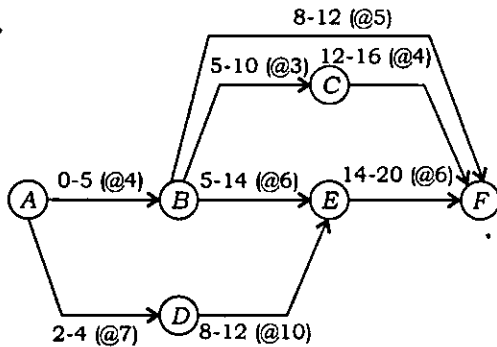
Z	f(Z)
0	0.500
0.1	0.540
0.2	0.579
0.3	0.618
0.4	0.655
0.5	0.691
0.6	0.726
0.7	0.758
0.8	0.788
0.9	0.816
1.0	0.841

- (a) 0.6
- (b) 0.4
- (c) 0.5
- (d) 0.24

110. A sewer of 400 mm diameter and slope 1 in 400, running half-full, has a flow velocity of 0.82 m/sec. What velocity of flow will be obtained if the slope is made 1 in 100?

- (a) 3.28 m/s
- (b) 1.64 m/s
- (c) 0.82 m/s
- (d) 0.41 m/s

111.



Scheduled durations (in days) of activities and their respective resource requirement (in units per day) are shown on the diagram. What is the total number of units of resource required on the 11th and the 16th days?

- (a) 21 and 10
- (b) 18 and 12
- (c) 18 and 10
- (d) 21 and 12

Directions :

Each of the following **nine (9)** items consists of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. You are to examine these two statements carefully and select the answers to these items using the code given below :

Code :

- (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

112. Statement (I) :

Planks sawn from trees with twisted fibers are stronger than those cut from trees with normal growth.

Statement (II) :

Timber from trees with twisted fibers is used straightaway as poles.

113. Statement (I) :

Attention must be extended to the results of the phenomenon of bulking of sand towards ascertaining the water demand in mortar preparation.

Statement (II) :

The total volume of mortar prepared per batch of mix preparation for use-in-work should be mindful of the initial settling time.

114. Statement (I) :

When plastering on building exteriors, more of coarser particles of sand are used in regions where seasonal rainfall is often intense and the total annual rainfall also is relatively more.

Statement (II) :

Such type of 'dhabbah' plastering effects the minimization of rainfall impacts resulting in less formation of mosses and less surface discolouration but may not reduce seepage to the interior.

115. Statement (I) :

Rainwater is collected and harvested using storage structures like underground tanks for future use and also for recharging the aquifer.

Statement (II) :

Rainwater harvesting pits allow the rainwater to percolate and recharge the aquifer.

116. Statement (I) :

The sludge processing utilizes the aerobic digestion in which it is converted to CO₂ and methane.

Statement (II) :

The acid-forming bacteria convert the complex organics such as fats, proteins and carbohydrates into organic fatty acids. The methane-forming bacteria convert organic acids to CO₂ and CH₄.

117. Statement (I) :

Timber suitable for tension members is obtained from coniferous trees.

Statement (II) :

Coniferous trees have distinct annular rings and straight grains.

118. Statement (I) :

Closely-graded materials are better than well-graded materials in so far as designs of concrete mixes are concerned.

Statement (II) :

Interparticle spaces must be well-packed densely for resulting in a good mix.

119. Statement (I) :

Finer grinding of cement results in early development of strength.

Statement (II) :

Rate of hydration of cement is increased when it is ground finer.

120. Statement (I) :

Method of substitution is validly employed in the analysis of member forces in certain geometries of truss structures.

Statement (II) :

It is always easier to analyze determinate truss forms by geometrical diagramming irrespective of conditions at the support points.

SPACE FOR ROUGH WORK

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