## TEST BOOKLET

CIVIL ENGINEERING
PAPER I
IES-2011 UPSC (ESE)
A

## 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 $\mathbf{1 2 0}$ 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 response ONLY on the separate Answer Sheet provided. See direction 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 rake 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.

1. For different concrete specimens, each hydrated tot he same degree, the permeability is
(a) Higher with lower water cement ratio and higher cement content
(b) Lower with lower water cement ratio and higher cement content
(c) Lower with higher water cement ratio and lower cement content
(d) Lower with higher water cement ratio and higher cement content

Ans: (b)
2. Modulus of elasticity of concrete is increased with
(a) Higher W/C ratio
(b) Shorter curing period
(c) Lesser vibration
(d) Increase in age

Ans: (d)
3. Increase-strain curve of concrete is
(a) A perfect straight line upto failure
(b) Straight line up to $0.002 \%$ strain value and then parabolic upto failure
(c) Nearly parabolic up to $0.002 \%$ strain value and the a straight line upto failure
(d) Hyperbolic up to $0.002 \%$ strain value and then a straight line upto failure

Ans: (c)
4. Match List I with List II and select the correct answer using the code given below the lists:

List I
(Grade of cement \& Age)
A. Grade 33 (7 days)
B. Grade 43 (28 days)
C. Grade 53 (3 days)

1. 27
2. 43
D. Grade 43 (7 days)
3. 22
4. 33

ListII
(Compressions strength in $\mathrm{Nlmm}^{2}$ )

Code:

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

Ans: (b)
5. When percentage of mica present in sand is large, it
(a) Reduces the strength of mortar, or concrete
(b) Increases the strength of mortar or concrete
(c) Has no effect on mortar, or concrete strength
(d) Enhances the strength of mortar, or concrete, but only marginally

Ans: (c)
6. Consider the following statements:

1. Dry rot in sap wood is caused by fungal attack
2. Brown rot in coniferous woods is a result of fungal attack
3. Alternate wetting and drying of unseasoned timber causes 'powdery' form of decay in wood.
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

Ans: (a)
7. Which of the following statements refer to correct purpose as regards testing of concrete by ultrasonic pulse velocity method?

1. To assess the quality of concrete in-situ.
2. To determine the dynamic modulus of elasticity of concrete.
3. To locate the presence of cracks in it
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

## Ans: (d)

8. If ' $W$ ' is the percentage of water required for normal consistency of cement, water to be added for determination of initial setting time is
(a) 0.50 W
(b) 0.62 W
(c) 0.75 W
(d) 0.85 W

Ans: (d)
9. Consider the following statements

Fibre saturation point in wood is reached when

1. Free water is removed
2. Cell water is removed
3. Shrinkage of wood is rapid
4. Strength gain is rapid

Which of these statements are correct?
(a) 1, 2 and 3
(b) 1 and 2 only
(c) 2 and 4 only
(d) 1,3 and 4

Ans: (d)
10. Which of the following theories of failure is most appropriate for a brittle material?
(a) Maximum principal strain theory
(b) Maximum principal stress theory
(c) Maximum shear stress theory
(d) Maximum strain energy theory

Ans: (b)
11. A simply supported beam AB is subjected to a concentrated load at C , the centre of the span. The area of the SF diagram from A to C will give
a) BM at C
b) Load at $S$
c) SF at C
d)Difference between BM values at A and C

Ans: (d)
12. In a strained material, the principal stresses in the $X$ and $Y$ directions respectively are $100 \mathrm{~N} / \mathrm{mm}^{2}$ (Tensile) and $60 \mathrm{~N} / \mathrm{mm}^{2}$ (Compressive). On an inclined plane, the normal to which makes an angle of $30^{\circ}$ to the X -axis, the major principal stress, in $\mathrm{N} / \mathrm{mm}^{2}$ would be
(a) 60
(b) 80
(c) 20
(d) 40

Ans: (c)
13. Which one of the following statements is correct?
(a) Principal stress is defined as the shear stresses on planes on which the normal stress is maximum or minimum
(b) The centre of Mohr's circle for a two-dimensional stress system always lies in the $y$ axis (adopting conventional axes notation).
(c) The plane of maximum shear stress is inclined to the plane of principal stress at an angle of $45^{\circ}$
(d) In case of biaxial state of normal stresses, the normal stress on $45^{\circ}$ plane is equal to the sum of normal stresses.

Ans: (c)
14. Consider the following statements:

1. Failure occurs beyond elastic limit
2. Rupture takes place immediately after elastic limit
3. Permanent set occurs beyond elastic limit

Which of these are considered in the theories of failure?
(a) 1, 2 and 3
(b) 1 and 3 only
(c) 2 and 3 only
d) 1 and 2 only

Ans: (d)
15. Consider the following salient points in a stress-strain curve of a mild steel bar:

1. Yield point 2. Braking point 3. Yield plateau
2. Proportionality limit 5. Ultimate point

The correct sequence in which they occur while testing the mild steel bar in tension from initial zero strain to failure is
(a) 4, 1, 2, 3 and 5
(b) 1, 4, 3, 5 and 2
(c) 4, 1, 3, 5 and 2
(d) 1, 4, 2, 3 and 5

## Ans: (c)

16. A pedestal of rectangular cross-section of size $\mathrm{B} \times \mathrm{D}$ is subjected to a vertical load P. For the stress to be zero at the farthest point in the first quadrant of X-Y axes of the section (with the origin at the symmetric midpoint) due to the load acting in the third quadrant is bounded by the straight line.
(a) $\frac{6 X}{B}-\frac{6 Y}{D}=1$
(b) $\frac{6 X}{B}+\frac{6 Y}{D}=-1$
(c) $\frac{6 X}{B}+\frac{6 Y}{D}=1$
(d) $\frac{6 X}{D}+\frac{6 Y}{B}=1$

Ans: (d)
17. Match List I with List II and select the correct answer using the code given below the lists

List I
Mohr's Circle
A.

B.

C.

3.

D.


Code:

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

Ans: (c)
18. A uniformly distributed load (w) of length shorter than the span crosses a girder. The bending moment at a section in the girder will be maximum when
(a) Head of the load is at the section
(b) Tail of the load is at the section
(c) Section divides the load in the same ratio as it divides the span
(d) Section divides the load in two equal lengths.

Ans: (c)
19.


The bending moment diagram for the above shown portal frame is
a)

(b)

(c)

(d)


Ans: (c)
20.


The truss is shown in figure. The cross-sectional area of each member is 'A' and the modules of elasticity of the material is uniformly E . The strain energy in the member XY is given by
(a) $\frac{p^{2} L}{6 A E}$
(b) $\frac{p^{2} L}{3 A E}$
(c) Zero
(d) $\frac{p^{2} L}{2 A E}$

## Ans: (c)

21. 

The force in the member CD is
(a) $\quad \mathrm{P}$ Tensile
(b) P Compressive
(c) 2P Tensile

(d) 2P Compressive

Ans: (a)
22.


The influence line for vertical reaction at A of the beam is
(a)
(b)


Ans: (a)
23. The moment capacity of section at plastic hinge equals
a) Yield moment
b) Zero
c) Fully plastic moment
d) Twice the yield moment

Ans: (c)
24. Which one of the following is the correct ratio of plastic moment to yield moment for a simply supported beam of uniform square cross section throughout the span
(a)
1.5
(b) 1.7
(c) 2.0
(d) 2.34

Ans: (a)
25. A fixed beam with central point load undergoes a slight settlement at one end. Select suitable answer from the following:
(a) Moment induced at both ends will be same
(b) Moment induced at the end that has undergone settlement will be maximum
(c) Moment induced will be maximum at the end having no settlement
(d) Zero moment at the end that has settled.

Ans: (c)
26. An increase in temperature on the top fibre of a simply supported beam will cause
(a) Downward deflection
(b) Upward deflection
(c) No deflection
(d) Angular rotation about neutral axis

Ans: (b)
27. The number of independent equations to be satisfied for static equilibrium in a space structure is
(a) 3
(b) 6
(c) 4
(d) 2

Ans: (b)
28. The loading on a beam is shown


The shear force diagram for the above figure is
(a)

(b)

(c)

(d)


Ans: (a)
29. The correct bending moment diagram for the column is

$$
\begin{aligned}
& \mathrm{P} \xrightarrow[l / 2]{\stackrel{A}{l / 2}+} \\
& \text { BoHinge } \\
& -\quad l \mid
\end{aligned}
$$

The correct bending moment diagram for the column is
(a)

(b)

(c)

(d)


Ans: (c)
30. A propped cantilever $A B$ of span $L$ is subjected to a moment $M$ at the prop end $B$. The moment at fixed end A is
(a) 2 M
(b) $\frac{M}{2}$
(c) M
(d) $\frac{3 M}{4}$

Ans: (b)
31. Which of the following steel sections should preferably be used at places where torsion occurs?
(a) Box-type section
(b) Channel section
(c) Angle section
(d) Any of the above

Ans: (a)
32. The effective length of the fillet weld is
(a) Total length -2 x throat size
(b) Total length -2 x weld size
(c) 0.7 x total length
(d) Total length $-\left(\frac{\text { Weldsize }}{\sqrt{2}}\right)$

Ans: (b)
33. The compatibility conditions in terms of strains in a two-dimensional problem are associated with
(a) Stresses
(b) Forces
(c) Properties of materials
(d) Deformations

Ans: (d)
34. The material in which large deformation is possible before absolute failure by rupture takes place, is known as
(a) Ductile
(b) Plastic
(c) Brittle
(d) Elastic

Ans: (a)
35. The moment-distribution method in structural analysis falls in the category of
(a) Displacement method
(b) Force method
(c) Flexibility method
(d) First order approximate method

Ans: (a)
36. Consider the following statements:

Web crippling due to excessive bearing stress can be avoided by

1. Increasing the web thickness
2. providing suitable stiffeners
3. Increasing the length of the bearing plates

Which of these statements are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: (d)
37. In the virtual work method of plastic analysis of steel structures, the virtual quantity is
(a) Slope
(b) Moment
(c) Load
(d) Displacement

Ans: (d)
38. A protective or decorative non-structural element placed at the level of the truss supports and column head is called
(a) Eaves girder
(b) Baluster
(c) Eaves board
(d) Tie girder

Ans: (c)
39. The purlins in roof trusses are placed at the panel points essentially to avoid
(a) Axial force in rafter
(b) Shear force in rafter
(c) Deflection in rafter
(d) Bending moment in rafter

Ans: (d)
40. When the distance between centers of two adjacent rivets connecting the members subjected to either compression or tension exceeds the maximum pitch, then the additional rivets which are not subjected to the calculated stresses are known as
(a) Packing rivets
(b) Long-grip rivets
(c) Tacking rivets
(d) Auxiliary rivets

## Ans: (c)

41. Which of the following conditions is to be satisfied both in elastic and plastic analyses?
(a) Equilibrium condition
(b) Yield condition
(c) Plastic moment condition
(d) Mechanism condition

Ans: (a)
42. The base of a column is subjected to moment. If the intensity of bearing pressure due to axial load is equal to stress due to moment, then the bearing pressure between the base and the 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) Compression, verying as a parabolic profile

Ans: (b)
43. The allowable shear stress in the web of mild steel beams decreases with
(a) Decrease in $h / t$ ratio
(b) Increase in $\mathrm{h} / \mathrm{t}$ ratio
(c ) Decrease in thickness
(d) Increase in height
Where h is the height and t is the thickness

## Ans: (b)

44. The most critical consideration in the design of a rolled steel column carrying axial loads is the
(a) Percentage elongation at yield and the net cross-sectional area
(b) Critical bending strength and axial yield strength of material
(c) Buckling strength based on the net area of the section and percentage elongation at ultimate load
(d) Compressive strength based on slenderness ratio and gross cross-sectional area.

## Ans: (d)

45. For an I beam, the shape factor is 1.12. If the allowable stress (with factor of safety in bending as 1.5 ) is increased by $20 \%$ for wind and earthquake loads, the modified load factor is
(a) 1.10
(b) 1.25
(c) 1.35
(d) 1.40

Ans: (d)
46. Top chord of a truss is continuous over joints $l$ apart. Effective lengths of the member in the plane perpendicular to the truss is
(a) $0.7 l$
(b) $0.85 l$
(c) $l$
(d) $1.5 l$

Ans: (c)
47. The mechanism method and the statical method guide in estimating
(a) The lower and upper bounds respectively on the strength of structure
(b) The upper and lower bounds respectively on the strength of structure
(c) The lower bound on the strength of structure
(d) The upper bound on the strength of structure

Ans: (b)
48. If the shape factor of a section is 1.5 and the factor of safety to be adopted is 2 , then the load factor will be
(a) 3
(b) 4
(c) 1.5
(d) 2

Ans: (a)
49.


A tie bar $100 \mathrm{~mm} \times 16 \mathrm{~mm}$ thick is to be welded to another plate as shown in figure using 8 mm fillet welds. If the tensile stress in plates is $150 \mathrm{~N} / \mathrm{mm}^{2}$ and shear stress in weld is 110.0 $\mathrm{N} / \mathrm{mm}^{2}$, minimum overlap required will be
(a) 50 mm
(b) 75 mm
(c) 100 mm
(d) 150 mm

Ans: (c)
50. A propped cantilever beam of span ' L ' and constant plastic moment $\mathrm{M}_{\mathrm{p}}$, carries a concentrated load at midspan. The load at collapse will be
(a) $\frac{2 M_{P}}{L}$
(b) $\frac{8 M_{p}}{L}$
(c) $\frac{6 M_{P}}{L}$
(d) $\frac{4 M_{P}}{L}$

Ans: (c)
51. For two plates of equal thickness, full strength of square-edged fillet weld can be ensured if its maximum size is limited to
(a) 1.5 mm less than the plate thickness
(b) $67 \%$ of the plate thickness
(c) $80 \%$ of the plate thickness
(d) Thickness of the plate

Ans: (a)
52. When a column is supported throughout its length either by masonry walls or by construction on all the sides, then its slenderness ratio is
(a) Infinite
(b) Zero
(c) Reasonably high
(d) Low

Ans: (b)
53. The allowable shear stress in stiffened webs of mild steel beams decreases with
(a) Decrease in the spacing of the stiffeners
(b) Increase in the spacing of the stiffeners
(c) Decrease in the effective depth
(d) Increase in the effective depth

Ans: (b)
54. In a roof truss, if pitch is $1 / 2$ and slope is 1 , the angle of inclination with the horizontal would be
(a) $30^{\circ}$
(b) $45^{0}$
(c ) $60^{\circ}$
(d) $75^{\circ}$

Ans: (b)
55. In a plastic hinge, the actual distribution of strain across the section is essentially as
(a)
(a)

(b)


(c)
(d)

Ans: (a)
56. Consider the following statements in respect of design of web and flange as splices:

1. Flange splice shall be designed for actual BM at the section.
2. Flange splice shall be designed to resist the actual shear at the section.
3. Web splice shall be designed to resist the actual shear at the section
4. Web splice shall be designed for actual BM.

Which of these statements are correct?
(a) 1 and 3
(b) 2 and 3
(c) 3 and 4
(d) 1 and 4

Ans: (a)
57. Lap length of reinforcement in compression shall not be less than
(a) $30 \not \subset$
(b) $24 \varnothing$
(c) $20 \not \subset$
(d) $15 \varnothing$
Where $\phi=$ diameter of bar

Ans: (b)
58. Match List I with List II and select the correct answer using the code given below the lists:

## List I

A. Doubly reinforced section
B. Limit state design
C. Minimum cover
D. Span-depth ratio

## List II

1. Serviceability
2. Durability
3. Reduction in sectional depth
4. Ultimate moment capacity

Code:

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

## Ans: (d)

59. The main reinforcement of a R.C. slab consists of 10 mm bars at 100 mm spacing; if it is desired to replace the 10 mm bars by 12 mm bars, then the spacing of 12 mm bars should be
(a) 120 mm
(b) 140 mm
(c ) 144 mm
(d) 160 mm

Ans: (c)
60. In prestressed concrete members, the shear force depends upon
(a) Distributed load
(b) Torsion
(c) Concentrated load
(d) Variation in net bending moment

## Ans: (d)

61. In case of Magnel- Blaton system of prestressing, each sandwich plate can generally anchor
(a) 6 wires
(b) 8 wires
(c) 10 wires
(d) 16 wires

Ans: (a)
62. Inc case of prestressed concrete members, the bursting stresses develop at
(a) Bond zone
(b) Maximum bending moment zone
(c) Maximum shear stress zone
(d) Anchorage zone

Ans: (d)
63. In limit state approach, spacing of main reinforcement controls primarily
(a) Cracking
(b) Deflection
(c) Durability
(d) Collapse

Ans: (a)
64. Minimum clear cover (in mm) to the main steel bars in slab, beam, column and footing respectively, are
(a) $10,15,20$ and 25
(b) $15,25,40$ and 75
(c) $20,25,30$ and 40
(d) 20, 35, 40 and 75

Ans: (b)
65. Shear resistance of concrete in a reinforced concrete beam is dependent on
(a) Tension reinforcement in the beam
(b) Compression reinforcement in the beam
(c) Shear reinforcement in the beam
(d) None of the reinforcements in the beam

Ans: (a)
66. A prestressed concrete section is said to have failed in strength at the moment when all the material in the section has exhausted its
(a) Stress limitations
(b) Strain limitations
(c) Stress as well as strain limitations
(b) Laad limitations

Ans: (a)
67. The minimum wall thickness of any load bearing wall in case of public building built with mortar, as per IS code, should be not less than
(a) $\frac{1}{2}$ brick
(b) 1 brick
(c ) $1 \frac{1}{2}$ brick
(d) 2 brick

Ans: (c)
68. The position of the neutral axis in reinforced brick masonry is independent of the loading and is at a depth of
(a) One-third of the effective depth
(b) Half of the effective depth
(c) Full depth
(d) $\frac{1}{\sqrt{2}}$ times the effective depth

Ans: (a)
69. Maximum slenderness ratio for load-bearing masonry wall in cement mortar, as per IS code, shall not exceed.
(a) 13
(b) 20
(c) 27
(d) 30

Ans: (c)
70. As per masonry code, the stiffening coefficient for walls stiffened by piers, buttresses or intersecting walls can be
(a) 0 to 1.0
(b) 1.0 to 2.0
(c) Greater than 2.0
(d) Invariantly 1.0

Ans: (b)
71. Consider the following statements:

Maximum slenderness ratio of load-bearing masonry walls for a dwelling having more than two storeys shall not exceed.

1. 12, if lime mortar is used
2. 18 , if cement-lime mortar $1: 2: 9$ is used
3. 24 , if cement mortar $1: 6$ is used $\backslash$

Which of these statements are correct?
(a) 1 and 2 only
b) 2 and 3 only
c) 1 and 3 only
d)1, 2 and 3

Ans: (b)
72. The loss due to relaxation of stress in steel in PSC member depends on

1. Applied stress level
2. Temperature
3. Type of steel
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1, 2 and 3
(d) 1 and 3 only

Ans: (c)
73. The 'transmission length' requirement is to be satisfied in the design of
(a) Pre-tensioned concrete beams
(b) Post-tensioned concrete beam
(c) Unbonded post-tensioned concrete
(d) Post-tensioned continuous concrete beams

Ans: (a)
74. Which one of the following statements is not correct with respect to PSC beams?
(a) Loss due to shrinkage is proportional to water-cement ratio used in concrete
(b) Loss due to creep is proportional to the age of the member at the time of loading.
(c) Loss due to elastic deformation is directly proportionally to the modulus of elasticity of concrete
(d) Loss due to friction occurs in post tensioned concrete members

## Ans: (c)

75. In limit state design of concrete for flexure, the area of stress block is taken as
(a) $0.530 \mathrm{f}_{\mathrm{ck}}$. $\mathrm{X}_{\mathrm{u}}$
(b) $0.446 \mathrm{f}_{\mathrm{ck}} \cdot \mathrm{X}_{\mathrm{u}}$
(c) $0.420 \mathrm{f}_{\mathrm{ck}} . \mathrm{X}_{\mathrm{u}}$
(d) $0.360 \mathrm{f}_{\text {ck }} . \mathrm{X}_{\mathrm{u}}$

Where $f_{c k}$ is characteristic compressive strength of concrete and $X_{u}$ is the depth of neutral axis from top.

Ans: (d)
76. In a combined footing, in the zones where the shear stresses are less than $5 \mathrm{~kg} / \mathrm{cm}^{2}$, stirrups to be provided are generally
(a) 2 - legged
(b) 4-legged
(c) 8 - legged
(d) 12 legged

Ans: (b)
77. The purpose of lateral ties in short R.C. columns is to
(a) Increase the load carrying capacity of column
(b) Facilitate compaction of concrete
(c) Facilitate construction
(d) Avoid buckling of longitudinal bars

Ans: (d)
78. The number of plastic hinges required in a structure of indeterminate status for a 'mechanism' to develop is
(a) i
(b) $\mathrm{i}+1$
(c) $i+2$
(d) $\mathrm{i}-1$

Where ' i ' is the degree of indeterminacy
Ans: (b)
79. According to IS 456, minimum slenderness ratio for a short concrete column is
(a) Less than 12
(b) Between 12 and 18
(c) Between 18 and 24
(d) More than 24

Ans: (a)
80. For a continuous slab of $3 \mathrm{~m} \times 35 \mathrm{~m}$ size, the minimum overall depth of slab to satisfy vertical deflection limits is
(a) 120 mm
(b) 100 mm
(c) 75 mm
(d) 50 mm

Ans: (a)
81. The effective length of a R.C column continuing through two storeys, properly restrained at both ends in position and direction, is
(a) 0.50 L
(b) 0.75 L
(c) L
(d) 2 L

Ans: (b)
82. A reinforced concrete slab is 75 mm thick. The maximum size of reinforcement bar that can be used is
(a) 6 mm diameter
(b) 8 mm diameter
(c) 10 mm diameter
(d) 12 mm diameter

Ans: (b)
83. A reinforced concrete cantilever porch has thickness t . The main reinforcing steel will be placed
(a) At mid-thickness
(b) At $\mathrm{t} / 3$ from the top
(c) Close to the bottom surface
(d) Close to the top surface

Ans: (d)
84. A simply supported rectangular beam is uniformly loaded and is prestressed. The tendon provided for prestressing should be
(a) Straight, above centroidal axis
(b) Straight, below centroidal axis
(c) parabolic, with convexity upward
(d) Parabolic, with convexity downward

Ans: (d)
85. For a certain set of external loads, concordant profile in a prestressed beam represents to some scale the
(a) Influence line diagram
(b) Shear force diagram
(c) Bending moment diagram
(d) Williot-Mohr diagram

## Ans: (c)

86. Consider the following statements:

Cement mortars richer than 1:3 are not used in masonry work because

1. There is no gain in strength of masonry
2. There is high shrinkage
3. They are prone to segregation

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

Ans: (b)
87. Consider the following statements:

Percentage of steel for balanced designed of a singly reinforced rectangular section by limit state method depends on
(1) Characteristic strength of concrete
(2) Yield strength of concrete
(3) Modulus of elasticity of steel
(4) Geometry of the section.

Which of these statements are correct?
(a) 2, 3 and 4
(b) 1, 3 and 4
(c) 1,2 and 4
(d) 1,2 and 3

Ans: (b)
88. The minimum strain at failure in the tensile reinforcement $\left(\mathrm{F}_{\mathrm{y}}=400 \mathrm{MPa}\right)$ of RCC beam as per limit state method is
(a) 0.0020
(b) 0.0028
(c) 0.0037
(d) 0.0045

Ans: (c)
89. A bar chart is commonly used because
(a) It is simple to draw and easy to understand
(b) It indicates at a glance the overall progress of the project
(c) It shows critical and non-critical activities
(d) It incorporates uncertainties for delay in estimation of time required for completion of activities.

Ans: (a)
90. Which one of the following rollers is suitable for soil-cement stabilized road construction?
(a) Vibratory roller
(b) Sheepfoot roller
(c) Pneumatic roller
(d) Smooth wheel roller

Ans: (c)
91. In a group housing project, it is proposed to use pre-fabricated RCC beams and columns. The most useful construction equipment is
(a) Derrick Crane
(b) Chute
(c) Weigh Batcher
(d) Transit Mixer

Ans: (a)
92. Tractive coefficient of a Crawler truck in loose soil is
(a) Less than that of rubber tyre tractors
(b) More than that of rubber tyre tractors
(c) Same as that of rubber tyre tractors
(d) Nearly zero

Ans: (d)
93 The thickness of web for unstiffened plate girder with clear distance' $d$ ' between the flanges shall be not less than
(a) $\frac{d}{200}$
(b) $\frac{d}{85}$
(c) $\frac{d}{100}$
(d) $\frac{d}{160}$

Ans: (b)
94. The maximum longitudinal pitch in bolted joints, subjected to tensile forces, wherein $t=$ thickness of the plate and $D=$ diameter of bolt, is
(a) 32 D
(b) 16 D
(c) 32 t
(d) 16 t

Ans: (d)
95. A centrifugal pump 18 cm diameter, running at 1460 rpm delivers $0.096 \mathrm{~m}^{3} / \mathrm{sec}$ water against a head of 36 m of water with an efficiency of $86 \%$. If another pump, twice the size of this said pump, is run at the same speed, how much water would the bigger pump deliver and at what head of water? (Take $\sqrt[3]{2}=1.26$ )
(a) $0.192 \mathrm{~m}^{3} / \mathrm{sec}$ and 45.36 m
(b) $0.192 \mathrm{~m}^{3} / \mathrm{sec}$ and 90.72 m
(c) $0.384 \mathrm{~m}^{3} / \mathrm{sec}$ and 45.36 m
(d) $0.384 \mathrm{~m}^{3} / \mathrm{sec}$ and 90.72 m

Ans: (d)
96.


In the network shown above, the number on the arrow gives the duration of the activity. The earliest expected time for event 6 to be attached is
(a)
22
(b) 27
(c) 23
(d) 24

Ans: (b)


Consider a series of activities $\mathrm{A}, \mathrm{B}, \mathrm{C}, \mathrm{D}$ and E comprising a project wherein, $\mathrm{a}, \mathrm{m}, \mathrm{b}$ durations of each activity are indicated. What is the probability of completing the project in 45 days? The area under the normal probability curve is indicated in the table by adopting standard notations.

| Z | 1.0 | 0.8 | 0.6 | 0.4 | 0.2 | 0.0 |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| X | 0.841 | 0.788 | 0.725 | 0.655 | 0.579 | 0.500 |

(a) 0.20
(b) 0.23
(c) 0.26
(d) 0.29

Ans: (d)
98. Which one of the following is the objective in crashing?
(a) Reduction in duration
(b) Reduction in resources
(c) Reduction in cost
(d) Reduction in project size

## Ans: (c)

99. If the depth of actual axis in a beam is more than the depth of critical axis, then the beam is called
(a) Over reinforced beam
(b) Under-reinforced beam
(c) Balanced beam
(d) Deep beam

Ans: (a)
100.


Consider the three activities indicated in sequence. The possible alternatives for individual durations (D) in days, and the corresponding cost of resource consumption in units of money per day ( R ) respectively, are also indicated beside the activities. Overhead costs are to be added at 12 units of money per day of duration. What is the most optimal total cost including overheads, if all the activities are to be completed in either 22 or 21 days?
(a) 466 units of cost
(b) 460 units of cost
(c) 453 units of cost
(d) 450 units of cost

Ans: (c)
101. In a R.C section under flexure, the assumption that "a plane section before bending remains plane after bending" leads to
(a) Strain distribution being linear across the depth
(b) Stress distribution being linear across the depth
(c) Both stress and strain distribution being linear across the depth
(d) Shear stress distribution being uniform along the depth

Ans: (a)
102. Critical path moves along the activities having total float as
(a) Positive
(b) Negative
( c) Zero
(d) Unity

Ans: (c)
103. The probability distribution taken to represent the completion of time in PERT analysis is
(a) Normal Distribution
(b) Bet Distribution
(c) Gamma Distribution
(d) Gaussain Distribution

Ans: (a)
104. The output from a power shovel is $144 \mathrm{cum} / \mathrm{hr}$. The required number of trucks of 12 cum capacity each with 16 minute cycle time and with $80 \%$ operating efficiency will be
(a) 5
(b) 4
(c) 3
(d) 2

Ans: (c)
105. A supercharger is used in the engines of earthmoving machines at higher altitudes because
(a) The ambient atmospheric pressure is less at higher altitudes
(b) Four-cycle engines depend on the suction of the engines for the supply of air
(c) Two-cycle engines are not rugged enough for higher altitude
(d) The ambient temperature is less as the altitude is higher

Ans: (a)
106. A contractor wishes to determine a suitable combination of manual labour and machine work for the excavation of a multistory construction. For every cum of excavation, 3 man-hours are needed; or 0.2 machine-hour. Costs involved are Rs. 20 per man-hour and Rs. 500 per machine-hour. The total quantity of excavation is estimated to be 4,000 cum. The optimal quantity of excavation to be done manually for minimum total cost will be
(a) 1500 cum
(b) 1800 cum
(c) 2250 cum
(d) 2500 cum

Ans: (d)
107 Match List I with List II and select the correct answer using the code given below the lists:

## List I

A. Concrete pumps
B. Agitating trucks
C. Transit Mixer
D. Crane Bucket

Code:

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

(b) $\begin{array}{llll}2 & 1 & 4 & 3\end{array}$

## List II

1. Ready Mix concrete
2. Multi-storey concreting works
3. Tunnel works
4. Built up and busy area

| (c) | 3 | 1 | 4 | 2 |
| :--- | :--- | :--- | :--- | :--- |
| (d) | 2 | 4 | 1 | 3 |

Ans: (d)
108. Match List I with List II and select the correct answer using the code given below the lists:

## List I

A. Crawler-mounted lifting cranes
B. Rubber-tire mounted Lifting cranes
C. Drag lines with 1.34 cum Bucket, digging and loading In gravel
D. Power shovel converted Into hoe

## List II

1. Limiting load is within $75 \%$ of tipping load
2. Allow use of dipper with its stick
3. Time taken in swinging between $45^{\circ}$ to $180^{\circ}$ is 23 to 35 seconds
4. Limiting load is up to $85 \%$ of tipping load

Code

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

Ans: (c)
109. Slack time is associated with
(a) A real activity
(b) An event
(c) Both event and real activity
(d) Dummy activity

Ans: (b)
110. A crane is purchased now; its useful life is 8 years after which a new crane must be purchased. If the interest rate is $6 \%$, the capital recovery factor (crf) is
(a) 0.3141
(b) 0.5420
(c) 0.1610
(d) 0.1259

Ans: (c)
111. If the effective length, effective height and effective thickness of a masonry wall are $l, \mathrm{~h}$ and to respectively; then the slenderness ratio of the wall shall be
(a) $\frac{l}{t}$
(b) $\frac{h}{t}$
(c) Larger of $\frac{l}{t}$ and $\frac{h}{t}$
(d) Smaller of $\frac{l}{t}$ and $\frac{h}{t}$

Ans: (d)
112. Which one of the following statements is correct?
(a) Adding $5 \%$ to $6 \%$ of moisture by weight increases the volume of dry sand from $18 \%$ to $38 \%$
(b) The bulking of fine sand is more than that of coarse sand
(c) Volume of fully saturated sand is equal to that of dry sand
(d) All of the above

## Ans: (d)

113. What is the distance away from midspan of a plastic hinge if developing in a simply supported beam of rectangular cross-section and span 6 m , subjected to a point load at the centre?
(a) Zero
(b) 1 m
(c) 2 m
(d) 3 m

Ans: (a)
Directions: Each of the next seven (07) items consists of two statements, one labelled as the 'Assertion (A)' and the other as Reason (R )'. You are to examine these two statements carefully and select the answers to these items using the codes given below:

## Codes:

(a) Both A and R are individually true and R is the correct explanation of A
(b) Both A and R are individually true but R is not the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true
114. Assertion (A) : Pumps for concreting are generally of the positive displacement category
Reason (R) : Roto-dynamic pumps may effect more crushing of the coarse aggregate

Ans: (b)
115. Assertion (A) : The tests for determining the setting times of coments are of little use in assessing the hardening of cement concrete
Reason (R) : Ultimate strength of concrete in-situ is not dependent upon the setting times of cement used.
Ans: (b)
116. Assertion (A) : A material is incompressible if its Poisson's ratio is 0.5 Reason (R) : The Bulk modulus K is related to Modulus of elasticity E and to Poisson's ratio $\mu$ as per well known relationship

Ans: (b)
117.


Assertion (A) : For the frame shown above, the BM at every cross-section is zero
Reason (R) : The shape of the structure follows the funicular polygon

## Ans: (d)

118. 



Assertion (A) : The propped cantilever beam shown in figure above is a determinate structure.
Reason (R) : At the internal hinge shown, there exists a shear transfer and no bending moment.
Ans: (a)
119. Assertion (A) : In a plate girder of uniform cross-section, intermediate vertical stiffeners are provided at closer spacing in the middle rather than at supports.
Reason (R) : Intermediate vertical stiffeners are provided to prevent the web from buckling under a complex and variable stress situation resulting from combined action of shear force and bending moment.

Ans: (a)
120. Assertion (A) : Centrifugal pumps are not normally usable for pumping mixed concrete even if the concrete (to be pumped) can be dropped in by a hopper system.
Reason (R) : When dropping (mixed) concrete, segregation of aggregates may occur.

Ans: (b)

