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T.B.C. : PKL-D-CVL

Test Booklet Series

Serial No.

0052513

**TEST BOOKLET****Paper II  
(CIVIL ENGINEERING)****A**

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Time Allowed : Three Hours

Maximum Marks : 300

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**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.
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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 **150** 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 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 **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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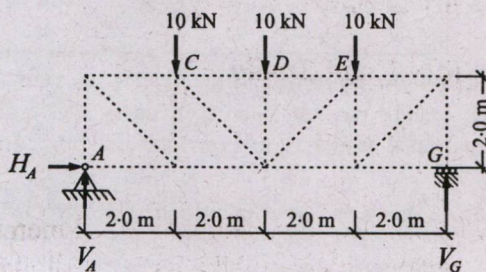
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1. Which one of the following statements is NOT correct regarding the relationships between bending moment, shear force and applied load ?

- (a) The rate of change of shear force along a beam is equal to the distributed load
- (b) The rate of change of bending moment along a beam is equal to the shear force
- (c) The rate of change of bending moment along a beam is equal to the distributed load
- (d) The shear force and bending moment at free end is always zero

2. What is the support reaction  $V_G$  from the following figure ?



- (a) 15 kN (upward)
- (b) 20 kN (upward)
- (c) 15 kN (downward)
- (d) 20 kN (downward)

3. Consider the following assumptions for pure bending theory :

- 1. The material is heterogeneous and isotropic.
- 2. The stress is purely longitudinal and local effects near concentrated loads will be neglected.

3. The radius of curvature is large compared with the dimensions of the cross-section.

Which of the above statements are correct ?

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

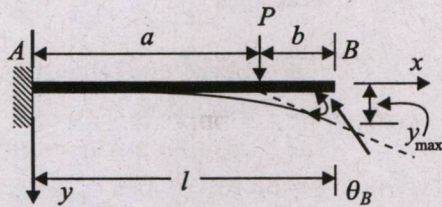
4. For a fixed-connected collar type of support connection in coplanar structures, the number of unknown(s) is/are

- (a) three and the reactions are two forces and a moment component
- (b) one and the reaction is a moment component
- (c) two and the reactions are two forces (one horizontal and one vertical)
- (d) two and the reactions are a force and a moment

5. For a rectangular beam of 4 m long with 100 mm wide and 200 mm deep, it carries a shear force of 100 kN. What is the maximum shear stress ( $\tau_{\max}$ ) due to the bending of rectangular section ?

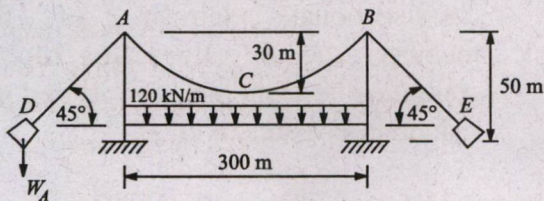
- (a) 2.5 N/mm<sup>2</sup>
- (b) 5 N/mm<sup>2</sup>
- (c) 7.5 N/mm<sup>2</sup>
- (d) 10 N/mm<sup>2</sup>

6. What is the maximum deflection ( $y_{\max}$ ) for a cantilever beam of span  $l$  subjected to a point load acting at a distance  $a$  from the fixed end as shown in figure? (Take Young's modulus as  $E$  and moment of inertia of beam section as  $I$ )



- (a)  $y_{\max} = \frac{Pa^2}{6EI}(3l-a)$
- (b)  $y_{\max} = \frac{Pa^2}{3EI}(3l-a)$
- (c)  $y_{\max} = \frac{3Pa^2}{2EI}(3l-a)$
- (d)  $y_{\max} = \frac{Pa^2}{2EI}(3l-a)$

7. What is the maximum tension (approximately) in the cable as shown in figure, if it carries a uniform horizontally distributed load of intensity  $120 \text{ kN/m}$ ?



- (a) 48.5 kN
- (b) 48.5 MN
- (c) 485 kN
- (d) 4850 N

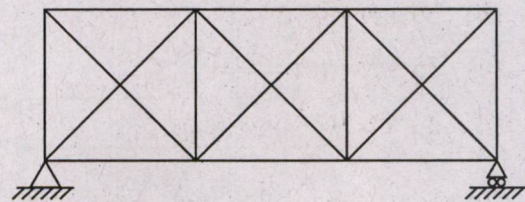
8. Consider the following statements :

1. For a given load, the deflection of an indeterminate structure is smaller than that of determinate structure.
2. For a given load, the maximum stress of an indeterminate structure is higher than that of determinate structure.
3. For a given load, the maximum stress of an indeterminate structure is smaller than that of determinate structure.

Which of the above statements is/are correct?

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

9. What is the degree of kinematic indeterminacy of the truss as shown in figure?

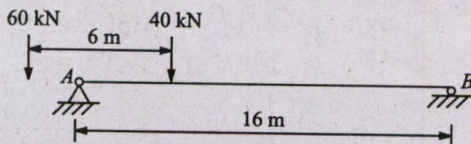


- (a) 10
- (b) 11
- (c) 12
- (d) 13

10. Which one of the following statements is NOT correct ?

- (a) The influence lines are constructed for establishing the maximum design forces at critical sections produced by moving loads
- (b) As a moving load passes over a structure, the internal forces at each point in the structure do not vary
- (c) To ensure the safety of a structure, the capacity of section should be greater than or equal to all the combination of loads
- (d) The maximum deflection occurs at the centre of a simply supported beam, when a concentrated load applied at the mid-span

11. Two loads of 40 kN and 60 kN are moving towards support  $B$  as shown in figure. What is the maximum negative shear force at  $B$  ?



- (a)  $-77.5$  kN
- (b)  $-7.75$  kN
- (c)  $-37.5$  kN
- (d)  $-3.75$  kN

12. Consider the following statements related to the uses of computer programs in the structural analysis :

1. To analyze a truss with rigid joints would be a lengthy computation by the classical methods of analysis.
2. The rigid joints (in truss analysis) are assumed to be pinned joints by the designers to simplify the problem.
3. The computer programs enable to consider the real situation (rigid joints) and also give the accurate results in a quick time.

Which of the above statements are correct ?

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

13. If the load is transmitted by bolts or rivets through some but not all the cross-sectional elements of the member, the effective area  $A_e$  is computed by using net area  $A_n$  and the reduction coefficient  $U$  as

- (a)  $A_e = UA_n$
- (b)  $A_e = A_n/U$
- (c)  $A_e = 0.87UA_n$
- (d)  $A_e = 0.66UA_n$

14. If the net end moments of a compression member are zero then such member is called

- (a) beam column
- (b) axially loaded column
- (c) a truss
- (d) a girder

15. Consider the following factors that affect the behavior of a column under a compression load :

1. The stress-strain properties remain constant throughout the section.
2. The column may not be perfectly straight as the load is applied to it.
3. End conditions may vary from case to case.

Which of the above statements are being ignored in the Euler approach ?

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

16. What is the effective length of a steel prismatic compression member for which, the translation and rotation are restricted at both the ends ?

- (a) 0.80 L
- (b) 1.00 L
- (c) 1.20 L
- (d) 0.65 L

17. By considering the net area as  $A_n$ , ultimate stress as  $f_u$  and the partial safety factor as  $\gamma_{ml}$ , the IS code formula for preliminary design of a tension member for design strength due to rupture ( $T_{dn}$ ) of the critical section is

(a) 
$$T_{dn} = \frac{\alpha A_n f_u}{2 \gamma_{ml}}$$

(b) 
$$T_{dn} = \frac{A_n f_u}{\alpha \gamma_{ml}}$$

(c) 
$$T_{dn} = \frac{\gamma_{ml} A_n f_u}{\alpha}$$

(d) 
$$T_{dn} = \frac{\alpha A_n f_u}{\gamma_{ml}}$$

18. Consider the following statements regarding the classification of beams :

1. Floor beams are often referred to as girders.
2. Joist is a beam supporting floor construction but not a major beam.
3. Rafter is a roof beam, usually supported by roof truss.

Which of the above statements are correct ?

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

19. A simply supported steel beam of 8 m long and subjected to a uniformly distributed load of 10 kN/m. What is the maximum bending stress ( $f_b$ ) of the member at a distance of 50 mm from the neutral axis?

(Take  $I = 10 \times 10^5 \text{ mm}^4$ )

- (a) 400 N/mm<sup>2</sup>
- (b) 4000 N/mm<sup>2</sup>
- (c) 800 N/mm<sup>2</sup>
- (d) 8000 N/mm<sup>2</sup>

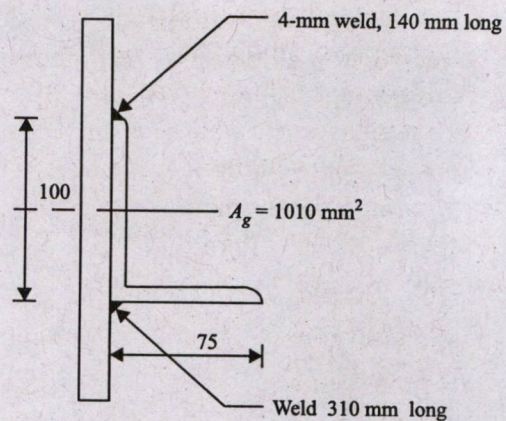
20. Arrange the following steps involved in the design of beam-columns in a correct sequence :

1. Determine the factored loads and moments acting on the beam-column using a first-order elastic analysis.
2. Choose an initial section and calculate the necessary section properties.
3. Classify the cross section as per the IS code.
4. Find out the bending strength of the cross section about the major and minor axis of the member.

Select the correct answer using the code given below :

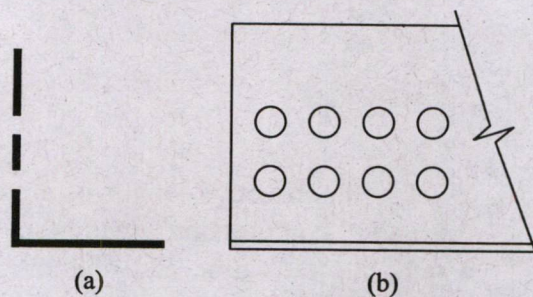
- (a) 2, 3, 1, 4
- (b) 3, 1, 2, 4
- (c) 1, 2, 3, 4
- (d) 4, 3, 2, 1

21. What is the approximate value of the tensile strength governed by yielding of the cross section of a roof truss diagonal  $100 \times 75 \times 6 \text{ mm}$  ( $f_y = 250 \text{ MPa}$ ) connected to the gusset plate by 4-mm welds as shown in figure? (Take partial safety factor as 1.10)



- (a) 230 kN
- (b) 23 kN
- (c) 320 kN
- (d) 32 kN

22. A tension member is made up of a single angle  $200 \text{ mm} \times 150 \text{ mm} \times 15 \text{ mm}$  with a gross area of  $30 \text{ cm}^2$ . Two rows of 18 mm diameter bolts (take hole diameter = 20 mm) are used (as shown in figure (a) and (b)). What is the net area?



- (a) 2460 mm<sup>2</sup>
- (b) 2500 mm<sup>2</sup>
- (c) 2400 mm<sup>2</sup>
- (d) 2560 mm<sup>2</sup>

23. In a plate girder subjected to a bending moment of 200 kNm, the width and thickness of flange are 200 mm and 10 mm respectively. What is the economical depth of the girder by assuming the moment is resisted by the flange only? (Take  $f_y = 250$  MPa)
- 800 mm
  - 400 mm
  - 500 mm
  - 700 mm
24. Which one of the following statements is NOT correct regarding gross section yielding?
- Generally, a tension member without bolt holes can resist loads up to the ultimate load without failure
  - A tension member when subjected to an ultimate load will deform considerably in the longitudinal direction
  - A structure becomes more serviceable under the large deformation
  - The IS code limits design strength by substituting a partial safety factor of 1.10 for failure in tension

**Directions for the following five (05) items :**

Read the following information and answer the five items that follow :

A singly reinforced concrete beam with an effective span of 4 m has a rectangular cross section with a width of 300 mm and an overall depth of 550 mm. The beam is reinforced with steel of Fe-415 grade of area  $250 \text{ mm}^2$  at an effective depth of 500 mm. The self-weight with dead load of the beam is 4 kN/m. Consider M-15 grade concrete and  $\sigma_{cbc} = 5$  MPa;  $\sigma_{st} = 230$  MPa.

25. What is the bending moment due to dead load?
- 8000 Nm
  - 80 kNm
  - 32 kNm
  - 3200 Nm
26. What is the modular ratio?
- 28/3
  - 40/3
  - 56/3
  - 86/3
27. What is the depth of critical neutral axis?
- 134.33 mm
  - 124.33 mm
  - 154.33 mm
  - 144.33 mm
28. What is the moment of resistance of the section if the actual depth of neutral axis is 100 mm?
- 36.83 kNm
  - 26.83 kNm
  - 16.83 kNm
  - 46.83 kNm

29. What is the permissible live load on the beam ?

- (a) 13.43 kN/m
- (b) 9.43 kN/m
- (c) 8.43 kN/m
- (d) 6.43 kN/m

30. A section is said to be under-reinforced when

- (a) the depth of actual neutral axis is greater than the depth of critical neutral axis
- (b) the depth of actual neutral axis is less than the depth of critical neutral axis
- (c) the depth of actual neutral axis is equal to the depth of critical neutral axis
- (d) it is not related to the depth of neutral axis

31. Consider the following statements regarding the slabs :

1. When the longer span to shorter span ratio is greater than or equal to two, it is a two-way slab.
2. In one-way slab, the load transfer is chiefly by bending in the shorter direction.
3. In two-way slabs, the load transferred by bending in both orthogonal directions.

Which of the above statements is/are correct ?

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

32. Which one of the following statements is NOT correct in reinforced concrete design ?

- (a) In the cracked section, concrete below the neutral axis is neglected in calculations
- (b) When section is subjected to external loading, resisting moment is developed due to compression in concrete and tension in steel
- (c) In the cracked section, the steel area below the neutral axis is converted into equivalent concrete area
- (d) The neutral axis depth does not depend on the modular ratio

33. A concrete beam is post-tensioned by a cable carrying an initial stress of  $1000 \text{ N/mm}^2$ . The slip at the jacking end was observed to be 5 mm. The modulus of elasticity of steel is  $210 \text{ kN/mm}^2$ . What is the percentage loss of stress due to anchorage slip if the length of the beam is 30 m ?

- (a) 3.5%
- (b) 35%
- (c) 0.35%
- (d) 30.5%



34. The Indian Standard (IS) code used for design of prestressed concrete is

- (a) IS 4326 : 2013
- (b) IS 3920 : 2012
- (c) IS 6512 : 2013
- (d) IS 1343 : 2012

35. Which one of the following statements is NOT correct related to the earthquake resistant design ?

- (a) Overall depth of a beam should not be greater than one-fourth of the clear span
- (b) The percentage tensile reinforcement should not exceed 2.5
- (c) The reinforcement resisting positive moments at a joint face must be less than half the negative moment reinforcement
- (d) The width to depth ratio should be more than 0.30 to avoid lateral instability

36. Consider the following statements related to isolation concepts in earthquake resistant design :

1. Development of shock-isolation concepts are generally applied to earthquake resistant structures.
2. The shock-isolation concept is a radical departure from current seismic design practice.
3. The successful implementation of shock-isolation concept will ensure the simplification in the design of tall reinforced concrete structures

Which of the above statements are correct ?

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

37. Dozer primarily is

- (a) a pushing unit
- (b) a lifting unit
- (c) a digging unit
- (d) a pulling unit

38. The process of breaking a major project into its major and sub systems and discrete activities which can be identified easily is called

- (a) Line of balance technique
- (b) Work break system
- (c) Milestone chart technique
- (d) PERT technique

39. Which one of the following statements is NOT correct in respect of stages of construction ?

- (a) Conceptual stage is before study and evaluation
- (b) Construction stage is after tendering stage
- (c) Design stage is after tendering stage
- (d) Study and evaluation stage is before design stage

40. In a construction project, generally 50% of total project cost is attributed to

- (a) Equipment cost only
- (b) Material cost only
- (c) Manpower cost only
- (d) Material plus equipment cost

41. Consider the following statements regarding the advantages of planning to the contractor :

1. The program provides a standard, by which actual work can be measured.
2. The program provides a pre-conceived plan for the whole job as well as for various stages of the work.

Which of the above statements is/are correct ?

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

42. Arrange the stages of construction of highway projects in correct sequence :

1. Cleaning site of work or construction
2. Construction of drainage work such as culvert etc.
3. Earth work
4. Construction of road and its shoulders

Select the correct answer using the code given below :

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

43. Return on Investment method is useful for

- (a) Economic analysis of project
- (b) Ecological analysis of project
- (c) Financial analysis of project
- (d) Commercial analysis of project

44. To measure the performance of project against established target and identify deviation from the target are part of which one of the following management functions ?

- (a) Planning
- (b) Directing
- (c) Coordinating
- (d) Controlling

45. In bar chart, the length of bar shows

- (a) materials required for large scale projects
- (b) time required to complete that activity
- (c) interdependencies of project
- (d) critical activities of the project

46. Which one of the following is the amount of time by which the start of an activity may be delayed without delaying the start of a following activity ?
- Total float
  - Interference float
  - Independent float
  - Free float
47. Which of the following is/are consumed time and resources ?
- Event only
  - Activity (other than dummy) only
  - Dummy activity only
  - Both event and activity (other than dummy)
48. Construction quality can NOT be directly affected by
- whether a clear set of designs and drawings is available
  - whether a clear, well-laid-out and unambiguous set of specifications is available
  - whether a clearly defined time duration of project
  - whether there has been usage of proper materials, workers and equipments during the construction processes
49. Marble is an example of
- Metamorphic Rock
  - Sedimentary Rock
  - Igneous Rock
  - Argillaceous Rock
50. Which one of the following is caused by the crushing of fibres running transversely during the growth of the tree ?
- Shake
  - Knot
  - Upset
  - Rind gall
51. Which one of the following statements is NOT correct for Aluminium ?
- It is less ductile than copper
  - It is harder than tin
  - It can be soldered
  - It can be welded
52. Which one of the following limes is the quick-lime coming out of kilns ?
- Lump lime
  - Fat lime
  - Hydraulic lime
  - Hydrated lime

53. Which one of the following is generally recommended for small jobs only ?

- (a) Volume batching
- (b) Weigh batching
- (c) Machine mixing
- (d) Non-tilting mixer

54. Consider the following statements regarding the transit mixer :

1. Their function is mainly to keep the mix in an agitated condition.
2. These mixers in addition to the outer spirals have four inner spirals.
3. A number of special nozzles provided on the lower side of inner mixing spirals, precisely and uniformly spray water on the mix under pressure along the entire length of the drum.

Which of the above statements are correct ?

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

55. In the acceptance criteria for concrete in accordance with IS 456 : 2000, the variation in strength of individual specimen should not be more than

- (a)  $\pm 30\%$  of the average
- (b)  $\pm 25\%$  of the average
- (c)  $\pm 15\%$  of the average
- (d)  $\pm 20\%$  of the average

56. Which one of the following is NOT required for concrete mix design ?

- (a) Maximum free water-cement ratio by weight
- (b) degree of workability of concrete
- (c) Initial setting time of cement
- (d) Maximum/minimum cement content

57. Which one of the following statements is NOT correct in respect of wet process of manufacturing of cement ?

- (a) It requires longer kilns
- (b) It produces more homogenous mix
- (c) It is less responsive to a variable clinker demand
- (d) It is high cost of excavating and grinding raw materials

58. The compaction factor test of cement concrete is performed to determine its

- (a) porosity
- (b) percentage voids
- (c) strength
- (d) workability

59. Which one of the following is obtained by burning kankar or clayey limestones ?

- (a) Hydraulic lime
- (b) Quick lime
- (c) Fat lime
- (d) White lime

60. Slaked fat lime is used to prepare mortar for
- (a) plastering
  - (b) masonry construction
  - (c) pointing
  - (d) reinforced brickwork

61. The value of Poisson's ratio for Brass material is
- (a) 0.14
  - (b) 0.24
  - (c) 0.34
  - (d) 0.44

62. A hole is to be punched through a steel plate of 8 mm thickness. What is the least diameter of hole which can be punched, if the steel punch can be worked to a compressive stress of  $800 \text{ N/mm}^2$  and the ultimate shear strength is  $300 \text{ N/mm}^2$ ?
- (a) 1.2 mm
  - (b) 12 mm
  - (c) 21 mm
  - (d) 2.1 mm

63. Consider the following statements regarding the strain displacement :

1. The strain depends on the displacement of points within the body.
2. The strain at points within the body does not depend on the relative displacements of various points within the body.

Which of the above statements is/are correct ?

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

64. A flat bar 10 mm thick and 100 mm wide is subjected to a pull of 100 kN. One side of the bar is polished and lines are ruled on it to form a square of 50 mm side, one diagonal of the square being along the middle line of the polished side. What is the change in the sides ? (Take  $E = 200 \text{ kN/mm}^2$  and Poisson's ratio is 0.30)

- (a) 0.0875 mm (increases)
- (b) 0.00875 mm (decreases)
- (c) 0.00875 mm (increases)
- (d) 0.0875 mm (decreases)

65. In a tensile test carried out in the laboratory on a steel specimen for 5 minutes. The strain value noted at that time was 0.30. What is the average strain rate of that steel specimen ?

- (a) 0.01/second
- (b) 0.001/minute
- (c) 0.001/second
- (d) 0.01/minute

66. Maximum principal strain theory of elastic failure is also known as

- (a) Guest's Theory
- (b) Rankine's Theory
- (c) Haigh's Theory
- (d) Saint Venant's Theory

67. Which one of the following is the limitation of the maximum strain energy theory?
- The theory does not apply to the ductile materials
  - It can only be applicable for the materials under the hydrostatic pressure
  - It cannot be applied for materials under the hydrostatic pressure
  - The theory does not give accurate results in case of torsion test.
68. What are the values of maximum shear stress ( $\tau_{\max}$ ) and the angle of twist ( $\theta$ ) respectively for an equilateral triangle with side  $a$  and twisting moment  $M_t$ ? (Take the modulus of rigidity is  $G$ )
- $\frac{20M_t}{a^3}$  and  $\frac{46M_t}{a^4G}$
  - $\frac{20M_t}{a^2}$  and  $\frac{26M_t}{a^4G}$
  - $\frac{46M_t}{a^3}$  and  $\frac{20M_t}{a^4G}$
  - $\frac{20M_t}{a^4}$  and  $\frac{46M_t}{a^3G}$
69. A cantilever beam of length  $L$  is loaded by a transverse load varying linearly from  $w_0$  at fixed end and zero at free end. What is the shear at  $L/2$  of the beam?
- $w_0L/4$
  - $w_0L^2/8$
  - $w_0L^2/4$
  - $w_0L/8$
70. Two of the principal stresses at a point are 130 MPa and 90 MPa. What is the safe range of the third principal stress at the point by using maximum shear stress theory? (Take the failure stress in tension as  $f_y = 210 \text{ N/mm}^2$ )
- $-80 \text{ MPa} \leq \sigma \leq 300 \text{ MPa}$
  - $-155 \text{ MPa} \leq \sigma \leq 210 \text{ MPa}$
  - $-112 \text{ MPa} \leq \sigma \leq 222 \text{ MPa}$
  - $-210 \text{ MPa} \leq \sigma \leq 210 \text{ MPa}$
71. A close-coiled helical spring is subjected to an axial pull of  $W$ . The spring is made out of  $d$  mm diameter rod, and has  $n$  complete coils, each of radius  $R$  and modulus of rigidity as  $N$  then the deflection under the pull is
- $\delta = \frac{16WR^3n}{Nd^4}$
  - $\delta = \frac{32WR^3n}{Nd^4}$
  - $\delta = \frac{64WR^3n}{Nd^4}$
  - $\delta = \frac{64WR^2n}{Nd^3}$
72. A steel wire of cross-sectional area  $100 \text{ mm}^2$  and length  $100 \text{ m}$  is used to lift a weight of  $2.5 \text{ kN}$  at its lowest end. What is the total elongation of the wire if the mass density of the wire is  $8 \text{ kg/m}^3$ ? (Take  $E = 200 \text{ GPa}$  and acceleration due to gravity is  $10 \text{ m/s}^2$ )
- $14.5 \text{ mm}$
  - $29 \text{ mm}$
  - $7.5 \text{ mm}$
  - $36.5 \text{ mm}$

73. For non-homogeneous clays, the coefficient of permeability in (mm/s) should be ranges between

- (a)  $10^{-1}$  to  $10^{-2}$
- (b)  $10^{-2}$  to  $10^{-3}$
- (c)  $10^{-3}$  to  $10^{-4}$
- (d)  $10^{-4}$  to  $10^{-6}$

74. Large parts of northern India lying north of Vindhya-Satpura range in the Indo-Gangetic and Brahmaputra flood plains are covered by

- (a) the colluvial soils
- (b) the aeolian soils
- (c) the alluvial soils
- (d) the talus soils

75. The maximum test load on a working pile should not exceed

- (a) 250 kN
- (b) 180 kN
- (c) two and a half times the design load
- (d) one and a half times the design load

76. Which one of the following does NOT affect the permeability of soils ?

- (a) Void ratio
- (b) Soil strength
- (c) Grain size
- (d) Temperature

77. Consistency is a term used to indicate

- (a) the quantitative analysis of soils
- (b) the degree of firmness of cohesive soils
- (c) the fineness of non-cohesive soils
- (d) the fineness of clay soils

78. The primary function of geogrids is

- (a) connecting two layers
- (b) separators
- (c) reinforcement
- (d) protection from corrosion

79. Which of the following is/are the laboratory methods of determination of coefficients of permeability of soils ?

1. Constant head permeability method
2. Falling head permeability method

Select the correct answer using the code given below :

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

80. Which one of the following characteristics is NOT measured by geophysical method of soil exploration ?

- (a) Magnetism
- (b) Density
- (c) Electrical resistivity
- (d) Plasticity

81. Which one of the following is a method of wet mechanical analysis of a fine-grained material ?

- (a) Partial sedimentation
- (b) Sedimentation into dirty water
- (c) Observation of partial sedimented soil
- (d) Elutriation

82. According to Highway Research Board (HRB) classification system, which one of the following is NOT relevant for dependency of group index of soil ?

- (a) The amount of material passing the 75-micron IS sieve
- (b) The liquid limit
- (c) The plastic limit
- (d) The shrinkage limit

83. An oven-dried soil having a mass of 200 g is placed in a pycnometer which is then completely filled with water. The total mass of the pycnometer with water and soil inside is 1605 g. The pycnometer filled with water alone has a mass of 1480 g. What is the specific gravity of the soil ?

- (a) 2.21
- (b) 2.41
- (c) 2.67
- (d) 3.32

84. A soil sample has a porosity of 40 percent. The specific gravity of solids is 2.70. What is voids ratio ?

- (a) 0.467
- (b) 0.567
- (c) 0.667
- (d) 0.743

85. Which one of the following is used for determining different strata in the earth's crust ?

- (a) Mine survey
- (b) Topographic survey
- (c) Archaeological survey
- (d) Geological survey

86. Consider the following statements related to set out the curve using two theodolite method :

To set out the curve,

1. set up a theodolite over  $T_1$  and another over  $T_2$ .
2. set the vernier of each of the instruments to zero.
3. direct the instrument at  $T_1$  to the ranging rod at the point of intersection  $B$  and bisect it.

Which of the above statements are correct ?

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



87. In setting out location of piers, the central points of the piers are located by intersection of sights, simultaneous sights being taken from
- the ends of a base
  - the top of the pier
  - the back of the pier
  - the front of the pier
88. Which one of the following tapes is generally used for work of the highest precision ?
- Linen tape
  - Metric woven metallic tape
  - Metric steel tape
  - Invar tape
89. A vertical circle which is at right angles to the meridian is also known as
- an altitude
  - a co-altitude
  - a prime vertical
  - an azimuth
90. Which one of the following is a staff reading taken on a point whose elevation is to be determined ?
- Fore sight
  - Back sight
  - Intermediate sight
  - Line of sight
91. Which one of the following is the source of error in curve computations and layout ?
- Ability to set on the plates of the theodolite, the required subdivision of a minute for the deflection angles.
  - Use of less than full tape-lengths on arc-definition curves.
  - Carrying out computed elevations to more than 10 mm.
  - Good intersections between tape line and site line on flat curves.
92. Photographic surveying is suitable for
- small-scale mapping of open hilly or mountainous countries
  - flat or wooded country
  - roads
  - transmission lines
93. What is the difference of longitude between two places C and D from the following longitudes ?
- Longitude of C =  $46^{\circ}$  W
  - Longitude of D =  $64^{\circ}$  W
- $18^{\circ}$
  - $36^{\circ}$
  - $110^{\circ}$
  - $220^{\circ}$

94. If the focal length of lens ( $f$ ), flying height ( $H$ ) and height of ground above mean sea level ( $h$ ) are known, then the scale at height 'h' ( $S_h$ ) is equal to
- $f/(H-h)$
  - $(H-h)/f$
  - $(h-H)/2f$
  - $2f/(h-H)$
95. The terrestrial photogrammetry can be divided into how many branches ?
- Four
  - Three
  - Two
  - Five
96. Which one of the following is an aerial photograph taken with the camera axis directed intentionally between the horizontal and the vertical ?
- Tilted photograph
  - Oblique photograph
  - Slanting photograph
  - Vertical photograph
97. A plate load test is carried out on submerged soil using a 300 mm radius rigid plate. A load of 5 Tons resulted in a deflection of 1.20 mm. What is the elastic modulus of the soil by considering the Poisson's ratio as 0.50 ?
- 5216 kPa
  - 521.6 GPa
  - 52.16 MPa
  - 52160 Pa
98. In case of horizontal curves in pavement, the purpose of super-elevation or banking of curves is to
- counteract the centripetal acceleration produced as a vehicle rounds a curve
  - provide proper cross-drainage
  - prevent vehicle from sliding inwards
  - make road look good
99. Which of the following are the design elements in highway embankments ?
- height
  - fill material
  - settlement
- Select the correct answer using the code given below :
- 1, 2 and 3
  - 1 and 3 only
  - 2 and 3 only
  - 1 and 2 only

**100.** Consider the following statements related to construction of bituminous pavements :

1. It is not possible to construct relatively thin bituminous pavement layers over an existing pavement.
2. In India, the bituminous construction is by and large adopted on the surface course.
3. The black top construction is in extensive use in developing nations.

Which of the above statements are correct ?

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

**101.** The held water in subgrade soil forms ice crystals at some spots if the freezing temperatures continue for a certain period. These ice crystals grow further in size if there is a continuous supply of water due to capillary action and the depressed temperature continues. This results in raising of portion of the pavement structure known as

- (a) Frost heave
- (b) Frost melting
- (c) Alternate freeze-thaw cycle
- (d) Frost action

**102.** Consider the following statements related to IRC recommendations for the CBR method of design (IRC : 37-1970) :

1. The CBR tests should be performed on remoulded soils on the field.
2. For the design of new roads, the subgrade soil sample should be compacted at OMC to proctor density.
3. In new constructions, the CBR test samples may be soaked in water for four days period before testing.

Which of the above statements are correct ?

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

**103.** Which one of the following measures should be taken for maintaining rolling stock ?

- (a) The different parts of rolling stock need not be cleaned every day.
- (b) All axles completed service life need not be replaced.
- (c) The parts of rolling stock which get worn out need not be replaced.
- (d) Lubrication of all the reciprocating parts and bearings with a suitable lubricant should be done.

**104.** Space-mean speed represents

- (a) the instantaneous speed of a vehicle at a specified section or location
- (b) the effective speed with which a vehicle traverses a particular route between two terminals
- (c) the average speed of vehicles in a certain road length at any time
- (d) the average of instantaneous speeds of observed vehicles at the spot

**105.** A vehicle has a wheel base of 6.5 m. What is the off tracking while negotiating a curved path with a mean radius 32 m ?

- (a) 1.32 m
- (b) 1.15 m
- (c) 0.86 m
- (d) 0.66 m

**106.** The Thickness design of pavement mainly depends on

- (a) the pavement materials
- (b) the climatic factors
- (c) the design wheel road
- (d) the subgrade soil

**107.** For traffic surveys using origin and destination studies, the most suitable method in case of heavy traffic and absence of skilled or trained personnel is

- (a) Road side interview method
- (b) License plate method
- (c) Work spot or home interview method
- (d) Return post card method

**108.** In traffic control, the speed at which vehicles are presumed to travel through the coordinated signal system is known as

- (a) Signal coordination
- (b) Speed of progression
- (c) Cycle
- (d) Through band

**109.** The pressure outside the droplet of water of diameter 0.04 mm is  $10.32 \text{ N/cm}^2$  (atmospheric pressure). What is the pressure within the droplet if surface tension is  $0.0725 \text{ N/m}$  of water ?

- (a)  $11.045 \text{ N/cm}^2$
- (b)  $10.32 \text{ N/cm}^2$
- (c)  $9.45 \text{ N/cm}^2$
- (d)  $8.595 \text{ N/cm}^2$

**110.** What is the viscosity of a liquid whose kinematic viscosity is 6 stokes and specific gravity is 1.90 ?

- (a) 1.14 poise
- (b) 11.40 poise
- (c)  $0.114 \text{ Ns/m}^2$
- (d)  $11.40 \text{ Ns/m}^2$

111. A 2 m wide tank contains water upto a height of 0.50 m above its base. An immiscible liquid of specific gravity 0.80 is filled on the top of the water upto 1 m height. What is the total pressure force on one side of the tank? (Take density of water as  $1000 \text{ kg/m}^3$  and  $g = 9.81 \text{ m/s}^2$ )
- (a) 7.85 kN  
 (b) 24.52 kN  
 (c) 10.3 kN  
 (d) 18.15 kN
112. A pipeline of uniformly varying cross section carries an oil of specific gravity 0.87. The diameter of pipe is 200 mm at end *A* and 500 mm at end *B*. The end *B* is located at 4 m higher than *A*. What is the loss of head in the pipeline if the pressure reading at *A* is  $9.81 \text{ N/cm}^2$  and at *B* is  $5.886 \text{ N/cm}^2$ ? (Take discharge is 200 litres/s and  $g = 9.81 \text{ m/s}^2$ )
- (a) 2.609 m  
 (b) 26.09 cm  
 (c) 2.109 m  
 (d) 21.09 cm
113. Air at standard conditions flows over a flat plate. The free stream speed is 3 m/s. What is the thickness of boundary layer at a distance of 1 m from the leading edge of the flat plate? (Take the kinematic viscosity of air is  $1.5 \times 10^{-5} \text{ m}^2/\text{s}$  and density is  $1.23 \text{ kg/m}^3$ )
- (a) 1.80 mm  
 (b) 1.80 cm  
 (c) 10.3 cm  
 (d) 10.3 mm
114. The water is flowing with a velocity of 1.5 m/s in a pipe of length 2500 m and diameter 500 mm. A valve is provided at the end of the pipe. What is the rise in pressure if the valve is closed in 25 seconds? (Take velocity of pressure wave is 1460 m/s)
- (a)  $15 \text{ N/cm}^2$   
 (b)  $1500 \text{ N/cm}^2$   
 (c)  $150 \text{ N/m}^2$   
 (d)  $15 \text{ kN/m}^2$
115. The depth of flow of a channel section at which the specific energy is minimum, is called
- (a) Critical velocity  
 (b) Critical depth  
 (c) Critical energy  
 (d) Subcritical flow
116. Which one of the following statements is correct with respect to Kaplan Turbine?
- (a) The peripheral velocity at inlet is more than peripheral velocity at outlet.  
 (b) Velocity of flow at inlet is more than velocity of flow at outlet.  
 (c) The peripheral velocity at inlet and outlet are equal.  
 (d) Velocity of flow at outlet is more than velocity of flow at inlet.

117. The speed of the generator can be maintained constant only if the speed of the turbine runner is constant equal to the one given by equation  $N = \frac{60f}{p}$

and it is known as

- (a) Synchronous speed
- (b) Asynchronous speed
- (c) Derived speed
- (d) Measured variable speed

118. Consider the following statements related to negative slip of the reciprocating pump :

1. The actual discharge of a reciprocating pump is more than the theoretical discharge.
2. The co-efficient of discharge will be more than unity.
3. When the suction pipe is short and delivery pipe is long and pump is running at slow speed, then negative slip of the pump occurs.

Which of the above statements are correct ?

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

119. A single acting reciprocating pump has a plunger of diameter 250 mm and stroke of 350 mm. If the speed of the pump is 60 rpm and it delivers 16.5 lit/sec of water against a suction head of 5 m and a delivery head of 20 m, what is the co-efficient of discharge ?

- (a) 0.72
- (b) 0.79
- (c) 0.86
- (d) 0.96

120. The stream function is given by the expression  $\psi = 2x^2 - y^2$ . What is the resultant velocity at a point denoted by  $x = 2$  and  $y = 3$  ?

- (a) 10
- (b) 12
- (c) 15
- (d) 18

121. A catchment has six rain gauge stations. In a year, the annual rainfall recorded by the gauges are as follows :

Station	A	B	C	D	E	F
Rainfall (cm)	82.6	102.9	180.3	110.3	98.8	136.7

For a 10% error in the estimation of the mean rainfall, what is the optimum number of stations in the catchment ? (Take  $\bar{P} = 118.6$ ,  $\sigma_{m-1} = 35.04$  and  $\epsilon = 10$ )

- (a) 10
- (b) 9
- (c) 8
- (d) 7

122. Which one of the following is defined as the process by which the water leaves a living plant during photosynthesis, through its leaves, to enter the atmosphere as water vapour ?

- (a) Transpiration
- (b) Evapotranspiration
- (c) Stomata
- (d) Evaporation

123. Which one of the following is a gap developed in the canal bank due to erosion of some portion of the bank ?

- (a) Canal breach
- (b) Sub canal
- (c) Temporary outlet used for irrigation
- (d) Fault

124. Which one of the following stages does the river bed consist of a mixture of boulders, gravels, shingles and alluvial sand deposits created by itself ?

- (a) Rocky stage
- (b) Incised river stage
- (c) Boulder river stage
- (d) Rivers in alluvial flood plains stage

125. Which of the following are the only two factors which govern the storage capacity of the reservoir ?

- (a) Inflow to reservoir and the outflow from the reservoir
- (b) Inflow and catchment area
- (c) Catchment area and outflow
- (d) Height of reservoir and catchment area

126. Formation of successive bends of reverse order may lead to the formation of a complete *S* curve called

- (a) Concave or outer edge
- (b) Scouring
- (c) Meander
- (d) Convex or inner edge

127. The monthly consumptive use values for paddy are tabulated below. What is average monthly consumptive use ?

Month	Dates	Rice (Loam Soil) $C_u$ in cm
June	1-30	29.69
July	1-12	
July	13-31	14.38
August	1-31	22.73
September	1-30	21.29
October	1-31	25.50
November	1-24	15.06

- (a) 7.7 cm
- (b) 23.1 cm
- (c) 26.69 cm
- (d) 137.41 cm

128. Water bearing stratum, having no confined impermeable over burden lying over it, is known as

- (a) An unconfined aquifer
- (b) An artesian aquifer
- (c) Confined aquifer
- (d) Controlled aquifer

129. The permeable groynes made from timber stakes or wooden piles, are called

- (a) Balli spurs
- (b) Tree spurs
- (c) Balli crates
- (d) Wire crates

130. A reservoir with uncontrolled and ungated outlets is known as

- (a) Retarding basin
- (b) Storage reservoir
- (c) Controlled reservoir
- (d) Detention basin

131. The distance between the outer edges of clockwise and anti-clockwise loops of the meander

- (a) Meander length
- (b) Meander belt
- (c) Meander ratio
- (d) Cross-overs

132. Which one of the following is the one which rests in a pervious stratum and draws its supply from the surrounding material ?

- (a) Sidetrack well
- (b) Horizontal well
- (c) Deep well
- (d) Shallow well

133. The various types of water demand, which a city may have, may be broken down into which of the following classes ?

1. Domestic water demand
2. Industrial water demand
3. Demand for public uses

Select the correct answer using the code given below :

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

134. In a big city having population of 50 lakhs, if 6 moderate fires each of 3 hours break out in a day, what is the approximate amount of water required per person per day ? (Assume 3 jet streams simultaneously throwing water from a hydrant with discharge of 1100 litres/minute/stream)

- (a) less than 1 litre
- (b) between 1–3 litres
- (c) between 3–5 litres
- (d) 20 litres



135. For water supply scheme design of a town or a city, the suitable method of estimating future population by the end of the design period is

- (a) increasing rate method
- (b) decreasing rate method
- (c) exponential curve method
- (d) incremental decrease method

136. Which one of the following is NOT a factor affecting losses and wastes in water supply scheme ?

- (a) Metering
- (b) Unauthorised connections
- (c) Water demand
- (d) Pressure in the distribution system

137. Which one of the following forecasting methods for population is also known as uniform increase method ?

- (a) Arithmetic increase method
- (b) Decreasing rate method
- (c) Geometric increase method
- (d) Simple geographical method

138. Storage capacity of a reservoir can be estimated by using

- (a) Cuboidal formula
- (b) Cylindrical formula
- (c) Prismoidal formula
- (d) Conical formula

139. Modern commercial turbidimeter which works on the principle of scattering of light at right angles to the incident light, is called

- (a) Spectrometer
- (b) Nephelometer
- (c) Optimeter
- (d) Lightmeter

140. Which one of the following is a disease caused by protozoal infections under water-borne diseases ?

- (a) Infectious hepatitis
- (b) Amoebic dysentery
- (c) Infectious jaundice
- (d) Poliomyelitis

141. Which of the following methods adopted for purifying the public water supplies ?

1. Screening
2. Sedimentation aided with coagulation
3. Disinfection

Select the correct answer using the code given below :

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

142. According to Stoke's law, if the diameter ( $d$ ) is less than 0.1 mm, then the settling velocity of spherical particles is directly proportional to

- (a)  $d^2$
- (b)  $d^3$
- (c)  $d$
- (d)  $d^{1/2}$

143. What is the settling velocity of a discrete particle in water under conditions when Reynold's number is less than 0.5 ? (Take the diameter and specific gravity of the particle are  $5 \times 10^{-3}$  cm and 2.65 respectively and Kinematic viscosity of water at  $20^\circ\text{C}$  is  $1.01 \times 10^{-2}$  cm<sup>2</sup>/s and  $g = 9.81$  m/s<sup>2</sup>)

- (a) 0.22 cm/s
- (b) 0.35 cm/s
- (c) 0.14 cm/s
- (d) 0.46 cm/s

144. The rate of filtration of pressure filter as compared to rapid gravity filter is about

- (a) 10 times
- (b) 15 times
- (c) 2 to 5 times
- (d) 6 to 8 times

**Directions :**

Each of the next Six (06) items consists of two statements, one labelled as the '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 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

145. Statement (I) : The stone should be well seasoned.

Statement(II) : The resistances of stone against the wear and tear due to natural agencies should be high.

146. Statement (I) : The tensile strength (or ultimate strength) is defined as the highest value of the engineering stress.

Statement(II) : For ductile materials, the tensile strength corresponds to the point at which necking starts.

147. Statement (I) : The use of slope deflection method is limited to structures which are not highly indeterminate.

Statement(II) : The slope deflection equations can be obtained by using the principle of superposition by considering separately the moments developed at each support due to each of the displacements, and then the loads.

148. Statement (I) : In the partial safety factor-based design format, the design capacity is defined by considering the corresponding partial safety factors.

Statement(II) : The partial safety factors are associated with the inherent and modeling uncertainties.

149. Statement (I) : The theory of reinforced concrete is developed with the assumption that there is perfect bond between steel and concrete, in other words, there is no slip.

Statement(II) : In case of ribbed bars, there is no need to check the bond failures.

150. Statement (I) : The boundary layer thickness decreases as the distance from the leading edge increases.

Statement(II) : Greater is the kinematic viscosity of the fluid greater is the boundary layer thickness.

**SPACE FOR ROUGH WORK**

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