

27/AE/C/M-2022-5

Booklet Series

Candidate's Roll Number

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**A**

Serial No.

102556

Question Booklet

Paper—V

**CIVIL ENGINEERING**

Time Allowed : 1 Hour

( Objective )

Maximum Marks : 100

Read the following instructions carefully before you begin to answer the questions.

**IMPORTANT INSTRUCTIONS**

1. This Question Booklet contains **50** questions in all.
2. **All** questions carry equal marks.
3. Attempt **all** questions.
4. **Immediately after commencement of the examination, you should check up your Question Booklet and ensure that the Question Booklet Series is printed on the top right-hand corner of the Booklet and the Booklet contains 12 printed pages and no page or question is missing or unprinted or torn or repeated. If you find any defect in this Booklet, get it replaced immediately by a complete Booklet of the same series.**
5. You must write your Roll Number in the space provided on the top of this page. Do not write anything else on the Question Booklet.
6. An Answer Sheet will be supplied to you separately by the Invigilator to mark the answers. **You must write your Name, Roll No. and other particulars on the first page of the Answer Sheet provided, failing which your Answer Sheet will not be evaluated.**
7. You will encode your **Roll Number** and the **Question Booklet Series A, B, C or D** as it is printed on the top right-hand corner of this Question Booklet with Black/Blue ballpoint pen in the space provided on **Page-2** of your Answer Sheet. **If you do not encode or fail to encode the correct series of your Question Booklet, your Answer Sheet will not be evaluated correctly.**
8. Questions and their responses are printed in English only in this Booklet. Each question comprises **four** responses—(A), (B), (C) and (D). You are to select **ONLY ONE** correct response and mark in your Answer Sheet. In case you feel that there are more than one correct response, mark the response which you consider the best. In any case, choose **ONLY ONE** response for each question. Your total marks will depend on the number of correct responses marked by you in the Answer Sheet.
9. In the Answer Sheet, there are **four** brackets—(A), (B), (C) and (D) against each question. To answer the questions you are to **mark with Black/Blue ballpoint pen ONLY ONE** bracket of your choice for each question. Select one response for each question in the Question Booklet and mark in the Answer Sheet. If you mark more than one answer for one question, the answer will be treated as wrong. **Any erasure or change is not allowed.**
10. You should not remove or tear off any sheet from the Question Booklet. You are not allowed to take this Question Booklet and the Answer Sheet out of the Examination Hall during the examination. **After the examination has concluded, you must hand over your Answer Sheet to the Invigilator.** Thereafter, you are permitted to take away the Question Booklet with you.
11. Failure to comply with any of the above instructions will render you liable to such action or penalty as the Commission may decide at their discretion.

SEAL

1. Which of the following is the cube size used for laboratory test on compressive strength of cement?
- (A) 150 mm  
(B) 100 mm  
(C) 70.6 mm  
(D) 200 mm
2. What is the loading rate used in compressive strength test?
- (A) 14 N/mm<sup>2</sup> per hour  
(B) 14 N/mm<sup>2</sup> per minute  
(C) 20 N/mm<sup>2</sup> per minute  
(D) 40 N/mm<sup>2</sup> per hour
3. What is the depth should the needle in Vicat apparatus penetrate into the cement paste in consistency test?
- (A) 33–35 mm from bottom of the mould  
(B) 33–35 mm from top of the mould  
(C) 33–35 cm from top of the mould  
(D) 33–35 cm from bottom of the mould
4. The minimum strength of brick required for building wall is
- (A) 7.5 N/mm<sup>2</sup>  
(B) 5.0 N/mm<sup>2</sup>  
(C) 3.5 N/mm<sup>2</sup>  
(D) 2.5 N/mm<sup>2</sup>
5. Gypsum is added during the manufacture of cement
- (A) while mixing the raw materials  
(B) during burning in the kiln  
(C) at the beginning of grinding the clinker  
(D) after grinding the clinker
6. Indian standard specifications for estimating tensile strength and modulus of elasticity of concrete, if the characteristic strength  $f_{ck}$  is known, are respectively
- (A)  $0.75\sqrt{f_{ck}}$  and  $7000\sqrt{f_{ck}}$   
(B)  $0.7\sqrt{f_{ck}}$  and  $5000\sqrt{f_{ck}}$   
(C)  $0.75f_{ck}$  and  $7000f_{ck}$   
(D)  $0.7f_{ck}$  and  $5000f_{ck}$

7. The absolute bending moment in a simply supported beam of span 10 m due to a moving load of 40 kN/m spanning over 5 m is

- (A) 375 kN-m at 2.5 m from end A
- (B) 375 kN-m at midpoint
- (C) 375 kN-m at 3.75 m from end A
- (D) 500 kN-m at mid-span

8. Four point loads 8 kN, 15 kN, 15 kN and 10 kN have centre-to-centre spacing of 2 m between consecutive loads and they traverse a girder of 30 m span from left to right with 10 kN load leading. The maximum shear force at 8 m from left support will be

- (A) 8.2 kN
- (B) 25.4 kN
- (C) 30.2 kN
- (D) 42.2 kN

9. Which structure is more stable?

- (A) Determinate
- (B) Indeterminate
- (C) Both (A) and (B)
- (D) None of the above

10. The strain energy of a structure due to bending is given by

- (A)  $2 \int \frac{M^2 dx}{EI}$
- (B)  $\frac{1}{3} \int \frac{M^2 dx}{EI}$
- (C)  $\frac{1}{2} \int \frac{M^2 dx}{EI}$
- (D)  $\int \frac{M^2 dx}{EI}$

11. Total distribution factor for a rigid joint is always

- (A) 1
- (B) 0.5
- (C) 1.5
- (D) 0

12. A beam carries a uniform distributed load through its length. In which of the following configurations will the strain energy be maximum?

- (A) Cantilever
- (B) Fixed
- (C) Simply supported
- (D) Propped cantilever

13. Which expression represents shape factor?

(A)  $\frac{(MOB)_p}{(MOB)_e}$

(B)  $\frac{Z_p}{Z_e}$

(C) Both (A) and (B)

(D) None of the above

14. The rotation at a point in a real beam is equal to \_\_\_\_\_ in a conjugate beam.

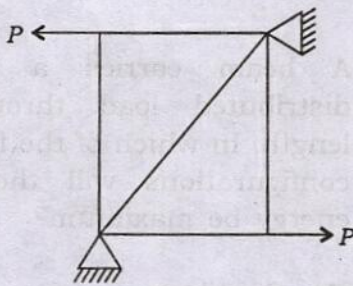
(A) translation

(B) twisting moment

(C) shear force

(D) bending moment

15. Calculate the number of zero force members for the following figure :



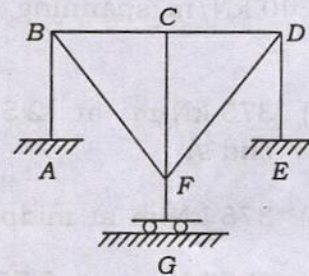
(A) 2

(B) 3

(C) 4

(D) 0

16. Calculate the degree of indeterminacy of the frame structure given in the figure :



(A) 12

(B) 9

(C) 10

(D) 8

17. In a continuous beam ABC, support A is fixed and supports B and C are simply supported. A uniformly distributed load of  $w$  per meter run is applied over the span AB and span BC is subjected to a point load  $W$  at mid-span. If the beam has uniform cross-section but differs in span lengths for AB and BC, the conditions to be used for the analysis of continuous beam by the slope deflection method are

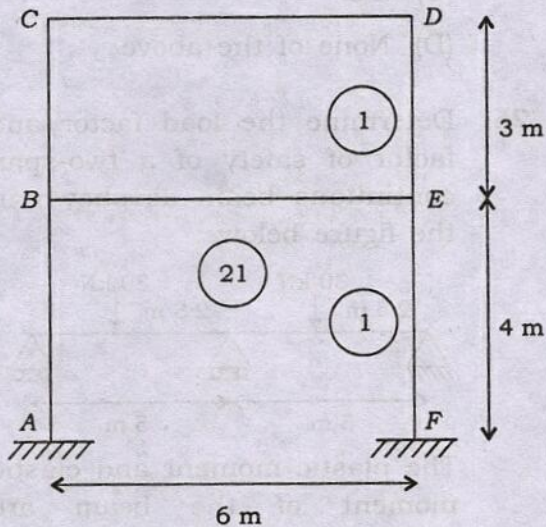
(A)  $\theta_A = 0, M_{BA} = M_{BC}, \theta_C = 0$

(B)  $\theta_A = 0, M_{BA} + M_{BC} = 0, \theta_C = 0$

(C)  $\theta_A = 0, M_{BA} + M_{BC} = 0, M_{CB} = 0$

(D)  $\theta_A = 0, M_{BA} = M_{BC}, M_{CB} = 0$

18. A frame to be analyzed by moment distribution as shown in the figure below :



The distribution factors for members  $EB$ ,  $ED$  and  $EF$  will be respectively

- (A)  $\frac{2}{9}, \frac{4}{9}, \frac{1}{3}$
- (B)  $\frac{8}{13}, \frac{3}{13}, \frac{4}{13}$
- (C)  $\frac{3}{10}, \frac{4}{10}, \frac{3}{10}$
- (D)  $\frac{4}{11}, \frac{4}{11}, \frac{3}{11}$

19. "If an internal stress component like shear force, bending moment or reaction component is allowed to act through a small distance thereby causing deformation of the structure, the curve of the deformed shape represents to some scale, the influence line diagram for that stress or the reaction component."

The above statement is known as

- (A) Macaulay's theorem
- (B) Müller-Breslau principle
- (C) Castigliano's theorem
- (D) Maxwell's theorem

20. An I section beam has the following dimensions :

Width of top flange = 250 mm  
Width of bottom flange = 400 mm

Thickness of both flanges = 50 mm

Width of web = 50 mm

Depth of web = 200 mm

The plastic neutral axis of the section from topmost fibre is at a distance of

- (A) 210 mm
- (B) 225 mm
- (C) 237.5 mm
- (D) 262.2 mm

21. "For a given structure and loading, if there exists any distribution of bending moment throughout the section which is both safe and statically admissible with a set of loads  $W$ , the value of  $W$  must be less than or equal to the collapse load  $W_C$ ."

The above theorem is known as

- (A) kinematic theorem  
 (B) static theorem  
 (C) uniqueness theorem  
 (D) None of the above
22. The moment which makes all the fibres at the section to yield is known as

- (A) flexural rigidity  
 (B) moment of resistance  
 (C) plastic moment capacity  
 (D) yield moment

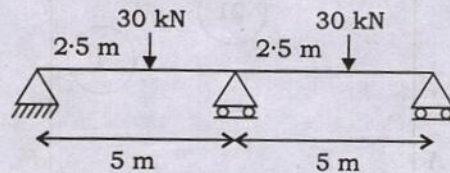
23. The stiffness matrix of a beam is given as  $K \begin{bmatrix} 12 & 4 \\ 4 & 5 \end{bmatrix}$ . Calculate the flexibility matrix.

- (A)  $K \begin{bmatrix} 12 & -4 \\ -4 & 5 \end{bmatrix}$   
 (B)  $K \begin{bmatrix} 5 & -4 \\ -4 & 12 \end{bmatrix}$   
 (C)  $\frac{1}{44K} \begin{bmatrix} 12 & -4 \\ -4 & 5 \end{bmatrix}$   
 (D)  $\frac{1}{44K} \begin{bmatrix} 5 & -4 \\ -4 & 12 \end{bmatrix}$

24. The shape factor of an I section is

- (A) 1.2  
 (B) 1.5  
 (C) 2.0  
 (D) None of the above

25. Determine the load factor and factor of safety of a two-span continuous beam as shown in the figure below :



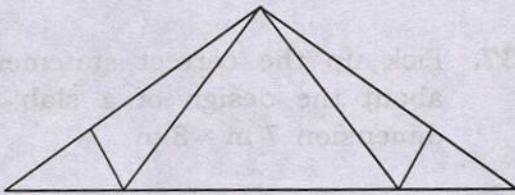
The plastic moment and elastic moment of the beam are 150 kN-m and 100 kN-m respectively.

- (A) 6.0 and 2.0  
 (B) 4.0 and 2.35  
 (C) 6.0 and 4.0  
 (D) 4.0 and 4.35
26. If  $t$  is the thickness of thinner plate in a bolted connection of tension member, pitch shall not be more than
- (A)  $16t$  or 200 mm whichever is less  
 (B)  $16t$  or 200 mm whichever is more  
 (C)  $12t$  or 150 mm whichever is less  
 (D)  $12t$  or 150 mm whichever is more

27. In a roof truss a member normally acting as tension member but occasionally subjected to compression due to wind load, slenderness ratio should not exceed

- (A) 150
- (B) 250
- (C) 350
- (D) 450

28. The truss shown in the figure below is known as



- (A) King post
- (B) Howe
- (C) Fink
- (D) Pratt

29. If standard deviation is  $4 \text{ N/mm}^2$ , the target mean strength of  $M_{20}$  concrete should be

- (A)  $16 \text{ N/mm}^2$
- (B)  $20 \text{ N/mm}^2$
- (C)  $24 \text{ N/mm}^2$
- (D)  $26.4 \text{ N/mm}^2$

30. IS 456 : 2000 considers concrete has reached its limit state of collapse when the strain is

- (A) 0.0015
- (B) 0.0020
- (C) 0.0030
- (D) 0.0035

31. The centroid of a compression block representing stress in concrete at limit state, the distance being measured from extreme compression edge is

- (A)  $0.36x_u$
- (B)  $0.42x_u$
- (C)  $0.48x_u$
- (D)  $0.53x_u$

where  $x_u$  = depth of compression cone.

32. Limiting value of depth of neutral axis in RC beam of depth  $d$  with Fe250 steel is

- (A)  $0.36d$
- (B)  $0.42d$
- (C)  $0.48d$
- (D)  $0.53d$



33. As per IS 456, in a column the maximum distance between two longitudinal bars should not be greater than

- (A) 200 mm
- (B) 300 mm
- (C) 250 mm
- (D) 350 mm

34. What is the effective length of the column when effectively restrained against translation at both the ends but restrained against rotation at one end only?

- (A)  $0.707L$
- (B)  $0.8L$
- (C)  $0.65L$
- (D)  $0.5L$

35. In an RC beam main reinforcement consists of 16 mm bars and coarse aggregate size used is 20 mm. The horizontal distance between two parallel reinforcing bars should not be less than

- (A) 16 mm
- (B) 20 mm
- (C) 21 mm
- (D) 25 mm

36. The maximum area of tensile reinforcement to be used in a beam is to be restricted to

- (A)  $0.04 \times$  gross area of the section
- (B)  $0.04 \times$  effective area of the section
- (C)  $0.057 \times$  gross area of the section
- (D)  $0.057 \times$  effective area of the section

37. Pick up the correct statement about the design of a slab of dimension 7 m  $\times$  3 m.

- (A) Main reinforcement will be in the direction 7 m and distribution reinforcement in 3 m.
- (B) Main reinforcement will be in 3 m direction and distribution in 7 m direction.
- (C) Provide main reinforcement in 7 m direction and there is no need of distribution steel.
- (D) Provide main reinforcement in 3 m direction and there is no need of distribution steel.

38. For a circular column of 200 mm radius, a circular footing of radius 1.25 m is provided. If the depth of footing is 600 mm and factored earth pressure is  $q_u$ , the design two-way shear will be

(A)  $1.5225pq_u$

(B)  $1.44pq_u$

(C)  $1.3125pq_u$

(D)  $0.9225pq_u$

39. Mortars used for brick masonry shall conform generally to

(A) IS 2116 : 1980

(B) IS 456 : 2000

(C) IS 1332 : 1982

(D) IS 2250 : 1981

40. Negative skin friction on piles is dominant in

(A) piles resting on hard sands

(B) friction piles in soft clays

(C) friction piles in sands

(D) friction per bearing piles

41. Higher density and a lower optimum water content is easily achieved by

(A) coarse grained soil

(B) fine grained soil

(C) cohesion-less soil

(D) saturated soil

42. Ratio of bearing capacity of double underreamed (UR) pile to that of single-reamed pile is nearly

(A) 2

(B) 1.5

(C) 1.2

(D) 1.7

43. Stokes' law is applicable to soil particles of size between

(A) 0.3 mm to 0.2 m

(B) 0.2 mm to 0.2 m

(C) 0.3 mm to 3 m

(D) 0.2 mm to 2 m

44. If consistency index is zero, it means that the soil

(A) is at plastic limit

(B) is at liquid limit

(C) behaves like liquid

(D) is stiff

45. Shear strength of soil increases with increase in

- (A) cohesion of soil
- (B) angle of internal friction
- (C) normal stress on soil
- (D) All of the above

46. In a tri-axial test when the drainage is allowed initially only and not during latter stage, the test is known as

- (A) consolidated drained test
- (B) consolidated undrained test
- (C) unconsolidated drained test
- (D) unconsolidated undrained test

47. The coefficient of active earth pressure for a dense sand is  $1/3$ . Then coefficient of passive earth pressure is

- (A)  $1/3$
- (B) 1
- (C) 3
- (D) None of the above

48. According to IS specifications in any case depth of foundation in sand and clay should not be less than \_\_\_\_ respectively.

- (A) 600 mm and 800 mm
- (B) 800 mm and 900 mm
- (C) 900 mm and 1000 mm
- (D) 1000 mm and 1200 mm

49. When width of foundation is 900 mm, the settlement is found to be 30 mm. Under the same condition, if width of footing is 600 mm, the settlement will be

- (A) 30 mm
- (B) 20 mm
- (C) 10 mm
- (D) None of the above

50. In plate load test preloading recommended by IS 1888 : 1982 is

- (A)  $70 \text{ gm/cm}^2$
- (B)  $100 \text{ gm/cm}^2$
- (C)  $120 \text{ gm/cm}^2$
- (D)  $125 \text{ gm/cm}^2$

SPACE FOR ROUGH WORK

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