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प्रश्नपुस्तिका क्रमांक
BOOKLET NO.

प्रश्नपुस्तिका-II

एकूण प्रश्न : 100

वेळ : 2 (दोन) तास

स्थापित्य अभियांत्रिकी पेपर-1

एकूण गुण : 200

सूचना

(1) सदर प्रश्नपुस्तिकेत 100 अनिवार्य प्रश्न आहेत. उमेदवारांनी प्रश्नांची उत्तरे लिहिण्यास सुरुवात करण्यापूर्वी या प्रश्नपुस्तिकेत सर्व प्रश्न आहेत किंवा नाहीत याची खात्री करून घ्यावी. असा तसेच अन्य काही दोष आढळल्यास ही प्रश्नपुस्तिका समवेक्षकांकडून लगेच बदलून घ्यावी.

(2) आपला परीक्षा-क्रमांक ह्या चौकोनात न विसरता बॉलपेनने लिहावा.

परीक्षा-क्रमांक										

केंद्राची संकेताक्षरे

शेवटचा अंक

- (3) वर छापलेला प्रश्नपुस्तिका क्रमांक तुमच्या उत्तरपत्रिकेवर विशिष्ट जागी उत्तरपत्रिकेवरील सूचनेप्रमाणे न विसरता नमूद करावा.
- (4) या प्रश्नपुस्तिकेतील प्रत्येक प्रश्नाला 4 पर्यायी उत्तरे सुचविली असून त्यांना 1, 2, 3 आणि 4 असे क्रमांक दिलेले आहेत. त्या चार उत्तरांपैकी सर्वात योग्य उत्तराचा क्रमांक उत्तरपत्रिकेवरील सूचनेप्रमाणे तुमच्या उत्तरपत्रिकेवर नमूद करावा. अशा प्रकारे उत्तरपत्रिकेवर उत्तरक्रमांक नमूद करताना तो संबंधित प्रश्नक्रमांकासमोर छायांकित करून दर्शविला जाईल याची काळजी घ्यावी. ह्याकरिता फक्त काळ्या शाईचे बॉलपेन वापरावे, पेन्सिल वा शाईचे पेन वापरू नये.
- (5) सर्व प्रश्नांना समान गुण आहेत. यास्तव सर्व प्रश्नांची उत्तरे द्यावीत. धाईमुळे चुका होणार नाहीत याची दक्षता घेऊनच शक्य तितक्या वेगाने प्रश्न सोडवावेत. क्रमाने प्रश्न सोडविणे श्रेयस्कर आहे पण एखादा प्रश्न कठीण वाटल्यास त्यावर वेळ न घालविता पुढील प्रश्नाकडे वळावे. अशा प्रकारे शेवटच्या प्रश्नापर्यंत पोहोचल्यानंतर वेळ शिल्लक राहिल्यास कठीण म्हणून वगळलेल्या प्रश्नांकडे परतणे सोईस्कर ठरेल.
- (6) उत्तरपत्रिकेत एकदा नमूद केलेले उत्तर खोडता येणार नाही. नमूद केलेले उत्तर खोडून नव्याने उत्तर दिल्यास ते तपासले जाणार नाही.
- (7) प्रस्तुत परीक्षेच्या उत्तरपत्रिकांचे मूल्यांकन करताना उमेदवारांच्या उत्तरपत्रिकेतील योग्य उत्तरांनाच गुण दिले जातील. तसेच "उमेदवारांना वस्तुनिष्ठ बहुपर्यायी स्वरूपाच्या प्रश्नांची दिलेल्या चार पर्यायांपैकी सर्वात योग्य उत्तरेच उत्तरपत्रिकेत नमूद करावीत. अन्यथा त्यांच्या उत्तरपत्रिकेत सोडविलेल्या प्रत्येक चार चुकीच्या उत्तरांसाठी एका प्रश्नाचे गुण वजा करण्यात येतील".

ताकीद

ह्या प्रश्नपत्रिकेसाठी आयोगाने विहित केलेली वेळ संपेपर्यंत ही प्रश्नपुस्तिका आयोगाची मालमत्ता असून ती परीक्षाकक्षात उमेदवारांला परीक्षेसाठी वापरण्यास देण्यात येत आहे. ही वेळ संपेपर्यंत सदर प्रश्नपुस्तिकेची प्रत/प्रती, किंवा सदर प्रश्नपुस्तिकेतील काही आशय कोणत्याही स्वरूपात प्रत्यक्ष वा अप्रत्यक्षपणे कोणत्याही व्यक्तीस पुरविणे, तसेच प्रसिद्ध करणे हा गुन्हा असून अशी कृती करणाऱ्या व्यक्तीवर शासनाने जारी केलेल्या "परीक्षांमध्ये होणाऱ्या गैरप्रकारांना प्रतिबंध करण्याबाबतचा अधिनियम-82" यातील तरतुदीनुसार तसेच प्रचलित कायद्याच्या तरतुदीनुसार कारवाई करण्यात येईल व दोषी व्यक्ती कमाल एक वर्षाच्या कारावासाच्या आणि/किंवा रुपये एक हजार रकमेच्या दंडाच्या शिक्षेस पात्र होईल. तसेच ह्या प्रश्नपत्रिकेसाठी विहित केलेली वेळ संपण्याआधी ही प्रश्नपुस्तिका अनधिकृतपणे बाळगणे हा सुद्धा गुन्हा असून तसे करणारी व्यक्ती आयोगाच्या कर्मचारीवृंदापैकी, तसेच परीक्षेच्या पर्यवेक्षकीयवृंदापैकी असली तरीही अशा व्यक्तीविरुद्ध उक्त अधिनियमानुसार कारवाई करण्यात येईल व दोषी व्यक्ती शिक्षेस पात्र होईल.

पुढील सूचना प्रश्नपुस्तिकेच्या अंतिम पृष्ठावर पहा

पर्यवेक्षकांच्या सूचनेविना हे सील उघडू नये

1. Which of the following is not a test for measuring workability of concrete ?
(1) Slump Test (2) Flow Test
(3) Std. Consistency Test (4) Kelly Ball Test
-
2. The stone whose crushing strength is maximum, is :
(1) granite (2) chalk (3) slate (4) marble
-
3. As per the Building Byelaws, how much should be the marginal distance that is to be left in the front ?
(1) At least 3 m (2) At least 5 m
(3) More than 5 m (4) More than 10 m
-
4. Generally at what rate should slip form be lifted ?
(1) 1 m per hour (2) 5 - 10 cm per hour
(3) 20 - 30 cm per hour (4) 50 - 60 cm per hour
-
5. What is a Mullion in a window shutter ?
(1) Vertical member running through shutter of window.
(2) Horizontal member of shutter.
(3) Inclined battening.
(4) None of the above
-
6. How much is the covering capacity of cement paint ?
(1) About 18 m²/kg per coat (2) About 20 m²/kg per coat
(3) About 12 m²/kg per coat (4) About 4 m²/kg per coat
-
7. As per IS specifications, the heat of hydration of low-heat portland cement for 28 days is :
(1) Not more than 100 calories/gm (2) Not more than 50 calories/gm
(3) Not more than 75 calories/gm (4) Not more than 150 calories/gm
-

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8. Which of the following is not a principle of _____ planning ?

- (1) Aspect (2) Floor Area Ratio
(3) Roominess (4) Prospect

9. To what, is Ease related in concrete technology ?

- (1) Geology of fresh concrete (2) Rheology of fresh concrete
(3) Mineralogy of fresh concrete (4) Ecology of fresh concrete

10. What does not fit into the classification of pile based on function ?

- (1) Bearing pile (2) Friction pile
(3) Compaction pile (4) Steel pile

11. Acceptable noise level in dB for auditorium is :

- (1) 25 to 30 (2) 40 to 45 (3) 35 to 40 (4) 45 to 55

12. Cavity or hollow space in a wall is provided for :

- (a) Prevention of dampness (b) Heat insulation
(c) Sound insulation (d) Efflorescence

Answer options :

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

13. If a solid shaft is subjected to a torque (T) at its end such that maximum shear stress does not exceed f_s , the diameter of the shaft will be :

- (1) $\frac{16 T}{\pi f_s}$ (2) $\left(\frac{16 T}{\pi f_s}\right)^{\frac{1}{2}}$ (3) $\left(\frac{16 T}{\pi f_s}\right)^{\frac{1}{3}}$ (4) None of these

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14. Maximum deflection of a cantilever due to pure moment 'M' at its free end, is :

- (1) $\frac{ML^2}{3EI}$ (2) $\frac{ML^2}{4EI}$ (3) $\frac{ML^2}{2EI}$ (4) $\frac{ML^2}{6EI}$

15. If the load on a column is increased to a value that on its removal the deflection remains, the load is known as :

- (1) Critical load (2) Crippling load (3) Buckling load (4) All of these

16. Magnitude of shear stress induced in a shaft due to applied torque varies from :

- (1) Maximum at centre to zero at circumference
 (2) Maximum at centre to minimum (Not Zero) at the circumference
 (3) Zero at centre to maximum at circumference
 (4) Minimum (Not Zero) at centre to maximum at circumference

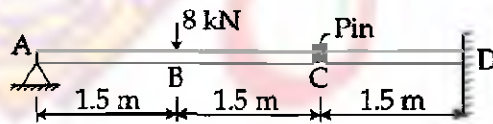
17. The ratio of the flexural strengths of two beams of square cross section, the first beam being placed with its top and bottom sides horizontally and second beam being placed with one diagonal horizontally, is :

- (1) $\sqrt{3}$ (2) $\frac{1}{\sqrt{3}}$ (3) $\frac{1}{\sqrt{2}}$ (4) $\sqrt{2}$

18. In an experiment it is found that the bulk modulus of a material is equal to its shear modulus then the Poisson's ratio is :

- (1) 0.125 (2) 0.250 (3) 0.375 (4) 0.500

19. The beam AC simply supported at A and at C is pinned to a cantilever beam CD as shown in figure. Both beams have identical flexural rigidities EI. The vertical load of 8 kN acts at point B. The deflection of point B is :



- (1) $\frac{2.25}{EI}$ (2) $\frac{4.5}{EI}$ (3) $\frac{6.75}{EI}$ (4) $\frac{8}{EI}$

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20. What is true if the areas of cross-section of square and circular beams, subjected to equal bending moments are the same ?

- (1) circular beam is more economical
- (2) square beam is more economical
- (3) both the beams are equally strong
- (4) both the beams are equally economical

21. Two rods of different materials having coefficient of linear expansion α_1, α_2 and Young's moduli E_1, E_2 respectively are fixed between two massive walls. The rods are heated such that they undergo the same increase in temperature. There is no bending of the rods. If $\alpha_1 : \alpha_2 = 2 : 3$, the thermal stresses are equal, what is the ratio of E_1 to E_2 ?

- (1) 2 : 3
- (2) 1 : 1
- (3) 3 : 2
- (4) 4 : 9

22. The phenomenon of slow growth of strain under a steady stress is called :

- (1) yielding
- (2) creeping
- (3) breaking
- (4) none of the above

23. A rectangular timber beam ($b \times d$) is cut out of a cylindrical log of diameter 'D'. The width (b) of the strongest timber beam will be :

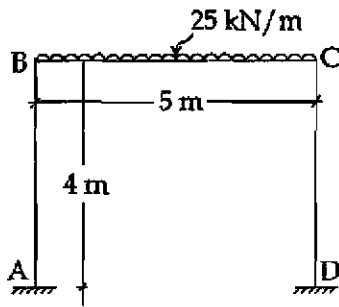
- (1) $\sqrt{3} D$
- (2) $\frac{D}{\sqrt{3}}$
- (3) $\sqrt{2} D$
- (4) $\frac{D}{\sqrt{2}}$

24. A rigid frame detailed to provide good ductility and support for both lateral and gravity loads by flexural action is called .

- (1) Ordinary moment resisting frame
- (2) Intermediate moment resisting frame
- (3) Special moment resisting frame
- (4) All of the above

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25. A fixed base symmetrical frame is shown in the figure write slope deflection equation for moment at B for member AB :



- (1) $M_{BA} = 0.5 EI \theta_B$ (2) $M_{BA} = EI \theta_B$
 (3) $M_{BA} = 0.5 EI \theta_A$ (4) $M_{BA} = EI \theta_A$

26. A propped cantilever is subjected to a concentrated load of 16 kN at the centre of the span. The length of beam is 4 m. The flexural rigidity $EI = 4 \times 10^2 \text{ kNm}^2$. The reactions at the fixed end and simply supported end are :

- (1) 9.87 kN at fixed end and 6.13 kN at simply supported end
 (2) 8 kN each at fixed end and simply supported end
 (3) 11 kN at fixed end and 5 kN at simply supported end
 (4) 16 kN at fixed end and zero kN at simply supported end

27. Fill in the blanks :

The primary unknowns in slope deflection methods are _____ and obtained by solving _____ equations.

- (1) rotational and translational displacements, joint force equilibrium
 (2) moment and forces, compatibility
 (3) stiffness and flexibility, differential
 (4) none of the above

28. A rigid jointed frame with three bays and two stories has two fixed column supports and two hinged. The degree of static indeterminacy of structure is :

- (1) 25 (2) 27 (3) 18 (4) 16

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29. Three prismatic members AB, BC and BD meet at a joint for a rigid frame to be analysed using moment distribution method. The distribution factors for members AB and BC are 0.5 and 0.3 respectively. The distribution factor for member BD shall be :

- (1) 0.2 (2) 1.67 (3) 0.6 (4) 0.15

30. A propped cantilever of span 'L' fixed at A and simply supported at B is subjected to concentrated load 'W' at centre, reaction at B :

- (1) $\frac{3}{16} W$ (2) $\frac{W}{4}$ (3) $\frac{5}{16} W$ (4) $\frac{7}{16} W$

31. A rigid frame ABCD with vertical members AB and CD is pinned at A and roller supported at 'D'. Horizontal member BC is loaded with vertical point load of 90 kN at the centre of

BC. $AB = BC = CD = 3$ m. If support A rotates by $\frac{1}{300}$ rad. and also sinks downward by 30 mm. The reactions at A and D :

- (1) shall be affected due to rotation and sinking
 (2) shall not be affected due to rotation and sinking
 (3) reaction at A shall change but reaction at B shall not change due to rotation and sinking
 (4) none of the above

32. A moment 'K' required to rotate near end of a prismatic beam through a unit angle without translation, the far end being freely supported is given by :

- (1) $K = \frac{3EI}{L}$ (2) $K = \frac{4EI}{L}$ (3) $K = \frac{EI}{L}$ (4) $K = \frac{L}{EI}$

33. A truss deflection is to be calculated for a point 'X' using unit load method. Find the contribution to deflection by a truss member having details as below

Length = 8.00 m Area = $11.25 \times 10^{-3} \text{ m}^2$

Internal force resisted by member under actual loading condition = 450 kN (compression)
 modulus of elasticity = $200 \times 10^6 \text{ kN/m}^2$

Internal force after unit load application = 0.0 kN

- (1) -0.5 mm (2) +0.5 mm (3) -1.6 mm (4) Zero

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34. A continuous beam ABCD has end A as fixed and support B and C are simple supports while end D is free. The fixed end moments for beam AB are $FEM_{AB} = -19.2$ kNm and $FEM_{BA} = 28.8$ kNm. The moment equation for slope deflection method for beam AB can be written as :

$$(1) \quad M_{ab} = \frac{2 EI}{L} (\theta_A + \theta_B) + 28.8$$

$$M_{ba} = \frac{2 EI}{L} (\theta_A + 2\theta_B) - 19.2$$

$$(2) \quad M_{ab} = \frac{2 EI}{L} (\theta_A) - 19.2$$

$$M_{ba} = \frac{4 EI}{L} (\theta_A) + 28.8$$

$$(3) \quad M_{ab} = \frac{4 EI}{L} (\theta_A) - 19.2$$

$$M_{ba} = \frac{2 EI}{L} (\theta_A) + 28.8$$

$$(4) \quad M_{ab} = \frac{2 EI}{L} (\theta_B) - 19.2$$

$$M_{ba} = \frac{4 EI}{L} (\theta_B) + 28.8$$

35. The degree of static indeterminacy of pin-jointed space frame is given by :

$$(1) \quad m+r-2j \quad (2) \quad m+r-3j \quad (3) \quad 3m+r-3j \quad (4) \quad m+r+3j$$

Where 'm' = the number of unknown member forces

'r' = unknown reaction components and

'j' = the number of joints.

36. If load system applied on the arch is entirely vertical the horizontal thrust at each of the supports must be :

$$(1) \quad \text{Same} \quad (2) \quad \text{Different}$$

$$(3) \quad \text{Zero} \quad (4) \quad \text{None of the above}$$

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37. If k_i is the stiffness of i^{th} member at a joint, the distribution factor for the member is :

- (1) k_i (2) $\frac{k_i}{\sum k_i}$ (3) $\sum k_i$ (4) $(\sum k_i - k_i)$

38. The Kinematic Indeterminacy of a frame as shown is :



- (1) $KI=1$ (2) $KI=2$ (3) $KI=3$ (4) $KI=5$

39. A rigid frame ABCD has AB member as overhang, with end 'A' being free. Supports C and D are fixed. DB is vertical member and BC is horizontal member. $DB=BC=5$ m. If the moment equations are given by :

$$M_{DB} = 0.4 EI \theta_B \quad M_{BD} = 0.8 EI \theta_B$$

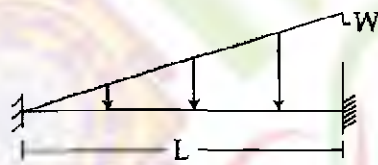
$$M_{BA} = 54 \quad M_{BC} = -135 + 1.6 EI \theta_B$$

$$M_{CB} = 135 + 1.6 EI \theta_B \text{ then}$$

θ_B rotation at B is given by :

- (1) $\frac{-112.5}{EI}$ (2) $\frac{33.75}{EI}$
- (3) Zero (4) None of the above

40. The fixed end moment for the beam loaded is :



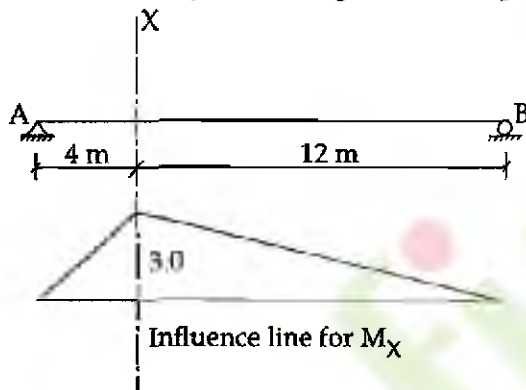
- (1) $-\frac{WL^2}{10}$ and $+\frac{WL^2}{20}$ (2) $-\frac{WL^2}{30}$ and $+\frac{WL^2}{20}$
- (3) $+\frac{WL^2}{20}$ and $-\frac{WL^2}{30}$ (4) $-\frac{WL^2}{15}$ and $-\frac{WL^2}{15}$

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41. If unit load moves from left to right on S.S. beam the nature of ILD for reaction is :
- (1) Parabolic (2) Hyperbolic
(3) Horizontal Straight Line (4) Inclined Straight Line

42. A portal frame consisting of three members is pinned at both the supports. All the members have same value of EI. The frame has height of 3 m and width of 4 m. It is subjected to horizontal load at top beam level of $P = 10$ kN in the plane of frame. Calculate maximum moment in the frame using approximate method or otherwise :
- (1) 15 kNm (2) 10 kNm (3) 30 kNm (4) 7.5 kNm

43. The influence line for bending moment at section X (M_X) at a distance of 4 m from the left support of a simply supported girder AB is shown in figure below. A uniformly distributed load of intensity 2 t/m longer than the span crosses the girder from left to right.



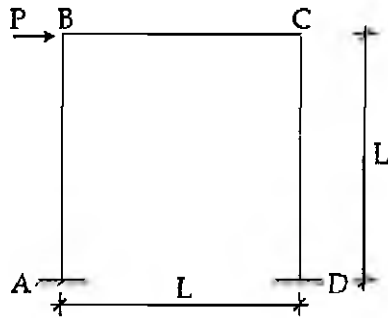
The max bending moment at section X is equal to :

- (1) 12 tm (2) 24 tm (3) 48 tm (4) 96 tm
44. A continuous beam has AB as one of the spans. It is subjected to fixed end moments at end A and B as FEM_A and FEM_B respectively under given loads. It has length 'L' and flexural rigidity EI. It rotates at end A and B by θ_A and θ_B respectively. The member axis rotates through clockwise angle $R = \frac{\Delta}{L}$. The moment at end A is given by :
- (1) $M_A = FEM_B + \frac{4EI}{L} (2\theta_A + \theta_B - 3R)$
 (2) $M_A = FEM_A + \frac{2EI}{L} (2\theta_A + \theta_B - 3R)$
 (3) $M_A = FEM_A + \frac{4EI}{L} (2\theta_A + \theta_B + 3R)$
 (4) None of the above

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45. What is the shear equation in slope deflection method for the portal frame shown below ?



(1) $\frac{M_{AB} + M_{BA}}{L} + \frac{M_{CD} + M_{DC}}{L} + P = 0$

(2) $\frac{M_{AB} + M_{BA}}{L} + \frac{M_{BC} + M_{CB}}{L} + P = 0$

(3) $\frac{M_{BC} + M_{CB}}{L} + \frac{M_{CD} + M_{DC}}{L} + P = 0$

(4) $\frac{M_{BC} + M_{CB}}{L} + P = 0$

46. A bolt is subjected to a shear stress of f_{sb} and a tensile stress of f_{tb} . If the permissible stresses in shear and tension are f_{asb} and f_{atb} respectively then the stress should satisfy .

(1) $\frac{f_{sb}}{f_{asb}} + \frac{f_{tb}}{f_{atb}} \leq 1.0$

(2) $\left(\frac{f_{sb}}{f_{asb}}\right)^{1.4} + \left(\frac{f_{tb}}{f_{atb}}\right)^{1.4} \leq 1.0$

(3) $\frac{f_{sb}}{f_{asb}} + \frac{f_{tb}}{f_{atb}} \leq 1.4$

(4) $\left(\frac{f_{sb}}{f_{asb}}\right)^2 + \left(\frac{f_{tb}}{f_{atb}}\right)^2 \leq 1.0$

47. The failure of a column depends upon :

(1) weight of a column

(2) length of column

(3) slenderness ratio

(4) cross sectional area of column

कच्चा कामासाठी जागा /SPACE FOR ROUGH WORK

48. In which form is the permissible stress in columns, f by Merchant - Rankine's formula ?

$$(1) f \propto \frac{\pi^2 E}{\lambda^2}$$

$$(2) f \propto \frac{f_y}{1 + 0.2 \sec(c \cdot \lambda \cdot \sqrt{f})}$$

$$(3) \frac{1}{(f)^n} \propto \frac{1}{(f_y)^n} + \frac{1}{(f_{cr})^n}$$

$$(4) f \propto \frac{f_y}{\phi + \sqrt{\phi^2 - \lambda^2}}$$

49. The partial safety factors for dead load and leading live load in calculation of vertical deflection in a steel beam are :

- (1) 1.0 and 1.0 (2) 1.0 and 1.2 (3) 1.2 and 1.0 (4) 1.2 and 1.2

50. A square base plate of $1200 \text{ mm} \times 1200 \text{ mm}$ is provided under a column 15 MB 400, which is carrying an axial force of 1440 kN along with bending moments of 288 kNm and 144 kNm about its Major and Minor axes respectively.

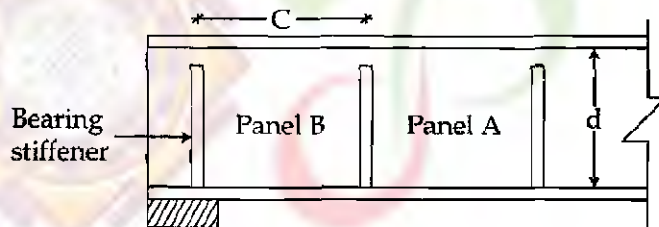
The maximum pressure (neglecting poisson's effect) any where on the base plate is :

- (1) 2.5 N/mm^2 (2) 2.6 N/mm^2 (3) 2.75 N/mm^2 (4) 3.0 N/mm^2

51. The effective throat thickness of a fillet weld depends upon :

- (1) angle between fusion faces (2) length of weld
(3) permissible shear stress (4) type of weld

52. For plate girder shown in figure below by using what action is panel A designed ?



- (1) Simple post critical action (2) Tension field action
(3) Bearing force action (4) None of the above

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P.T.O.

53. The maximum permissible vertical deflection of a simply supported beam in non industrial buildings if the element is susceptible for cracking is :

- (1) span/360 (2) span/350 (3) span/325 (4) span/300

54. Which of the options given below are true about how the commonly used structural steels are made ?

- (a) Very low carbon steels, < 0.1%
(b) Low carbon steel 0.1 to 0.25%
(c) Medium carbon steel 0.25 to 0.6%
(d) High carbon steel 0.6 to 1.1%

Answer options :

- (1) (a) is true (2) (a) and (b) are true
(3) (a), (b) and (c) are true (4) All are true

55. Effective length of groove welds in case of butt joint is equal to :

- (1) length of continuous full size weld.
(2) overall length of weld minus twice the size of weld.
(3) overall length of weld minus four times the size of weld.
(4) overall length of weld plus twice the size of weld.

56. For economical spacing of roof truss, if t , p and r are the costs of truss, purlin and roof covering respectively then :

- (1) $t = p + r$ (2) $t = 2p + r$ (3) $t = p + 3r$ (4) $t = p + 2r$

57. Which statement is correct if splices are provided in the reinforcing bars ?

- (1) Lap splices shall not be used for bars larger than 30 mm diameter.
(2) For flexure tension ; Lap length = L_d or 30ϕ whichever is greater.
(3) For direct tension ; Lap length = $2 L_d$ or 24ϕ whichever is greater.
(4) For compression members ; Lap length = L_d or 30ϕ whichever is greater.

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58. Dead weight of waist slab of a stair case spanning longitudinally is calculated as :

(1) $25 D \sqrt{1 + \left(\frac{R}{T}\right)^2}$

(2) $25 d \sqrt{1 + \left(\frac{R}{T}\right)^2}$

(3) $25 D \sqrt{1 + \left(\frac{T}{R}\right)^2}$

(4) $25 d \sqrt{1 + \left(\frac{T}{R}\right)^2}$

59. In the design of cantilever retaining wall, if the angle of repose (ϕ) is 30° then the relation between active earth pressure (K_a) and passive earth pressure (K_p) will be :

(1) $K_a = \frac{1}{3} K_p$

(2) $K_a = 3 K_p$

(3) $K_a = \frac{1}{9} K_p$

(4) $K_a = 9 K_p$

60. A continuous beam shall be deemed to be deep beam when, the ratio of effective span to overall depth is less than :

(1) 2.0

(2) 2.5

(3) 1.5

(4) 1.0

61. If a circular water tank resting on the ground has 275 mm thickness then for M-25 grade concrete and Fe 415 steel, the minimum percentage of area of steel (A_{st}) provided is :

(1) (0.12%) bT

(2) (0.16%) bT

(3) (0.20%) bT

(4) (0.24%) bT

62. Substitute frame method is used to analyse the building frame if the frame is subjected to _____

(1) Lateral loads due to wind

(2) Lateral loads due to earthquake

(3) Vertical live load only

(4) Vertical dead load and live loads

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63. Minimum depth of foundation calculated by Rankine's formula for the design of retaining wall is _____.

Where, q_0 = safe bearing capacity of soil

γ = Density of soil,

ϕ = Angle of repose

(1) $\frac{\gamma}{q_0} \left(\frac{1 - \sin \phi}{1 + \sin \phi} \right)^2$

(2) $\frac{q_0}{\gamma} \left(\frac{1 - \sin \phi}{1 + \sin \phi} \right)^2$

(3) $\frac{\gamma}{q_0} \left(\frac{1 + \sin \phi}{1 - \sin \phi} \right)^2$

(4) $\frac{q_0}{\gamma} \left(\frac{1 + \sin \phi}{1 - \sin \phi} \right)^2$

64. If 'L' is the length of cantilever slab measured parallel to the fixed edge, the effective width of the cantilever slab shall not exceed : (For slabs carrying concentrated load)

(1) $\frac{L}{3}$

(2) $\frac{2L}{3}$

(3) $\frac{L}{2}$

(4) $\frac{3L}{2}$

65. In singly reinforced sections, when the section is under-reinforced, the relation between depth of neutral axis (x_u) and the limiting value of depth of neutral axis ($x_{u, \max}$) is :

(1) $x_u = x_{u, \max}$

(2) $x_u < x_{u, \max}$

(3) $x_u > x_{u, \max}$

(4) none of the above

66. Maximum reinforcement provided in a beam section shall not exceed _____.

(1) $\frac{0.85}{f_y} (bd)$

(2) $\frac{0.87}{f_y} (bd)$

(3) $0.04 (bd)$

(4) $0.04 (bD)$

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67. Match the minimum number of longitudinal steel bars required in columns as per cross section of column :

- | | |
|------------------------|---------|
| (a) Rectangular column | (i) 4 |
| (b) Circular column | (ii) 5 |
| (c) Octagonal column | (iii) 6 |
| | (iv) 8 |

Answer options :

- | | | | |
|-----|-------|-------|-------|
| | (a) | (b) | (c) |
| (1) | (i) | (ii) | (iii) |
| (2) | (i) | (iii) | (iv) |
| (3) | (iv) | (iii) | (i) |
| (4) | (iii) | (i) | (iv) |

68. A post tensioned prestressed concrete beam is tensioned successively by 4 cables of equal area and equal stress. The percentage loss in each cable is found to be 6%, 4%, 2% and 0% respectively. What will be the total percentage loss in prestressing force ?

- | | | | |
|---------|--------|--------|--------|
| (1) 12% | (2) 4% | (3) 3% | (4) 6% |
|---------|--------|--------|--------|

69. In case of curved ducts, the loss of prestress depends upon the radius of curvature (R) of the duct and the coefficient of friction (μ) between duct surface and the tendon. The tension at any point of the cable distance 'x' from the end is given by _____

- | | | | |
|--------------------------------|----------------------|------------------------|--------------------------------|
| (1) $P_0 e^{-\frac{\mu x}{R}}$ | (2) $P_0 e^{-\mu R}$ | (3) $P_0 R e^{-\mu x}$ | (4) $P_0 e^{-\frac{\mu R}{x}}$ |
|--------------------------------|----------------------|------------------------|--------------------------------|

70. The time dependent inelastic deformation of steel resulting from sustained stress and a function thereof is known as _____

- | | | | |
|---------------|-----------|-----------------|----------------|
| (1) Shrinkage | (2) Creep | (3) Deformation | (4) Relaxation |
|---------------|-----------|-----------------|----------------|

71. In post-tensioned elements, the zone within which the applied prestressing force on steel is fully dissipated into concrete and made to act as a distributed force is known as _____

- | | |
|-----------------------|--------------------|
| (1) Transmission zone | (2) Anchor zone |
| (3) Distribution zone | (4) End block zone |

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72. A simply supported prestressed concrete beam of span 10 m and subjected to U.D.L. of 30 kN/m (inclusive of self weight). A prestressing force of 1500 kN is applied through a parabolic cable having zero eccentricity at both ends and maximum value (h) at centre of span then what will be the dip (h) if load balancing concept is applied ?

- (1) 250 mm (2) 100 mm (3) 50 mm (4) 25 mm

73. Prestressed concrete members which are designed to allow significant tensile stresses to occur at service loads and such tensile regions are usually additionally reinforced with non-prestressed reinforcement are known as _____.

- (1) Prestressing tension members (2) Fully prestressing members
(3) Non-prestressing members (4) Partial prestressing members

74. A simply supported prestressed concrete beam of 300×500 mm in c/s is subjected to a superimposed load of 20 kN/m over a span of 10 m. If a prestressing force of 1000 kN is applied through a straight tendon located along centroidal axis then what is the extreme top fibre stress at the end support :

- (1) 20 mPa (2) 26.67 mPa (3) 19.33 mPa (4) 6.67 mPa

75. Which statement is not applicable to prestressed concrete members ?

- (1) It combines high strength concrete with high strength steel in an active manner.
(2) High tension steel wires are used to transfer tensile stresses to concrete section.
(3) Prestressing the steel against the concrete to counter balance any tensile stress produced by dead load and live load.
(4) Load balancing concept enables the transformation of a flexure member into a member under direct stress.

76. For the production of pre-tensioned members on large scale, a system usually adopted is _____.

- (1) Gifford Udall System (2) Magnel Blaton System
(3) Hoyer System (4) P.S.C. Monowire System

77. When the tendons are placed at an eccentricity of e, the extreme fibre stresses in beam are :

- (1) $\frac{P}{A} \mp \frac{Pe}{Z} \pm \frac{M}{Z}$ (2) $\frac{P}{A} \mp \frac{Pe}{A} \pm \frac{M}{Z}$
(3) $\frac{P}{Z} \mp \frac{Pe}{Z} \pm \frac{M}{Z}$ (4) $\frac{P}{A} \mp \frac{Pe}{A} \pm \frac{M}{A}$

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78. In simply supported prestressed concrete beams with uniformly distributed loads over its entire span.

Statement 1 : The size of limiting zone is maximum at supports and reduces towards the midspan.

Statement 2 : The Bending moments due to uniformly distributed loads in a simply supported beam are zero at supports and maximum at midspan.

- (1) Statement 1 is true, statement 2 is true and statement 2 is the correct explanation of statement 1.
- (2) Statement 1 is true, statement 2 is true but statement 2 is not the correct explanation of statement 1.
- (3) Statement 1 is true and statement 2 is false.
- (4) Statement 1 is false and statement 2 is true.

79. The 'Force - Majeure' clause in a contract document generally refers to :

- (1) Agitation and strikes only
- (2) Epidemic of large proportion only
- (3) (1) and (2) above
- (4) None of the above

80. Injury frequency rate per lakh of man-hours worked is calculated as :

- (1) $\frac{\text{No. of days lost} \times 1,00,000}{\text{No. of man-hours worked}}$
- (2) $\frac{\text{No. of disabling injuries} \times 1,00,000}{\text{Total No. of man - hours worked}}$
- (3) $\frac{\text{Injury frequency rate} \times \text{Injury service rate}}{1000}$
- (4) $\frac{\text{No. of disabling injuries}}{\text{Total No. of man - hours worked}} \times 100$

81. Which of the following is not a type of fire extinguisher ?

- (1) Water type extinguishers
- (2) Foam type extinguishers
- (3) Dry chemical powder extinguishers
- (4) Nitrogen extinguishers

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82. Decrease or reduction in the value of an equipment or asset is called as :
- (1) Saturation (2) Depreciation (3) Negotiation (4) Valuation
-
83. The application of human biological science along with engineering sciences for achieving the optimum level of adjustment between man and his work is known as _____
- (1) Ergonomics (2) Economics
(3) Ecology (4) Engineering science and Economics
-
84. Which are the major methods of quality control ?
- (1) Sampling (2) Inspection (3) Testing (4) All the above
-
85. A process of transporting material from one place to another over a stationary structure in a continuous stream is known as _____.
- (1) Transporting (2) Hauling (3) Conveying (4) Hoisting
-
86. Which IS code is applicable for final inspection and testing ?
- (1) IS 14001 (2) IS 14003 (3) IS 14004 (4) IS 14000
-
87. Who among the following proposed the concept "Fourteen Principles of Administration"?
- (1) Elton Mayo (2) Taylor F.W.
(3) Henry Fayol (4) None of the above
-
88. Total float can be expressed as
- (a) latest start time - earliest start time
(b) latest finish time - earliest finish time
- Answer options :**
- (1) Both (a) and (b) are false (2) (a) is true but (b) is false
(3) Both (a) and (b) are true (4) (a) is false but (b) is true
-

कच्च्या कामासाठी जागा /SPACE FOR ROUGH WORK

89. What are the advantages of a good site layout or job layout ?

- (1) Smooth and economical working of project.
 - (2) It reduces the completion time of project.
 - (3) Provides more safety on site.
 - (4) All the above.
-

90. A method proposes a systematic strategy for reducing the system of equations to the upper triangular form using the forward elimination approach and then for obtaining values of unknowns using the back substitution process. This process is used in _____.

- (1) Gauss Elimination method
 - (2) Gauss Seidel method
 - (3) Matrix Inversion method
 - (4) Method of relaxation
-

91. The area under the polynomial for three equal intervals (h) calculated by Simpson's rule is _____.

- (1) $\frac{h}{6} \{f(x_0) + 4f(x_1) + 2f(x_2) + f(x_3)\}$
 - (2) $\frac{h}{3} \{f(x_0) + 4f(x_1) + 2f(x_2) + f(x_3)\}$
 - (3) $\frac{h}{3} \{f(x_0) + 4 [f(x_1) + f(x_3)] + 2f(x_2)\}$
 - (4) $\frac{h}{6} \{f(x_0) + 4 [f(x_1) + f(x_2)] + 2f(x_3)\}$
-

92. Name the iterative method which falls under the category of Bracketing methods that start with two initial guesses that bracket the root and then systematically reduce the width of the bracket until the solution is reached.

- (1) Newton Raphson method
 - (2) Bisection method
 - (3) Secant method
 - (4) Fixed point method
-

कच्चा कामासाठी जागा /SPACE FOR ROUGH WORK

P.T.O.

93. The solution of the equations,

$$20x + y - 2z = 17$$

$$3x + 20y - z = -18$$

$$2x - 3y + 20z = 25$$

by Jacobi's iteration method is :

(1) 1, -1, 1

(2) -1, -1, -1

(3) 1, 1, 1

(4) -1, -1, 1

94. The value of $\int_0^6 \frac{dx}{1+x^2}$ by using Trapezoidal rule is :

(1) 1.4108

(2) 1.3108

(3) 1.8104

(4) 1.0418

95. The solution for simultaneous equations by Gauss elimination method for,

$$2x + 3y - z = 5$$

$$4x + 4y - 3z = 3$$

$$2x - 3y + 2z = 2$$
 is :

(1) $x=3, y=2, z=1$

(2) $x=2, y=1, z=3$

(3) $x=1, y=2, z=3$

(4) $x=1, y=3, z=2$

96. The real root of the equation :

$$f(x) = x^3 - x - 1 = 0$$
 is :

(1) 1.26

(2) 1.25

(3) 1.24

(4) 1.23

97. What is the area of bending moment diagram of a simply supported beam subjected to triangular load of intensity 'W' kN/m at centre of span (L) and zero at both ends using

Simpson's rule, assuming an equal interval of $\left(\frac{L}{2}\right)$?

(1) $\frac{WL^3}{8}$

(2) $\frac{WL^3}{12}$

(3) $\frac{WL^3}{16}$

(4) $\frac{WL^3}{18}$

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98. From the following table the area bounded by the curve and the x -axis from $x=7.47$ to $x=7.52$ is :

x	7.47	7.48	7.49	7.50	7.51	7.52
$y=f(x)$	1.93	1.95	1.98	2.01	2.03	2.06

- (1) 0.09569 (2) 0.09659 (3) 0.09965 (4) 0.09865

99. The process of translating physical problem into a mathematical problem involves ; making a number of simplifying assumptions, identification of important variables and postulation of relationships between variables. The process is called as :

- (1) Modelling (2) Validation (3) Convergence (4) Pivoting

100. If 'A' is a square matrix as given below; then adjoint of matrix A will be _____

$$A = \begin{bmatrix} 3 & 1 & 1 \\ 1 & 3 & 1 \\ 1 & 1 & 3 \end{bmatrix}$$

(1) $\begin{bmatrix} 8 & -2 & -2 \\ 8 & -2 & -2 \\ 8 & -2 & -2 \end{bmatrix}$

(2) $\begin{bmatrix} -2 & 8 & -2 \\ +2 & 8 & 2 \\ -2 & 8 & -2 \end{bmatrix}$

(3) $\begin{bmatrix} 8 & 2 & 2 \\ 2 & 8 & 2 \\ 2 & 2 & 8 \end{bmatrix}$

(4) $\begin{bmatrix} 8 & -2 & -2 \\ -2 & 8 & -2 \\ -2 & -2 & 8 \end{bmatrix}$

- o o o -

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परीक्षेचे नांव : महाराष्ट्र अभियांत्रिकी सेवा (स्थापत्य) (मुख्य) परीक्षा- २०१५ परीक्षेचा दिनांक : ९ व १० जानेवारी, २०१६
विषय : प्रश्नपत्रिका क्र.२ (स्थापत्य अभियांत्रिकी पेपर - I)

महाराष्ट्र लोकसेवा आयोगामार्फत घेण्यात आलेल्या महाराष्ट्र अभियांत्रिकी सेवा (स्थापत्य), (मुख्य) परीक्षा - २०१५ या स्पर्धा परीक्षेच्या प्रश्नपत्रिकेची उत्तरतालिका उमेदवारांच्या माहितीसाठी संकेतस्थळावर प्रसिध्द करण्यात आली होती. त्यासंदर्भात उमेदवारांनी अधिप्रमाणित (Authentic) स्फोटकरण / नोंद घेऊन परीक्षेची लेखी निवेदने, तसेच तज्ज्ञांचे अधिप्राय विचारात घेऊन आयोगाने उत्तरतालिका सुधारित केली आहे. या उत्तरतालिकेतील उपास अंतिम समजण्यात येतील. यासंदर्भात आलेली निवेदने विचारात घेतली जाणार नाहीत व त्याबाबत कोणताही पत्रव्यवहार केला जाणार नाही, याची कृपया नोंद घ्यावी.

उत्तरतालिका - KEY

प्रश्न क्रमांक	उत्तरे			
	संच A	संच B	संच C	संच D
1	3	1	1	1
2	1	3	1	3
3	1	3	2	4
4	3	4	2	3
5	1	1	3	4
6	4	2	1	1
7	3	3	3	3
8	2	4	3	2
9	2	4	4	3
10	4	2	4	4
11	3	1	3	1
12	4	3	4	2
13	3	3	4	2
14	3	1	3	3
15	4	4	3	3
16	3	2	2	3
17	4	4	3	4
18	1	2	2	1
19	3	3	1	3
20	2	3	2	4
21	3	2	4	2
22	2	3	3	3
23	2	3	3	2
24	4	4	4	3
25	2	4	2	1

प्रश्न क्रमांक	उत्तरे			
	संच A	संच B	संच C	संच D
26	3	2	2	4
27	1	1	4	3
28	4	2	3	1
29	1	3	3	4
30	3	1	1	2
31	2	1	4	4
32	1	4	1	2
33	4	3	1	4
34	4	4	4	1
35	2	2	2	3
36	1	1	1	1
37	2	2	1	2
38	3	3	3	4
39	2	1	3	2
40	2	3	2	2
41	4	1	1	2
42	1	4	4	1
43	3	2	2	1
44	2	2	2	2
45	1	2	2	3
46	4	1	2	3
47	3	3	1	3
48	3	1	1	1
49	1	3	3	1
50	1	3	1	4

प्रश्नपत्रिका क्र.२ (स्थापत्य अभियांत्रिकी पेपर - 1)

प्रश्न क्रमांक	उत्तरे			
	संच A	संच B	संच C	संच D
51	1	1	1	1
52	2	2	3	1
53	1	1	4	2
54	3	4	2	1
55	1	2	3	3
56	2	1	1	2
57	2	1	4	2
58	1	2	2	2
59	3	3	4	3
60	2	2	2	1
61	3	2	1	2
62	4	4	3	4
63	2	1	3	4
64	1	4	2	2
65	2	3	2	3
66	4	2	1	2
67	2	2	2	1
68	4	4	1	4
69	1	4	4	4
70	4	2	2	1
71	2	3	1	3
72	1	1	4	2
73	4	1	2	1
74	2	2	1	1
75	2	4	2	1

प्रश्न क्रमांक	उत्तरे			
	संच A	संच B	संच C	संच D
76	3	1	4	2
77	1	1	1	2
78	1	2	3	4
79	3	4	4	4
80	2	2	1	4
81	4	2	3	2
82	2	3	2	1
83	1	3	2	2
84	4	2	3	3
85	3	3	3	3
86	2	3	4	3
87	3	4	2	2
88	3	1	4	3
89	4	4	3	4
90	1	1	2	1
91	#	3	1	4
92	2	1	#	4
93	1	1	4	1
94	1	#	4	1
95	3	3	3	3
96	2	1	3	2
97	4	2	1	#
98	3	2	1	1
99	1	4	2	3
100	4	4	1	2