Q1. Which is the correct formula for calculating target strength during a trial mix of concrete?
(a) $f_m = f_{ck} + 1.65\ \sigma_d$
(b) $f_m = f_{ck} + 1.165\ \sigma_d$
(c) $f_m = f_{ck} + 5$
(d) $f_m = f_{ck} \times 1.3$

Q2. If E_c and E_s are modulus of elasticity of concrete and steel respectively, then the modular ratio (m) will be
(a) $\frac{E_c}{E_s}$
(b) $\frac{E_s}{E_c}$
(c) $\frac{E_c+E_s}{E_s-E_c}$
(d) $\frac{4E_c}{E_s}$

Q3. Mild steel used in RCC structures conforms to
(a) IS : 432
(b) IS : 1556
(c) IS : 1786
(d) IS : 2062

Q4. To prevent sulphate attack in concrete, for preparing concrete mix, water pH must be within:
(a) 5 – 7
(b) 6 – 9
(c) 7 – 10
(d) 4 – 6

Q5. According to IS 456, nominal mix concrete can be used up to which of the following grade
(a) 10
(b) 15
(c) 20
(d) 25

Q6. Creep of a materials is?
(a) disappearance of deformation on removal of load
(b) to become brittle
(c) not being ductile
(d) continued deformation with time under sustained loading

Q7. Modular ratio is denoted by:
(a) $m = \frac{280}{3\sigma_{cbc}}$
(b) $m = \frac{280}{5\sigma_{cbc}}$
(c) $m = \frac{2800}{3\sigma_{cbc}}$
(d) $m = \frac{300}{3\sigma_{cbc}}$

Q8. The assumption that the plane sections normal before bending remains normal after bending is used_____:
(a) only in the working stress method of design
(b) only in the limit-state method of design
(c) in both working stress and limit state methods of design
(d) only in the ultimate load methods of design

Q9. For concrete of grade M-50, short-term modulus of elasticity will be nearly
(a) 20000 N/mm^2
(b) 35000 N/mm^2
(c) 50000 N/ mm^2
(d) 75000 N/mm^2

Q10. Minimum grade of concrete to be used in reinforced concrete is –
(a) M 10
(b) M 15
(c) M 20
(d) M25

Q11. As per IS specifications, the nominal concrete cover for moderate exposure should not be less than……..
(a) 20 mm
(b) 30 mm
(c) 45 mm
(d) 50 mm

Q12. According to working stress method, the limiting value of permissible tensile stresses for a reinforced concrete member in tension for HYSD of grade Fe415 is:
(a) 190
(b) 230
(c) 250
(d) 415

Q13. Twisted bar has about _____ more yield stress than ordinary mild steel bar
(a) 10%
(b) 20%
(c) 35%
(d) 50%

Q14. The reinforcement in RCC takes –
(a) Tensile stress
(b) compressive stress
(c) Shear stress
(d) torsional stress

Q15. Consider the following statement regarding characteristic strength of concrete:
"the test result of the sample shall be the average of the strength of x specimens. The individual variation should not be more than $\pm$ Y% of the average."

(a) 5, 15 respectively
(b) 5, 5 respectively
(c) 3, 5 respectively
(d) 3, 15 respectively

Q16. What shall be the total strain in Fe 415 grade steel corresponding to the stress of 0.87 f_y?
(a) 0.0035
(b) 0.0038
(c) 0.002
(d) 0.004

Q17. The limit state of serviceability of a steel structure includes all of the following except.
(a) Corosion
(b) Crack due to fatigue
(c) Fire
(d) Fracture due to fatigue

Q18. The value of limiting moment of resistance of a RCC beam for M25 grade of concrete and Fe 500 grade of steel is given by (Notational have their usual meaning) –
(a) 3.33 bd^2
(b) 3.38 bd^2
(c) 3.35 bd^2
(d) 3.44 bd^2

Q19. Stress-strain curve of concrete is
(a) a perfect straight line upto failure
(b) straight line upto 0.002 strain value and the parabolic upto failure
(c) hyperbolic upto 0.002 strain value and a straight line upto failure
(d) parabolic upto 0.002 strain value and a straight line upto failure

Q20. The time period for which a structure or a structural element is required to perform its function without damage is called as
(a) Loading period
(b) Design life
(c) Life cycle of that structure
(d) Serviceability duration

Q21. Maximum strain in an extreme fiber in concrete and in the tension reinforcement (Fe-415 Grade and $E_s = 200\ kN/mm^2$) in a balanced section at limit state of flexure are respectively.
(a) 0.0035 and 0.0038
(b) 0.002 and 0.0018
(c) 0.0035 and 0.0041
(d) 0.002 and 0.0031

Q22. In limit state method of design for RCC flexural members, the centre of gravity of the compressive force acting on the section from the top most fibre of concrete is a distance of –
(a) 0.30 of the depth of neutral axis
(b) 0.57 of the depth of neutral axis
(c) 0.42 of the depth of neutral axis
(d) None of the above

Q23. According to the limit state method, neutral axis is said to be critical when:
(a) All of the above
(b) Strain in steel reaches its ultimate value earlier than strain in concrete
(c) Strain in steel and strain in concrete reach their ultimate value simultaneously
(d) Strain in concrete reaches its ultimate value earlier than strain in steel

Q24. The approximate allowable axial compressive stress under earthquake load condition in reinforced concrete is:
(a) 0.25 f_{ck}
(b) 0.3 f_{ck}
(c) 0.33 f_{ck}
(d) 0.44 f_{ck}

Q25. In limit state of collapse for direct compression, the maximum axial compressive strain in concrete is:
(a) 0.003
(b) 0.002
(c) 0.0035
(d) 0.006

Q26. A simply supported beam of span 'L' is loaded with dowunward uniformly distributed load of intensity W/m over it's entire length. Which of the following orientation of T-beames is preferred to resist bending?
(a) ⊥
(b) ⊢
(c) ⊣
(d) ⊤

Q27. A T-beam roof section has the following particulars:
Thickness of slab = 100 mm
Width of rib = 300 mm
Depth of beam = 500 mm
C/c distance of beams = 3.0 m
Distance between points of contraflexure is 3.6 m.
The effective width of flange of the beam is:
(a) 1600 mm
(b) 1900 mm
(c) 1500 mm
(d) 3000 mm

Q28. The flange width of isolated T-Beam is:

(a) $\frac{\ell_0}{\frac{\ell}{b}+6} + bw$
(b) $\frac{\ell_0}{\frac{\ell}{b}+4} + bw$
(c) $\frac{\ell_0}{\frac{\ell}{b}+0.85} + bw$
(d) $\frac{\ell_0}{\frac{\ell}{b}+0.47} + bw$

Q29. A T-beam behaves as a rectangular beam of width equal to its flange if its neutral axis …… .
(a) Coincides with centroid of reinforcement
(b) Coincides with centroid of T – section
(c) Remains within the flange
(d) Remains in the web

Q30. The width of the rib of a T-beam is generally kept between…….
(a) $\frac{1}{7}$ to $\frac{1}{3}$ of rib depth
(b) $\frac{1}{3}$ to $\frac{2}{3}$ of rib depth
(c) $\frac{1}{2}$ to $\frac{3}{4}$ of rib depth
(d) $\frac{1}{3}$ to $\frac{1}{2}$ of rib depth

Q31. Minimum diameter of a longitudinal reinforcement in a RCC column as per IS codal provisions shall be:

(a) 16 mm
(b) 12 mm
(c) 10 mm
(d) 8 mm

Q32. Spacing between lateral ties of RCC columns should not exceed:
(a) 150 mm
(b) 250 mm
(c) 300 mm
(d) 500 mm

Q33. The minimum eccentricity for design of column as per IS – 456 – 2000, where L is unsupported length and D = Lateral dimension.
(a) $\frac{L}{300} + \frac{D}{50}$
(b) $\frac{L}{500} + \frac{D}{30}$
(c) $\frac{L}{300} + \frac{D}{500}$
(d) $\frac{L}{500} + \frac{D}{300}$

Q34. In a axially loaded spirally reinforced short column, the concrete inside the core is subjected to:

(a) bending and compression
(b) biaxial compression
(c) triaxial compression
(d) none of the above

Q35. Lateral ties in RCC columns are provided to resist:
(a) bending moment
(b) shear
(c) buckling of longitudinal bars
(d) both bending moment and shear

Q36. Which one of the components strengthens the wall to resist lateral pressure without buckling?
(a) Load bearing wall
(b) Column
(c) Pier
(d) Beam

Q37. As the span of a bridge increase, the impact factor…….
(a) Decreases
(b) Increases
(c) Remains constant
(d) Increases up to a critical value of span and then decreases

Q38. As per IS (Indian Standard) specifications, the minimum number of longitudinal bars provided in a column shall be …… in rectangular columns and …… in circular columns.
(a) 6, 4
(b) 4, 6
(c) 4, 8
(d) 6, 8

Q39. A short column 20 cm × 20 cm in section is reinforced with 4 bars whose area of cross section is 20 sq. cm. If permissible compressive stresses in concrete and steel are 40 kg/cm² and 300 kg/cm², the safe load on the column should not exceed…….
(a) 412 kg
(b) 4120 kg
(c) 412000 kg
(d) None of these

Q40. If a concrete column 200 × 200 mm in cross-section is reinforced with four steel bars of 1200 mm² total cross-sectional area. What is the safe load for the column if permissible stress in concrete is 5 N/mm² and $E_s = 15\ E_c$?
(a) 264 MN
(b) 274 MN
(c) 284 MN

(d) 294 MN

Q41. A 90 m high R. C. C. building is to be constructed founded on a weak fine grained soil. The type of foundation used for this construction would be:
(a) Under reamed piles
(b) Isolated footings
(c) Raft foundation with piles
(d) Floating foundation

Q42. The critical section for the calculation of maximum bending moment for footing supporting a concrete column is
(a) at face of column
(b) halfway between the centre line of column and edge of column
(c) at a distance equal to half the effective depth of footing from face of column
(d) at a distance equal to the effective depth of footing from face of column

Q43. For the purpose of the design of reinforced concrete footing, pressure distribution is assumed to be:
(a) linear
(b) parabolic
(c) hyperbolic
(d) none of the above

Q44. The relationship for minimum depth of foundation is given by:
(a) $D_{min} = \frac{q}{sin\phi}\left\{\frac{1-sin\phi}{1+sin\phi}\right\}^2$
(b) $D_{min} = q\left\{\frac{1-sin\phi}{1+sin\phi}\right\}^2$
(c) $D_{min} = \frac{q}{\gamma}\left\{\frac{1-sin\phi}{1+sin\phi}\right\}^2$
(d) $D_{min} = \frac{q}{\gamma}\left\{\frac{1+sin\phi}{1-sin\phi}\right\}^2$

Q45. In reinforced concrete footing on soils, minimum thickness at the edge should normally not be less than…….
(a) 250 mm
(b) 150 mm
(c) 100 mm
(d) 200 mm

Q46. The stress in punching shear is checked _____ in an isolated reinforced column footing of effective depth ‘d’.
(a) at the centre of the column
(b) at a distance d/2 away from the face of the column
(c) at a distance d/2 away from the centre of the column
(d) at the face of the column

Q47. As per IS 456, the minimum nominal cover specified for footings is:
(a) 25 mm
(b) 40 mm
(c) 50 mm

(d) 75 mm

Q48. When R. C. C. footing is not to extend in the plot of the neighbouring house, the type of footing preferred is?
(a) cellular flat not footing and inverted flat not footing both
(b) strap footings
(c) inverted flat not footing
(d) cellular flat not footing

Q49. The ratio of the maximum diameter of the reinforcing bar in a slab and the total thickness of the slab should not exceed …….
(a) 1/4
(b) 1/5
(c) 1/6
(d) 1/8

Q50. Thickened part of a flat slab over the supporting column is called
(a) drop panel
(b) capital
(c) column head
(d) All of the above

S1. Ans.(a)
Sol. Mean strength of concrete (fm) = fck + 1.65 σ
σ → standard deviation
fm → It is strength below which not more then 50% of test result are expected to fall. (Target strength)

S2. Ans.(b)
Sol. $\boxed{\text{Modular Ratio (m)} = \frac{\text{Modulas of elasticity of steel}(E_s)}{\text{Modulus of plasticity of concrete}(E_c)}}$
$E_s = 2 \times 10^5\ N/mm^2$
$E_c = 5000\sqrt{fck}$ (Acc. To IS 456:2000)

S3. Ans.(a)
Sol. Mild steel → IS : 432
HYSD bar → IS: 1786

S4. Ans.(b)
Sol. the P^H value of water should not be less then '6'

S5. Ans.(c)
Sol. Nominal mix design used up to M20 Concrete.

$M10 \rightarrow 1:3:6$
$M15 \rightarrow 1:2:4$
$M20 \rightarrow 1:1.5:3$
$\rightarrow$ For M25 onward's we use design mix.

S6. Ans.(d)
Sol. when concrete is subjected to sustained compressive load (Dead load) its deformation keep increasing with time even stress is not change. Time dependent component of total strain excluding that of shrinkage & temperature is termed as creep.

S7. Ans.(a)
Sol. $\boxed{\text{Modular Ratio (m)} = \frac{280}{3\sigma_{cbc}}}$
σ_{cbc} = Permissible stress in concrete in bending compression.

S8. Ans.(c)
Sol. plane section normal before bending remains normal after bending is valid for working stress method & Limit state method.

S9. Ans.(b)
Sol. short term modulus of elasticity (E_c)
$E_c = 5000\sqrt{fck}$
for M50
$\boxed{fck = 50}$
$E_c = 5000\sqrt{50}$
$E_c\ 35355.33\ \ N/mm^2$
Most expected option is (b)

S10. Ans.(c)
Sol. ⇒ for Reinforced cement concrete minimum grade is M20
⇒ For plane cement concrete minimum grade is M15

S11. Ans.(b)
Sol.

Exposure condition	Minimum grade	Minimum cover
Mild	M20	20mm
Moderate	M25	30mm
Sever	M30	45mm
Very sever	M35	50mm
Extreme	M40	75mm

S12. Ans.(b)

Sol. Permissible stress in steel reinforcement

Type of stress	Mild steel	Fe415	Fe500
Tension & shear $\phi \leq 20$ mm $\phi > 20$ mm	 140 Mpa 130 Mpa	230 Mpa	275 Mpa
Compression	130 Mpa	190 Mpa	190 Mpa

S13. Ans.(d)
Sol. twisted bar has 50% more yield stress then ordinary mild steel bar.

S14. Ans.(a)
Sol. Reinforcement in RCC structure takes tensile stress because concrete has very low strength in tension.

S15. Ans.(d)
Sol. the test result of the sample shall be average of the strength of 3 specimens. The individual variation should not be more than $\pm 15\%$ of the average.

S16. Ans.(b)
Sol. Strain in HYSD bars (fe415)

$$= 0.002 + \frac{0.87fy}{E_s}$$

$$= 0.002 + \frac{0.87 \times 415}{2 \times 10^5} \Rightarrow 0.0038$$

Strain in mild steel = $\frac{0.87 \times fy}{E_s}$

$$= \frac{0.87 \times 250}{2 \times 105} = 0.00108$$

S17. Ans.(d)
Sol. Limit state of serviceability
(i) Deflection
(ii) Cracking
(iii) Fire
(iv) Corrosion
(v) Vibration

S18. Ans.(a)
Sol. Limiting value of moment.

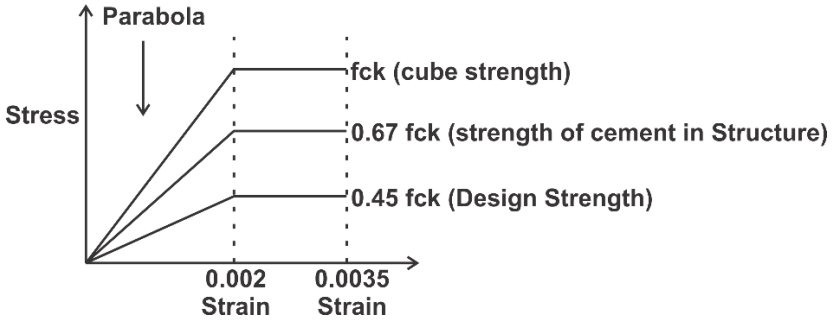
$$\begin{bmatrix} Fe\ 250 & \rightarrow & Mu = 0.148\ fck\ bd^2 \\ Fe\ 415 & \rightarrow & Mu = 0.138\ fck\ bd^2 \\ Fe\ 500 & \rightarrow & Mu = 0.133\ fck\ bd^2 \end{bmatrix}$$

For M25 & Fe500

$$Mu_{lim} = 0.133 \times 25 \times bd^2$$

$$Mu_{lim} = 3.325\, bd^2$$
$$= 3.33\, bd^2$$

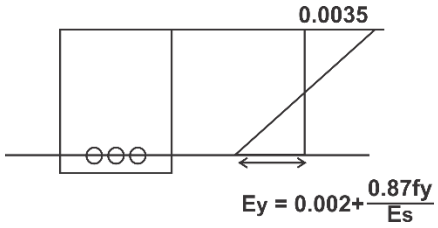
S19. Ans.(d)
Sol.



According to IS. Code stress strain curve is parabola up to 0.002 then straight line
Up to failure.

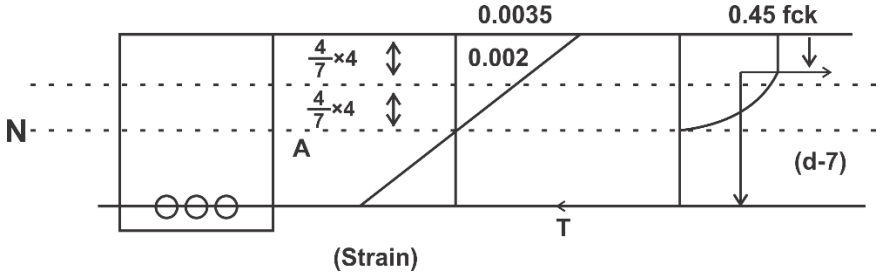
S20. Ans.(b)
Sol. structure perform its Function without damage is called design life of structure.

S21. Ans.(a)
Sol.



Maximum strain in extreme fibre of concrete
= 0.0035
Maximum strain in tension reinforcement =
$= 0.002 + \frac{0.87 \times 415}{200 \times 10^3}$
= 0.0038

S22. Ans.(c)
Sol.



$\boxed{\bar{y} = 0.42\, x_u}$

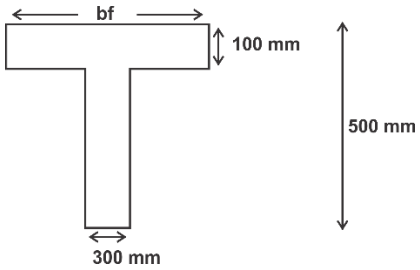
S23. Ans.(c)
Sol. when strain is steel & strain in concrete reach their ultimate value simultaneously than Neutral axis is said to be critical (Balance).

S24. Ans.(b)
Sol.

S25. Ans.(b)
Sol. in limit state of collapse for direct compression the maximum axial compression strain in concrete is 0.002.

S26. Ans.(d)

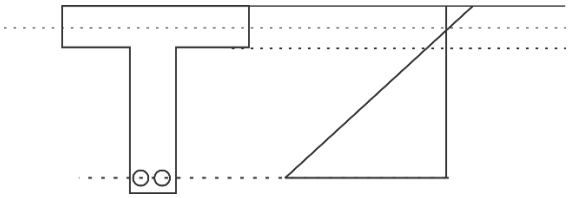
S27. Ans.(c)
Sol.



c/c distance b/w beam = 3000 mm
= 300 + $\frac{3000}{2} + \frac{3000}{2}$
$\boxed{b = 3300\ mm}$
Effective width = $\left(\frac{lo}{6} + bw + 6df\right)$
$= \left(\frac{3.6 \times 1000}{6} + 300 + 6 \times 100\right)$
$= (\ 600 + 300 + 600)$
$= 1500\ mm.$

S28. Ans.(b)
Sol. flange width for isolated T.beam
$\left[\frac{lo}{\frac{lo}{b} + 4} + bw\right]$
For monolithic T-beam
$\left[\frac{lo}{6} + bw + 6df\right]$

S29. Ans.(c)
Sol. T-beam behaves as a rectangular beam of width equal to flange if its neutral axis remains with in the flange.



S30. Ans.(b)

S31. Ans.(b)
Sol. in column minimum diameter for longitudinal reinforcement is 12mm. for Transverse reinforcement minimum diameter is 6 mm.

S32. Ans.(c)
Sol. Spacing between lateral ties –
Maximum spacing should not be greater than.

(i) 16×minimum diameter of bar
(ii) Least lateral dimension
(iii) 300 mm.

S33. Ans.(b)
Sol. minimum eccentricity of column= $\begin{bmatrix} \frac{L}{500}+\frac{D}{30} \\ or \\ 20mm \end{bmatrix}_{maximum}$

S34. Ans.(b)
Sol. in axially loaded reinforced short column. The concrete inside the core is subjected to biaxial compression.

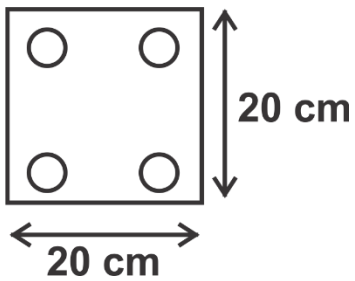
S35. Ans.(c)
Sol. lateral ties in R.C.C. columns are provided to resist buckling of longitudinal bar's

S36. Ans.(c)
Sol.

S37. Ans.(a)
Sol. if span of bridge increases.
Then its impact factor decreases.

S38. Ans.(b)
Sol. minimum number of longitudinal bars is 4 in rectangular column & 6 for circular column.

S39. Ans.(d)
Sol.



$A_T = 20 \times 20 = 400\ cm^2$
$A_{sc} = 4 \times 20 = 80\ cm^2$
$\sigma_{cc} = 40\ kg/cm^2$
$\sigma_{sc} = 300\ kg/cm^2$
Safe load on column = $\sigma_{cc}Ac + \sigma_{sc}\ A_{sc}$

$= 40 \times (400 - 80) + 300 \times 80$
$= 36800\ kg$

S40. Ans.(c)
Sol. $A_T = 200 \times 200$
= 40000 mm²
$A_{sc} = 1200\ mm^2$
$\sigma_{cc} = 5\ N/mm^2$
$E_s = 15\ E_c$
Modular Ratio (m) = $\frac{E_s}{E_c}$
$\boxed{m = 15}$
$\sigma_{sc} = m \times \sigma_{cc}$
$= 15 \times 5$
$= 75\ N/mm^2$
Safe load (p) = $\sigma_{cc}\ Ac + \sigma_{sc}\ Asc$
$= 5 \times (40{,}000 - 1200) + 75 \times 1200$
$= 284000\ N$
$\boxed{P = 284\ KN}$

S41. Ans.(c)

Sol. if soil below the foundation is weak & land is marshy than raft plus pile foundation is used.

S42. Ans.(a)

Sol. while calculating maximum bending moment for footing the critical section is face of the column.

S43. Ans.(a)

Sol. In R.C.C. footing pressure distribution is assumed to be linear.

S44. Ans.(c)

Sol. minimum depth of foundation is calculated by Rankine formula: -

$$\boxed{D = \frac{q}{r}\left[\frac{1 - sin\phi}{1 + sin\phi}\right]^2}$$

S45. Ans.(b)

Sol. in reinforced concrete footing minimum thickness at the edge is 150 mm

S46. Ans.(b)

Sol. → punching shear checked at a distance $\frac{d}{2}$ away from the face of the column.

→ In one way shear checked at 'd' distance from face of the column.

S47. Ans.(c)

Sol.

Component	Nominal cover
SLAB	20 mm
BEAM	25 mm
COLUMN	40 mm
FOOTING	50 mm

S48. Ans.(b)

Sol. strap footing is used when footing is not to extend in the plot of the neighbouring house.

S49. Ans.(d)

Sol. $\boxed{maximum\ diameter\ of\ reinforcement\ in\ slab\ \not> \frac{1}{8} \times\ thickness\ of\ slab}$

S50. Ans.(a)

Sol.