

Staff Selection Commission

SSC JE

Mains


Civil Engineering

Practice Book

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SSC Junior Engineer Paper Syllabus

CIVIL & STRUCTURAL ENGINEERING

The Examination will be conducted in two stages:

A. Paper-I (Pre) (200 marks)

B. Paper-II (Mains) (300 marks)

Total Written Test (500 marks)

Written Test :

Paper	Mode of Examination	Subject	Number of Questions/Max. Marks	Duration & Timing
Paper-I Objective type	Computer Based Examination	(i) General Intelligence & Reasoning	50/50	2 Hours
		(ii) General Awareness	50/50	
		(iii) General Engineering (CIVIL & Structural)	100/100	
Paper-II Objective Type	Computer Based Examination	General Engineering (CIVIL & Structural)	100/300	2 Hours

There will be **negative marking equal to one-fourth (1/4) of the marks** allotted to the question for each wrong answer in Paper-I & negative marking of one mark for each wrong answer in Paper-II.

SSC JE Syllabus

- **Indicative Syllabus:** The standard of the questions in Engineering subjects will be approximately of the level of Diploma in Engineering (Civil/Mechanical) from a recognized Institute, Board or University recognized by All India Board of Technical Education. All the questions will be set in SI units. The details of the syllabus are given below.

Paper-I (Prelims)

- **General Intelligence & Reasoning:** The Syllabus for General Intelligence would include questions of both verbal and non-verbal type. The test may include questions on analogies, similarities, differences, space visualization, problem solving, analysis, judgment, decision making, visual memory, discrimination, observation, relationship concepts, arithmetical reasoning, verbal and figure classification, arithmetical number series etc. The test will also include questions designed to test the candidate's abilities to deal with abstract ideas and symbols and their relationships, arithmetical computations and other analytical functions.
- **General Awareness:** Questions will be aimed at testing the candidate's general awareness of the environment around him/her and its application to society. Questions will also be designed to test knowledge of current events and of such matters of everyday observations and experience in their scientific aspect as may be expected of any educated person. The test will also include questions relating to India and its neighbouring countries especially pertaining to History, Culture, Geography, Economic Scene, General Polity and Scientific Research, etc. These questions will be such that they do not require a special study of any discipline.
- **General Engineering (Civil and Structural)**
- **Civil Engineering** : Building Materials, Estimating, Costing and Valuation, Surveying, Soil Mechanics, Hydraulics, Irrigation Engineering, Transportation Engineering, Environmental Engineering.
- **Structural Engineering** : Theory of Structures, Concrete Technology, RCC Design, Steel Design.

Paper-II (Mains)

Civil & Structural Engineering

- **Building Materials** : Physical and Chemical properties, classification, standard tests, uses and manufacture/quarrying of materials e.g. buildings stones, silicate based materials, cement (Portland), asbestos products, timber and wood based products, laminates, bituminous materials, paints, varnishes.
- **Estimating, Costing and Valuation** : Estimate, glossary of technical terms, analysis of rates, methods and unit of measurement, Items of work – earthwork, Brick work (Modular & Traditional bricks), RCC work, Shuttering, Timber work, Painting, Flooring, Plastering. Boundary wall, Brick building, Water Tank, Septic tank, Bar bending schedule, Centre line

method, Mid-section formula, Trapezoidal formula, Simpson's rule, Cost estimate of Septic tank, flexible pavements, Tube well, isolates and combined footings, Steel Truss, Piles and pile-caps. Valuation – Value and cost, scrap value, salvage value, assessed value, sinking fund, depreciation and obsolescence, methods of valuation.

- **Surveying** : Principles of surveying, measurement of distance, chain surveying, working of prismatic compass, compass traversing, bearings, local attraction, plane table surveying, theodolite traversing, adjustment of theodolite, Levelling, Definition of terms used in levelling, contouring, curvature and refraction corrections, temporary and permanent adjustments of dumpy level, methods of contouring, uses of contour map, tachometric survey, curve setting, earth work calculation, advanced surveying equipment.
- **Soil Mechanics** : Origin of soil, phase diagram, Definitions-void ratio, porosity, degree of saturation, water content, specific gravity of soil grains, unit weights, density index and interrelationship of different parameters, Grain size distribution curves and their uses. Index properties of soils, Atterberg's limits, ISI soil classification and plasticity chart. permeability of soil, coefficient of permeability, determination of coefficient of permeability, Unconfined and confined aquifers, effective stress, quick sand, consolidation of soils, Principles of consolidation, degree of consolidation, pre-consolidation pressure, normally consolidated soil, e-log p curve, computation of ultimate settlement. Shear strength of soils, direct shear test, Vane shear test, Triaxial test. Soil compaction, Laboratory compaction test, Maximum dry density and optimum moisture content, earth pressure theories, active and passive earth pressures, Bearing capacity of soils, plate load test, standard penetration test.
- **Hydraulics** : Fluid properties, hydrostatics, measurements of flow, Bernoulli's theorem and its application, flow through pipes, flow in open channels, weirs, flumes, spillways, pumps and turbines.
- **Irrigation Engineering** : Definition, necessity, benefits, 2II effects of irrigation, types and methods of irrigation, Hydrology – Measurement of rainfall, run off coefficient, rain gauge, losses from precipitation – evaporation, infiltration, etc. Water requirement of crops, duty, delta and base period, Kharif and Rabi Crops, Command area, Time factor, Crop ratio, Overlap allowance, Irrigation efficiencies. Different type of canal irrigation, loss of water in canals. Canal lining – types and advantages. Shallow and deep wells, yield from a well. Weir and barrage, Failure of weirs and permeable foundation, Slit and Scour, Kennedy's theory of critical velocity. Lacey's theory of uniform flow. Definition of flood, causes and effects, methods of flood control, water logging, preventive measure. Land reclamation, Characteristics of affecting fertility of soils, purposes, methods, description of land and reclamation processes. Major irrigation projects in India.

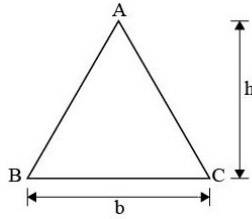
- **Transportation Engineering** : Highway Engineering – cross sectional elements, geometric design, types of pavements, pavements materials – aggregates and bitumen, different tests, Design of flexible and rigid pavements – Water Bound Macadam (WBM) and Wet Mix Macadam (WMM), Gravel Road, Bituminous construction, Rigid pavement joint, pavement maintenance, Highway drainage, Railway Engineering – components of permanent way – sleepers, ballast, fixtures and fastening, track geometry, points and crossings, track junction, stations and yards. Traffic Engineering – Different traffic survey, speed- flow-density and their interrelationships, intersections and interchanges, traffic signals, traffic operation, traffic signs and markings, road safety.
- **Environmental Engineering** : Quality of water, source of water supply, purification of water, distribution of water, need of sanitation, sewerage systems, circular sewer, oval sewer, sewer appurtenances, sewage treatments. Surface water drainage. Solid waste management – types, effects, engineered management system, Air pollution – pollutants, causes, effects, control. Noise pollution – cause, health effects, control.

Structural Engineering

- **Theory of structures** : Elasticity constants, types of beams – determinate and indeterminate, bending moment and shear force diagrams of simply supported, cantilever and over hanging beams, Moment of area and moment of inertia for rectangular & circular sections, bending moment and shear stress for tee, channel and compound sections, chimneys, dams and retaining walls, eccentric loads, slope deflection of simply supported and cantilever beams, critical load and columns, Torsion of circular section.
- **Concrete Technology** : Properties, Advantages and uses of concrete, cement aggregates, importance of water quality, water cement ratio, workability, mix design, storage, batching, mixing, placement, compaction, finishing and curing of concrete, quality control of concrete, hot weather and cold weather concreting, repair and maintenance of concrete structures.
- **RCC Design** : RCC beams-flexural strength, shear strength, bond strength, design of singly reinforced and double reinforced beams, cantilever beams. T-beams, lintels. One way and two way slabs, isolated footings. Reinforced brick works, columns, staircases, retaining wall, water tanks (RCC design questions may be based on both Limit State and Working Stress methods).
- **Steel Design** : Steel design and construction of steel columns, beams roof trusses plate girders.

Practice Set- 01

1. Consider a triangular section with base b and height h as shown in the figure.



The shape factor will be nearly
 (a) 2.3 (b) 3.2
 (c) 4.1 (d) 5.0

2. Web buckling occurs in a beam due to excessive
 (a) Direct tensile stress in the web
 (b) Bending tensile stress in the web
 (c) Torsional shear stress in the web
 (d) Compressive stress in the web
3. Considering the nature of loading on gantry girders, which type of loadings are gantry girders usually designed to resist?
 (i) Gantry load
 (ii) Lateral loads
 (iii) Longitudinal loads
 (iv) Wind loads
 Select the correct answer using the codes given below :
 (a) (i) and (ii)
 (b) (i), (ii) and (iii)
 (c) (i) and (iii)
 (d) (ii), (iii) and (iv)
4. The lacing bars in a steel column should be designed to resist :
 (a) Bending moment due to 2.5% of the column load.
 (b) Shear force due to 2.5% of the column load
 (c) 2.5% of the column load only
 (d) Both (a) and (b)
5. The maximum permissible slenderness ratio of tension members liable to reversal of stress due to action of wind and earthquake is-
 (a) 300 (b) 350
 (c) 400 (d) 425
6. A butt weld is specified by
 (a) effective throat thickness
 (b) plate thickness
 (c) size of weld
 (d) penetration thickness
7. In case of staggered pitch, pitch may be _____ of values specified for not staggered pitch.
 (a) increased by 20%
 (b) increased by 50%
 (c) decreased by 20%
 (d) decreased by 50%

8. A steel plate is 30 cm wide and 10 mm thick. A rivet of nominal diameter of 18 mm is driven. The net sectional area of plate is
 (a) 18.00 cm² (b) 28.20 cm²
 (c) 28.05 cm² (d) 32.42 cm²
9. Maximum strain theory for the failure of a material at the elastic limit is known as:
 (a) Haig's theory
 (b) Guest's or Tresca's theory
 (c) Rankine's theory
 (d) Saint Venant's theory
10. Match the List-I with List-II and select your correct answer using the codes given below:

List-I (Name of the associated with the methods)	List-II (Method)
A. G.N. Maney	1. Moment distribution
B. Hardy cross	2. Slope deflection method
C. Euler	3. Theorem of three moments
D. Clapeyron	4. Crippling load on column

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

11. The bending equation is :
 (a) $\frac{T}{J} = \frac{\tau}{r} = \frac{C\theta}{\ell}$ (b) $\frac{T}{J} = \frac{\tau}{r} = \frac{C\theta}{\ell}$
 (c) $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ (d) $\frac{\ell}{r} = \frac{\tau}{J} = \frac{C\theta}{\ell}$
12. For a beam, Shear span is defined as the zone where:
 (a) Shear force is constant
 (b) Shear force is zero
 (c) Bending moment is constant
 (d) Bending moment is zero
13. The resultant of two forces each equal to P and acting at right angles is
 (a) $P/\sqrt{2}$ (b) $P/2$
 (c) $P/2\sqrt{2}$ (d) $\sqrt{2} P$
14. Consider below statements,
 A. According to principle of transmissibility, "force can be applied at any point on the object in its line of action, which creates same moment about the considered point"
 B. According to Varignon's theorem "Moment of resultant force of a system of force acting on a body about a point is inversely proportional to moment of all the forces acting on same object about the same point."

- Identify the correct statement's**
- (a) Statement B is true A is false
 (b) Both statements are false
 (c) Both statements are true
 (d) Statement A is true B is false
15. **A symmetrical two-hinged parabolic arch when subjected to a uniformly distributed load on the entire horizontal span, is subjected to**
 (a) radial shear alone
 (b) normal thrust alone
 (c) normal thrust and bending moment
 (d) normal thrust, radial shear and bending moment
16. **The number of independent equations to be satisfied for static equilibrium of a space structure is :**
 (a) 1 (b) 2
 (c) 3 (d) 6
17. **In theodolite survey, the telescope is said to be inverted, if the**
 (a) Vertical circle is to the right of the observer and the bubble of the telescope is up
 (b) Vertical circle is to the right of the observer and the bubble of the telescope is down
 (c) Vertical circle is to the left of the observer and the bubble of the telescope is up
 (d) Vertical circle is to the left of the observer and the bubble of the telescope is down
18. **In a vertical curve, an upgrade of 3% is followed by a downgrade of 2%. The rate of change of grade is 0.06% per 20 m chain. The length of the vertical curve will be :**
 (a) 83.33 chains (b) 41.66 chains
 (c) 44 chains (d) 22 chains
19. **If the intercept on a vertical staff is observed as 0.75 m from a tacheometer with the line of sight horizontal, fitted with anallatic lens, the horizontal distance between the tacheometer and the staff station is-**
 (a) 0.75 m (b) 7.5 m
 (c) 75 m (d) 750 m
20. **The indirect method of contouring has all the following advantages over direct method except**
 (a) Economy
 (b) Suitability for hilly terrain
 (c) Accuracy
 (d) Suitability for large projects
21. **If the magnetic bearing of the sun at a place in noon in Southern hemisphere is 167° , the magnetic declination at that place is:**
 (a) 77° N (b) 23° S
 (c) 13° E (d) 13° W
22. **Correction due to sag of a tape is**
 (a) always positive
 (b) always negative
 (c) sometimes negative and sometimes positive
 (d) dependent on the temperature conditions
23. **Geodetic Surveying is used for-**
 (a) Detailing the topography for a large area
 (b) Getting control points for horizontal control
 (c) Finding the elevation of points precisely
 (d) Finding the latitude and longitude of points
24. **The scale of a given plan is written as 1:200. If an original length of 10 cm on the plan has now shrunk to 9.8 cm. determine the actual distance denoted by a line which currently measures 10 cm.**
 (a) 20.4 m (b) 19.4 m
 (c) 21.9 m (d) 18.9 m
25. **An engineering survey is proposed in a highway alignment project. The survey include following stages:**
 1. Preliminary Survey
 2. Reconnaissance
 3. Map study
 4. Final location & detailed Survey.
The sequential order of the stages in which the engineering survey is carried out is : (Use Codes 1 to 4 for answering)
 (a) 2 - 1 - 3 - 4 (b) 1 - 3 - 2 - 4
 (c) 2 - 3 - 1 - 4 (d) 3 - 2 - 1 - 4
26. **Two parallel railway lines are to be connected by a reverse curve, each section having the same radius. If the lines are 12 m apart and the maximum distance between tangent points measured parallel to the straights is 48m, then the maximum allowable radius will be**
 (a) 51.1 m (b) 52.3 m
 (c) 53.5 m (d) 54.7 m
27. **If the sleeper density is $N+6$, then what will be the number of sleepers required for constructing a 500 m broad gauge track (rail length = 13 m) ?**
 (a) 925 (b) 741
 (c) 1026 (d) 886
28. **The ratio of the soil reaction to the deflection at any point is defined as the :**
 (a) modulus of subgrade reaction
 (b) coefficient of deflection
 (c) elastic limit of the soil
 (d) bearing capacity of the soil
29. **VG30 grade of bitumen is suitable for 7-days average maximum air temperature (degree C) of:**
 (a) <30 (b) 30-38
 (c) >45 (d) 38-45
30. **The compensated gradient on a horizontal curve of 100 m radius, if the ruling gradient provided on the road is 4% is**
 (a) 2.7% (b) 3%
 (c) 3.25% (d) 4%
31. **The transition curve used in the horizontal alignment of highways as per IRC recommendation is**
 (a) Spiral (b) Lemniscates
 (c) Cubic parabola (d) Any of the above

32. According to the recommendations of Nagpur Conference, the width formation of an ideal National Highway (N.H.) in hard rock cutting is:

- (a) 8.9 m (b) 7.9 m
(c) 6.9 m (d) 6.5 m

33. The maximum spacing for vertical stirrups of shear reinforcements shall not exceed

- (a) 0.75 d (b) 0.45 d
(c) d (d) 0.6 d

34. Read the following statements for RCC column/compression members?

- (i) A compression member may be considered as short when the maximum slenderness ratio is less than 12.
(ii) For a compressive member, the unsupported length between end restrains shall not exceed 60 times the least lateral dimension.
- (a) Only (i) is correct
(b) Only (ii) is correct
(c) Both (i) and (ii) are correct
(d) Both (i) and (ii) are incorrect

35. Which of the following statements are correct with reference to ensuring minimum shrinkage of pre-stressed concrete?

- The water-cement ratio and proportion of cement paste should be kept minimum to reduce shrinkage.
 - Aggregates of larger size, well graded for minimum void, need a smaller amount of cement paste, and attendant shrinkage will be smaller.
 - Harder and denser aggregates of low water absorptions and high modulus of elasticity will exhibit small shrinkage.
- (a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

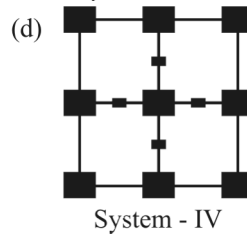
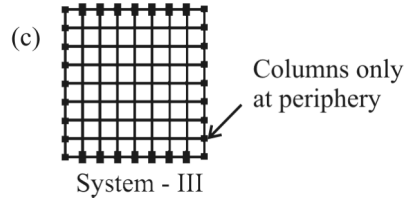
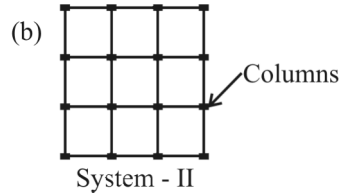
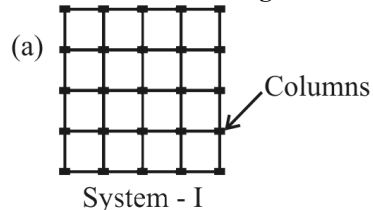
36. Consider the following statements regarding suspension cables :

- The horizontal component of the cable tension in a suspension bridge is constant at every point along the length of the cable
- Stiffening girders in a suspension bridge carry only the live load

Which of the above statements is/are correct ?

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

37. For a tall building, which framing system from the following, column placement is most economical for resisting lateral loads:

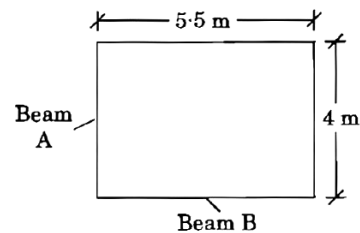


38. Which of the following are the desirable properties for efficient functioning in design for movement joint of water tank ?

- The joint should accommodate repeated movement of the structure without loss of water-tightness
- The design should provide for exclusion of grit and debris which would prevent the closing of the joint.
- The material used in the construction of movement joint should not slump unduly in hot weather or become brittle in cold weather.

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

39. Determine the slab area of which load is acting on supporting beams A and B



- (a) 5.5 m² and 7.0 m² (b) 4.0 m² and 5.5 m²
(c) 7.0 m² and 4.0 m² (d) 4.0 m² and 7.0 m²

40. The size of the rectangular section is fixed and the moment of resistance of a singly reinforced section is less than design moment. the beam shall be designed as :

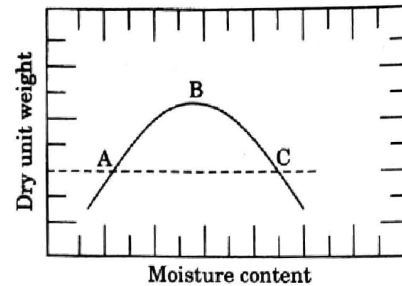
- (a) Under-reinforced (b) Over-reinforced
(c) Doubly reinforced (d) Compressive

41. Working stress of mild steel is determined from the

- (a) upper yield stress (b) ultimate stress
(c) fracture stress (d) lower yield stress

42. **In under-reinforced section**
- the depth of the actual neutral axis is less than the balanced neutral axis depth
 - the depth of the actual neutral axis is more than the balanced neutral axis depth
 - the concrete reaches maximum permissible stress first
 - both concrete and steel reach maximum permissible stresses simultaneously
43. **The main element for the initial hardening of cement paste is:**
- Tetra calcium aluminate
 - Dicalcium silicate
 - calcium oxide
 - Tricalcium silicate
44. **What is the maximum permissible acid soluble chloride content (kg/cum) for reinforced concrete?**
- 1.5
 - 0.6
 - 0.4
 - 3
45. **The top diameter, bottom diameter and the height of a slump mould are**
- 10 cm, 20 cm, 30 cm
 - 10 cm, 30 cm, 20 cm
 - 20 cm, 10 cm, 30 cm
 - 20 cm, 30 cm, 10 cm
46. **Which of the following properties is not required for concrete mix design, as per the guidelines given by the Indian Standard?**
- Specific gravity of cement
 - Density of aggregate
 - Maximum size of aggregate
 - Characteristic strength of concrete
47. **Strength of cement concrete mainly depends upon :-**
- Quality of water
 - Quantity of aggregate
 - Quantity of cement
 - Water cement ratio
48. **The striping time for the Reinforced Concrete slab spanning less than 4.5 m and using fly ash as an admixture should be-**
- 7 days
 - 10 days
 - 14 days
 - 21 days
49. **An unsupported vertical cut may be made in cohesive soil to a height of :**
- $\frac{2C}{\gamma} \tan\left(45^\circ + \frac{\phi}{2}\right)$
 - $\frac{2q_u}{\gamma} \tan\left(45^\circ + \frac{\phi}{2}\right)$
 - $\frac{4q_u}{\gamma} \tan\left(45^\circ - \frac{\phi}{2}\right)$
 - $\frac{4C}{\gamma} \tan\left(45^\circ + \frac{\phi}{2}\right)$
50. **A clay layer of thickness 10 cm and initial void ratio 0.5 undergoes settlement so that the final void ratio is 0.2. The settlement of the layer in cm is**
- 1
 - 1.5
 - 2
 - 2.5

51. **The standard Proctor compaction curve of a clay is depicted in the figure. Points A, B and C correspond to three compaction states of the soil, which fall on this curve. For which point(s) is the coefficient of permeability minimum?**



- A and C
 - A
 - B
 - C
52. **Match List-I (Test) with List-II (property) and select the correct answer using the codes given below the lists :**

List - I (Test)	List- II (property)
A. Proctor Test	1. Grain Size Analysis
B. Vane Test	2. Shear Strength
C. Penetration Test	3. Bearing Capacity
D. Hydrometer Test	4. Compaction

Code:

- | | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 4 | 1 | 3 |
| (b) | 4 | 2 | 1 | 3 |
| (c) | 4 | 2 | 3 | 1 |
| (d) | 2 | 4 | 3 | 1 |
53. **Consider the following statements regarding permeability of soils:**

- Permeability of coarse grained soil is inversely proportional to the specific surface at a given porosity.
- Direct measurement of permeability of a soil specimen at any stage of loading in Oedometer test can be made only in fixed-ring type Oedometer.
- The permeability of an aquifer increases with decrease in temperature of water moving through it.

Which of the above statements are correct?

- 1 and 2 only
 - 1 and 3 only
 - 2 and 3 only
 - 1, 2, and 3
54. **The property of the soil mass which permits the seepage of water through its interconnecting voids, is called**
- capillarity
 - permeability
 - porosity
 - none of these
55. **In comparison to Atterberg limits of normal soil, the expansive soils which of the following :**

- More liquid limit
- Less plastic limit
- Less shrinkage limit
- More volumetric shrinkage

Select the correct answers using the codes given below :

- (a) (i), (ii), (iii) and (iv)
 (b) (i), (iii) and (iv)
 (c) (ii), (iii) and (iv)
 (d) (i), (ii) and (iv)
56. If the volume of voids is equal to the volume of solids in a soil mass, then the values of porosity and void ratio respectively are
 (a) 1.0 and 0.0 (b) 0.0 and 1.0
 (c) 0.5 and 1.0 (d) 1.0 and 0.5
57. If 'A' = the maximum void ratio of the soil in the loosest condition, 'B' is the minimum void ratio of the soil in the densest condition and 'C' is the void ratio in the natural state, then the relative density is given by—
 (a) $(A - C) / (A - B)$ (b) $(A - B) / (A - C)$
 (c) $(B - C) / (B - A)$ (d) $(B - A) / (B - C)$
58. When the products of rock weathering are not transported as sediments but remain in place, the soil is known as :
 (a) alluvial soil (b) aeolian soil
 (c) residual soil (d) glacial soil
59. What is the quantity of cement (in kg) and of dry sand (in cubic meter) respectively required for preparing 1 cubic meter of wet cement mortar of 1:5 proportion?
 (a) 270 and 1.00 (b) 290 and 1.04
 (c) 290 and 1.00 (d) 310 and 1.04
60. The unit of measurement for earthwork in surface excavation exceeding 1.5 m in width as well as 10 sqm on plan but not exceeding 30 cm in depth, is in—
 (a) cu. m (b) sq. m
 (c) 10 sq.m (d) R.mt
61. While submitting tender by three envelope method, which envelope contains rates/ amount offered by the tenderer?
 (a) Envelope : 3
 (b) Envelope nos. : 1 and 2
 (c) Envelope : 1
 (d) None of the above
62. Calculate the earthwork (cum) required to fill a trapezoidal cross-section that has breadth of formation as 20m, center height as 4 m and side slopes as 1 vertical to 2 horizontal. The length of this section is 2km:
 (a) 168000 (b) 224000
 (c) 246400 (d) 268800
63. As per IS 1200, in the measurement of brickwork, no deductions shall be made for :
 (a) Opening up to 0.1 sq. m in area
 (b) Opening up to 0.01 sq. m in area
 (c) Opening up to 0.001 sq. m in area
 (d) Opening up to 1.0 sq. m in area
64. Read the following statements carefully
 (i) Plinth area is calculated by taking the external dimensions of the building at the floor level excluding plinth offsets if any.
 (ii) Balconies and cantilever projections are not included in the plinth area

(iii) Floor area is equal to plinth area minus area occupied by walls

Now, choose the correct answer from the following

- (a) Only (i) and (ii) are correct
 (b) Only (ii) and (iii) are correct
 (c) Only (i) and (iii) are correct
 (d) All (i), (ii), (iii) are correct

65. Floor Area Index (FAI) is

- (a) $\frac{\text{Covered area of all floors}}{\text{Plot area}} \times 100$
 (b) $\frac{\text{Covered area of ground floors}}{\text{Plot area}} \times 100$
 (c) $\frac{\text{Covered area of ground floors}}{\text{Plot area}} \times 100$
 (d) $\frac{\text{Covered area of all floors}}{\text{Covered area of all floors}} \times 100$

66. Direction : Match list-I with list-II and select the correct answer using code given below the two list in each question.

List I

- A. Valuation
 B. Mortgage
 C. Taxation
 D. Specification

List II

1. Determining price of property
 2. Charges levied on property
 3. Security taken for giving load
 4. Mode of describing nature and class of work

Code:

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

67. Cost slope is the ratio of

- (a) increase in cost by increase in time
 (b) decrease in cost by increase in time
 (c) increase in cost by decrease in time
 (d) decrease in cost by decrease in time

68. The relationship between the capital recovery factor and sinking fund factor in a uniform series of payments is given by

- (a) Capital recovery factor = Sinking fund factor - Interest rate
 (b) Capital recovery factor = Sinking fund factor - $(\text{Interest rate})^2$
 (c) Capital recovery factor = Sinking fund factor + $(\text{Interest rate})^2$
 (d) Capital recovery factor = Sinking fund factor + Interest rate

69. The short circulating occurring in a sedimentation tank is represented by

- (a) surface loading
 (b) displacement efficiency
 (c) recirculation ratio
 (d) detention time

70. Consider the below statements with respect to Air pollution control :
- A. Dispersion of air pollutants through long chimneys helps in diluting the air pollutants near their source.
- B. Dispersion of air pollutants through long chimneys, reduce long term undesirable effects on the community as a whole.
- Identify the correct statement/s.
- (a) Both statements are true
 (b) Statement A is true B is false
 (c) Statement B is true A is false
 (d) Both statements are false
71. Which one of the following methods would be best suited for disposal of plastic and rubber waste ?
- (a) Composting
 (b) Incineration
 (c) Pyrolysis
 (d) Sanitary landfill
72. Calculate the diameter of a circular sewer laid at a slope of 1 in 400 when it is running half full with a velocity of 1.9m/s. Take Manning's constant, $n = 0.012$.
- (a) 5.61 m (b) 3.42 m
 (c) 1.23 m (d) 2.73 m
73. The most economical and hygienic privy for rural areas is
- (a) A pit privy (b) An aqua privy
 (c) A soak pit (d) A septic tank
74. Surface loading or overflow rate of a sedimentation tank, passing a discharge Q and having length = L , Depth = D , Width = B , is given by
- (a) $Q/B D$ (b) $Q/B L$
 (c) $Q/B D$ (d) $Q/B D.L$
75. List-I contains some properties of water/wastewater and List-II contains some tests on water/wastewater. Match the property with corresponding test and select the correct answer using the codes given below the Lists-
- List-I
- A. Suspended solids concentration
 B. Metabolism of biodegradable organics
 C. Bacterial concentration
 D. Coagulant dose
- List-II
1. BOD
 2. MPN
 3. Jar
 4. Turbidity
- Codes :
- | | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 1 | 4 | 3 |
| (b) | 4 | 1 | 2 | 3 |
| (c) | 2 | 4 | 1 | 3 |
| (d) | 4 | 2 | 1 | 3 |
76. Coincident draft in relation to water demand is based on:
- (a) Peak hourly demand
 (b) Maximum daily demand
 (c) Maximum daily demand + fire demand
 (d) Greater of (a) and (c)
77. If 'p' is the precipitation, 'a' is the area represented by a rain gauge, and 'n' is the number of rain gauges in a catchment area, then the weighted mean rainfall is
- (a) $\frac{\sum ap^3}{\sum a^2}$ (b) $\frac{\sum ap}{n}$
 (c) $\frac{\sum ap}{\sum a}$ (d) $\frac{\sum ap^5}{\sum a^3}$
78. Tropical grasslands receive.....cm of annual precipitation.
- (a) 25–100 (b) 30–45
 (c) upto 150 (d) 200–210
79. The pressure on the phreatic line in case of homogeneous earthen dam
- (a) is positive
 (b) is atmospheric
 (c) is negative
 (d) depends on condition of soil
80. Silt excludes are provided
- (a) near the canal head regulator
 (b) at the lowest portion of the dam
 (c) near the afflux bunch
 (d) below the spillway
81. The available moisture of soil is equal to its
- (a) the moisture content at permanent wilting point
 (b) the difference in the moisture content of the soil between field capacity and permanent wilting point
 (c) the maximum moisture holding capacity
 (d) all of the above
82. Drag force is a function of :
- (1) projected area of the body
 (2) mass density of the fluid
 (3) velocity of the body
- The correct answer is :
- (a) 1 and 2 (b) 2 and 3
 (c) 1 and 3 (d) all of the above
83. Name the ratio of power available at the shaft of a turbine to the power delivered by water to the runner.
- (a) volumetric efficiency
 (b) overall efficiency
 (c) mechanical efficiency
 (d) hydraulic efficiency

84. **Discharge through a single acting reciprocating pump is:**
 (a) $Q = ALN/60$ (b) $Q = ALN$
 (c) $Q = 2ALM/60$ (d) $Q = 2ALN$
85. **In which of the following types of flow, the losses are maximum?**
 (a) Laminar flow (b) Turbulent flow
 (c) Critical flow (d) Transition flow
86. **In a friction loss in pipe flow, the expression for coefficient of friction (f) in terms of shear stress is :**
 (a) $\frac{\tau_0}{\rho V^2}$ (b) $\frac{2\tau_0}{V^2}$
 (c) $\frac{2\tau_0}{\rho V^2}$ (d) $\frac{2\tau_0}{\rho V}$
87. **In a barrage, crest level is kept**
 (a) high with small gates
 (b) low with small gates
 (c) low with large gates
 (d) high with large gates
88. **The value of friction factor for smooth pipes for Reynolds number equal to 10^6 is approximately**
 (a) 0.0001 (b) 0.001
 (c) 0.01 (d) 0.1
89. **The metacentric height of an object is related to period of oscillation by the relation :**
 (a) $2\pi\sqrt{\frac{k^2}{h.g}}$ (b) $2\pi\sqrt{\frac{h.g}{k^2}}$
 (c) $\frac{1}{2\pi}\sqrt{\frac{k^2}{h.g}}$ (d) $\frac{1}{2\pi}\sqrt{\frac{h.g}{k^2}}$
 where, k = radius of gyration of the floating body about its centre of gravity
 h = meta-centric height of the floating body.
90. **A hand pump is a type of**
 (a) Centrifugal pump
 (b) Reciprocating pump
 (c) Rotary pump
 (d) Jet pump
91. **Jhama bricks are**
 (a) Well burnt having smooth and even surface
 (b) Slightly over burnt having rough surface
 (c) Under burnt and can be easily broken
 (d) Over burnt with irregular shape
92. **Rocks behave as _____ masses towards operating stresses.**
 (a) inelastic (b) elastic
 (c) isotropic (d) anisotropic
93. **The fineness modulus of aggregates approximately**
 (a) Is directly proportional to the average size of the particles
 (b) Is inversely proportional to the average size of the particles
 (c) Indicates the water absorption of the aggregates
 (d) Indicates the modulus of elasticity of the aggregates
94. **The central part of a tree is called**
 (a) Heart wood (b) Cambium
 (c) Sap wood (d) Pith
95. **Match list I with list II in question and select the correct answer by using code given below:**
- | List I | List II |
|-------------------------|------------------------------------------------------|
| A. Aluminium paint | 1. For resisting corrosive reaction |
| B. Anti corrosive paint | 2. For painting iron work under water |
| C. Bituminous paint | 3. For painting surfaces exposed to high temperature |
| D. Cellulose paint | 4. For painting oil storage tank |
- Code:**
- | | A | B | C | D |
|-----|---|---|---|---|
| (a) | 1 | 2 | 3 | 4 |
| (b) | 3 | 2 | 4 | 1 |
| (c) | 4 | 1 | 2 | 3 |
| (d) | 1 | 3 | 2 | 4 |
96. **Consider the following methods of preservation of timber**
 1. Pressure application
 2. Brush application
 3. Dipping
 4. Open tank application
The correct sequence of these methods in the increasing order of their effectiveness is
 (a) 1, 3, 4, 2 (b) 3, 4, 2, 1
 (c) 2, 3, 4, 1 (d) 4, 2, 1, 3
97. **A first class brick should have a minimum crushing strength of :**
 (a) 7 MN/m² (b) 10.5 MN/m²
 (c) 12.5 MN/m² (d) 14 MN/m²
98. **What is determined by conducting an abrasion test?**
 (a) aggregate crushing value
 (b) toughness
 (c) hardness
 (d) soundness
99. **Which one of the correct sequence of various operations of preparation of Brick Earth**
 I. Blending II. Digging
 III. Weathering IV. Unsoiling
 V. Tempering
 (a) IV, II, III, V, I (b) IV, II, III, I, V
 (c) II, IV, V, III, I (d) II, III, IV, V, I
100. **Which of the following pairs is not matched correctly?**
- | Cement test | Apparatus |
|-----------------|---------------------|
| (a) Fineness | 1. Nurse and Blains |
| (b) Consistency | 2. Vicat |
| (c) Soundness | 3. Le-Chatelier |
| (d) Sp. Gravity | 4. Lea and Nurse |

Answer Key

1. (a)	11. (c)	21. (c)	31. (a)	41. (d)	51. (c)	61. (a)	71. (c)	81. (b)	91. (d)
2. (d)	12. (a)	22. (b)	32. (b)	42. (a)	52. (c)	62. (b)	72. (c)	82. (d)	92. (b)
3. (b)	13. (d)	23. (b)	33. (a)	43. (d)	53. (a)	63. (a)	73. (b)	83. (c)	93. (a)
4. (b)	14. (d)	24. (a)	34. (c)	44. (b)	54. (b)	64. (d)	74. (b)	84. (a)	94. (d)
5. (b)	15. (b)	25. (d)	35. (d)	45. (a)	55. (a)	65. (a)	75. (b)	85. (b)	95. (d)
6. (a)	16. (d)	26. (a)	36. (c)	46. (b)	56. (c)	66. (b)	76. (c)	86. (c)	96. (c)
7. (b)	17. (b)	27. (b)	37. (c)	47. (d)	57. (a)	67. (c)	77. (c)	87. (c)	97. (b)
8. (c)	18. (a)	28. (a)	38. (a)	48. (b)	58. (c)	68. (d)	78. (c)	88. (c)	98. (c)
9. (d)	19. (c)	29. (d)	39. (d)	49. (d)	59. (d)	69. (b)	79. (b)	89. (a)	99. (b)
10. (a)	20. (c)	30. (d)	40. (c)	50. (c)	60. (b)	70. (b)	80. (a)	90. (b)	100. (d)

Solution

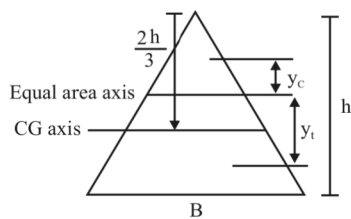
1.

Ans. (a) : Shape factor for triangular section :-

$$\left[\text{Shape factor} = \frac{\text{Plastic Modulus}}{\text{Section Modulus}} \right]$$

$$\text{Plastic Modulus 'Zp'} = \frac{A}{2}(y_c + y_t)$$

$$\text{Section Modulus 'Z'} = \frac{\frac{bh^3}{36}}{\frac{2h}{3}} = \frac{bh^2}{24}$$



$$S = \frac{Z_p}{Z} = \frac{\frac{A}{2}(y_c + y_t)}{\frac{bh^2}{24}}$$

$$\boxed{S = 2.346}$$

■ Shape factor of various section-

- Rectangular 'S' = 1.5
- Circular 'S' = 1.7
- I-section 'S' = 1.132

2.

Ans. (d) : Web buckling occurs when the vertical compressive stress in the web at mid height reaches the critical buckling stress, as the thin web acts as a long slender column due to the action of heavy concentrated load on a beam a reason of high compressive stress is formed directly under the loads.

3.

Ans : (b) In design of gantry girder we consider gantry load, lateral load and longitudinal loads.

4.

Ans. (b) : As per IS 800-1984 clause 5.7.2.1. The lacing of compression members shall be proportioned to resist a total transverse shear 'V' equal to at least 2.5% of the axial force in the member.

5.

Ans. (b) : The maximum permissible slenderness ratio of tension members liable to reversal of stress due to action of wind and earthquake is 350.

6.

Ans: (a) A butt weld is specified by effective throat thickness.

7.

Ans. (b) In case of staggered pitch may be increased by 50% of values specified above provided gap distance is less than 75 mm (sec clause 10.2.3.4 of code IS 800 : 2007)

Staggered system $p_{\max} = 18t$ or 300 mm

non-staggered $p_{\max} = 12t$ or 200 mm (non-staggered)

8.

Ans : (c) Given $B = 30 \text{ cm} = 300 \text{ mm}$, $t = 10 \text{ mm}$

Given nominal diameter $d = 18 \text{ mm}$

Gross diameter of hole $(D) = 18 + 1.5 = 19.5 \text{ mm}$

$$\begin{aligned} \text{Net sectional area} &= (B - nD) t \\ &= (300 - 19.5) \times 10 \\ &= 2805 \text{ mm}^2 \\ &= 28.05 \text{ cm}^2 \end{aligned}$$

9.

Ans. (d) :		
Theory	Given by	Remark
Maximum Principal Stress or Maximum Normal Stress	Rankine	Suitable for Brittle
Maximum Principal Strain	St. Venant	Neither accurate for Brittle nor Ductile
Maximum shear Stress	Guest and Treseca	Suitable for Ductile
Maximum Strain Energy	Haigh and Beltrami	Ductile
Maximum shear Strain Energy	Vonmises and Henky	Ductile

10.

Ans. (a) :

- G.N. Money developed slope deflection method.
- Hardy cross developed moment distribution method.
- Euler gave formula for crippling load on a column.
- Claypeyron found three moment equation for continuous beams.

11.

Ans. (c) : Bending Equation (Flexure formula)

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

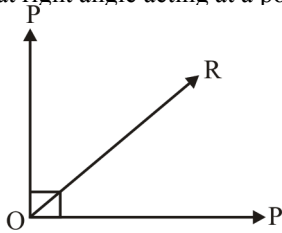
12.

Ans. (a) : For a beam, shear span is defined as the zone where shear force is constant.

13.

Ans. (d)

Two force 'P' at right angle acting at a point 'O'.



According to Parallelogram law of forces if two forces acting at a point are represented in magnitude and direction by the two sides of parallelogram, then the resultant of these two force is represented in magnitude and direction by the diagonal of parallelogram passing through the same point.

So,

$$R = \sqrt{P^2 + P^2 + 2P.P \cos 90^\circ} \quad \because [\theta = 90^\circ]$$

$$R = \sqrt{2P^2 + 0}$$

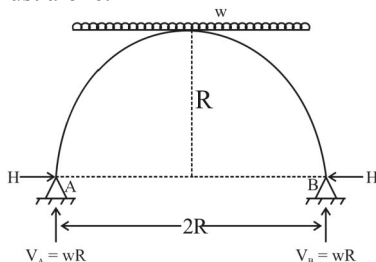
$$R = \sqrt{2} P \text{ Resultant.}$$

14.

Ans. (d)

15.

Ans. (b) : A two hinged parabolic arch carries a UDL of w per unit run on entire span then it is subjected to normal thrust alone.



$$\text{normal thrust (H)} = \frac{4WR}{3\pi}$$

16.

Ans. (d) : For space frames number of equation of equilibrium is 6.

Equations of equilibrium for space frames

$$\Sigma f_x = 0 \quad , \quad \Sigma M_x = 0$$

$$\Sigma f_y = 0 \quad , \quad \Sigma M_y = 0$$

$$\Sigma f_z = 0 \quad , \quad \Sigma M_z = 0$$

17.

Ans. (b) : In theodolite survey, the telescope is said to be inverted, if the vertical circle is to the right of the observer and the bubble of the telescope is down.

18.

Ans. (a) $g_1 = +3\%$, $g_2 = -2\%$

change in gradient,

$$N = g_1 - (-g_2) = 3 + 2 = 5\%$$

since rate of change of gradient is 0.06% per 20 m chain

$$\therefore \text{length of curve} = \frac{20}{0.06} \times 5$$

$$= 1666.66 \text{ m or } 83.3 \text{ chain}$$

19.

Ans. (c) : $D = KS + C$

$K = 100$, $C = 0$

$$D = 100 \times 0.75 + 0 = 75 \text{ m}$$

20.

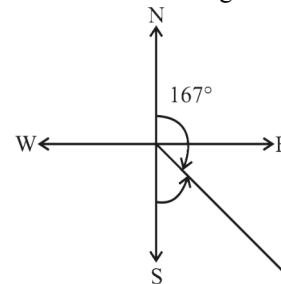
Ans.: (c) Compare Direct and Indirect Method—

Direct Method	Indirect Method
Very tedious	Not tedious
Accurate	Less accurate
Slow	Fast
Requires more resources	Less resources
Suitable small area	Large area
Point are physically located on the ground	Points are interpolated in the office

21.

Ans. (c) : Magnetic bearing of sun = 167°

Magnetic declination = $180^\circ - \text{magnetic bearing}$.



$$\delta = 180^\circ - 163^\circ$$

$$\delta = 13^\circ \text{ E (towards east)}$$

22.

Ans. (b) : Correction of sag is always be negative because when tape is supported at two ends but due to weight, it is sag thus apparent length is greater than actual length thus correction is negative

$$C_{\text{sag}} = \frac{W^2 L}{24P^2}$$

W = Weight of tape, $W = wL$

P = Pull applied

L = Length between ends

23.

Ans. (b) : Geodetic Surveying is used for getting control points for horizontal control.

24.

Ans. (a) : Shrinkage Factor (S.F) = $\frac{9.8}{10} = 0.98$
 Correct R.F = $\frac{1}{200} \times 0.98$

$$= \frac{1}{204.08}$$

$\therefore 1 \text{ cm} = 204.08 \text{ cm}$

$\therefore 10 \text{ cm} = 20.40 \text{ cm}$

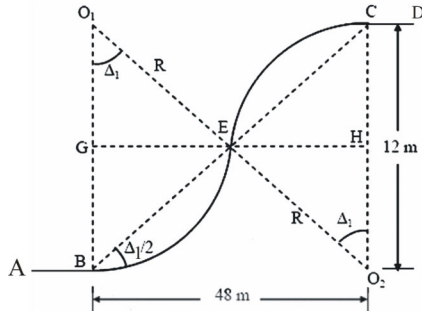
25.

Ans. (d) : The correct sequence of the survey is

- (a) Map study
- (b) Reconnaissance survey
- (c) Preliminary survey
- (d) Detailed survey or location survey.

26.

Ans. (a) Let AB and CD are two parallel line which is to be connected by a reverse curve BEC.



$$\tan\left(\frac{\Delta_1}{2}\right) = \frac{12}{48} = \frac{1}{4}$$

$$\therefore \frac{\Delta_1}{2} = 14^\circ 2'$$

$$\therefore \Delta_1 = 28^\circ 4'$$

From fig

$$GE = R \sin \Delta_1$$

$$GH = 2R \sin \Delta_1 \quad \therefore (GH = 2GE \quad \therefore [GE = EH])$$

$$2R \sin \Delta_1 = 48 \text{ m}$$

$$R = \frac{48}{2 \sin \Delta_1} = \frac{48}{2 \sin 28^\circ 4'} = 51.1 \text{ m}$$

27.

Ans. (b) :

$$\text{ sleeper density} = N + 6$$

$$N = 13 \text{ for broad gauge}$$

$$\text{ sleeper density} = 13 + 6 = 19$$

Total no. of sleeper required for

$$500 \text{ m broad gauge track construction} = \frac{19}{13} \times 500$$

$$= 730.76 \approx 741 \text{ (nearest value)}$$

28.

Ans. (a) : Soil reaction pr (P) = kΔ

k = modulus of subgrade reaction

Δ = deflection

$$k = \frac{P}{\Delta}$$

29.

Ans. (d) : VG-30 is specially used to construct extra heavy duty bitumen pavements that need to tolerate significant traffic loads. It has 7 days temperature as 38-45°C.

30.

Ans. (d) : Grade compensation,

$$\frac{75}{R} = \frac{75}{100} = 0.75\%$$

$$\frac{30 + R}{R} = \frac{30 + 100}{100} = 1.3\%$$

} minimum

$$\text{Compensated grade} = 4\% - 0.75\%$$

$$= 3.25\% \neq 4\%$$

31.

Ans : (a) Common type transition curve used are -

- (1) spiral (also called clothoid)
- (2) lemniscates
- (3) Cubic parabola

IRC recommended spiral transition which fulfill the below condition.

$$L_s \propto \frac{1}{R} \text{ or } \{L_s R = \text{const.}\}$$

32.

Ans. (b) : • Nagpur Road Congress conference is famous as Nagpur Plan. A twenty year development programme for the period (1943-1963) was finalized. It was the first attempt to prepare a coordinated road development programme in a planned manner.

• In this plan roads are classified in the following categories as

- National Highway
- State Highway
- Major District roads
- Other District Roads
- Village Roads

33.

Ans. (a) : IS 456 stipulates that the maximum spacing of shear reinforcement measured along the axis of the member shall not be more than 0.75 d for vertical stirrups and d for inclined stirrups at 45°.

34.

Ans. (c) : For RCC column/compression member

(1) A compression members may be considered as short when the maximum slenderness ratio < 12.

(2) For a compression member, the unsupported length between end restraint shall not exceed 60 times the least lateral dimension.

35.

Ans. (d) : Shrinkage in concrete is its contraction due to drying and chemical charges. It depends upon the quantity of water, type of aggregates used in the mix and surrounding atmospheric conditions.

If minimum shrinkage is desired, the water cement ratio and the proportion of cement paste should be kept to a minimum aggregates of larger size, well graded for minimum void, need a smaller amount of cement paste, and shrinkage will be smaller. Harder and denser aggregates of low absorptions and high modulus of elasticity will exhibit small shrinkage. Shrinkage is