CIVIL ENGINEERING

Time Allowed: **Three Hours** Maximum Marks: **300**

INSTRUCTIONS

1. *IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES NOT HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.*
2. ***Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet series Code A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.***
3. *You have to enter your Roll Number on the Test. Booklet in the Box provided alongside.* ***DO NOT write anything else*** *on the Test Booklet.*
4. *This Test Booklet contains* ***150*** *items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case, you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose* ***ONLY ONE*** *response for each item.*
5. *You have to mark all your response* ***ONLY*** *on the separate Answer Sheet provided. See directions in the Answer Sheet.*
6. *All items carry equal marks.*
7. *Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particular in the Answer Sheet as per instructions sent to you with your Admission Certificate.*
8. *After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator only the Answer Sheet. You are permitted to take away with you the Test Booklet.*
9. *Sheets for rough work are appointed in the Test Booklet at the end.*
10. ***Penalty for wrong answer:***

    THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE.

    - ***(i)*** *There are alternate for the answer to every question. For each question for which a wrong answer has been given by the candidate, one-third (0.33) of the marks assigned to that question will be deducted as penalty.*
    - ***(ii)*** *If a candidate gives more than one answer, it will be treated as a wrong answer even if one of the given answers happens to the correct and there will be same penalty as above to that question.*
    - ***(iii)*** *If a question is left blank, i.e., no answer is given by the candidate, there will be no penalty for that question.*

1. A network of pipes conveying water to a city has the following specifications. The diameter of a main pipe is 30 cm and it branches into two pipes of diameters 20 cm and 15 cm respectively. If the average velocity in the main pipe is 2.5 m/s and the average velocity in the 20 cm pipe is measured as 2 m/s, what is the velocity in the 15 cm pipe?

(A) 8.84 m/s

(B) 7.44 m/s

(C) 5.84 m/s

(D) 6.44 m/s

2. A centrifugal pump delivers water against a net head of 14.5m and a design speed of 1000 r.p.m. The vanes are curved back to an angle of 30° with the periphery. The impeller diameter is 300 mm and the outlet width is 50 mm. What is the tangential velocity of impeller at outlet?

(A) 15.7 m/s (B) 13.2 m/s

(C) 9.7 m/s (D) 11.2 m/s

3. A 7.5 cm diameter jet of water strikes a curved plate at its centre with a velocity of 20 m/s. The curved plate is moving with a velocity of 8 m/s in the direction of the jet. The jet is deflected through an angle of 165°. By assuming the plane as smooth, what is the angle made by the relative velocity at the outlet of the plate?

(A) 45° (B) 30° (C) 15° (D) 0°

4. A reservoir has a head of 40 m and a channel leading from the reservoir permits a flow rate of 34 m^3/s. If the rotational speed of the rotor is 150 r.p.m., what is the power of the turbine? (Take g = 9.81 m/s^2)

(A) 14.34 MW

(B) 13.34 MW

(C) 12.34 MW

(D) 11.34 MW

5. A stream function is given by $\psi = 3x^2 - y^3$. What is the magnitude of velocity components at the point (2, 1)?

(A) 8.52 (B) 9.17 (C) 10.81 (D) 12.37

6. Full load is supplied by the turbine shaft when the diameter of jet issuing from the nozzle is 150 mm. If the load suddenly drops to 36% of the full load, what diameter of the jet should be attained by regulating the spear rod?

(A) 15 mm

(B) 45 mm

(C) 90 mm

(D) 180 mm

7. What is the depth of a point below water surface in sea, where pressure intensity is 1.006 MN/m^2? (Specific gravity of sea water is 1.025)

(A) 60 m (B) 80 m (C) 100 m (D) 120 m

8. Two pressure points in a water pipe are connected to a manometer which has the form of an inverted U-tube. The space above the water in the two limbs of the manometer is filled with toluene (specific gravity is 0.875). If the difference of level of water columns in

the two limbs reads 12.0 cm, what is the corresponding difference of pressure?

(Take g = 9.81 m/s^2)

(A) 110.49 N/m^2

(B) 128.12 N/m^2

(C) 131.34 N/m^2

(D) 147.15 N/m^2

9. What is the minimum size of glass tube that can be used to measure water level if the capillary rise in the tube is to be restricted to 2mm? (Take surface tension of water in contact with air as 0.073575 N/m)

(A) 1.5 cm (B) 1.0 cm

(C) 2.5 cm (D) 2.0 cm

10. A semi-tubular cylinder of 75 mm radius with concave side upstream (drag coefficient = 2.3) is submerged in flowing water of velocity 0.6 m/s. If the cylinder is 7.2 m long and density of water is 1000 kg/m^3, what is the drag?

(A) 150 N

(B) 173 N

(C) 955 N

(D) 223 N

11. A double acting reciprocating pump having piston area 0.1 m^2 has a stroke length 0.30m. The pump is discharging 2.4 m^3 of water per minute at 45 r.p.m. throughout a height of 10m. What is the slip of the pump?

(A) $0.005\,m^3/s$ (B) $0.015\,m^3/s$

(C) $0.025\,m^3/s$ (D) $0.035\,m^3/s$

12. If pressure head of water is 100 m and specific gravity of kerosene is 0.81, what is the pressure head of kerosene?

(A) 123.5 m of kerosene

(B) 241.3 m of kerosene

(C) 75.1 m of kerosene

(D) 52.4 m of kerosene

13. A lake has an area of 15 km^2. Observation of hydrological variables during a certain year has shown as follows:

Precipitation = 700 mm/year;

Average inflow $Q_{in} = 1.4\,m^3/s$;

Average outflow $Q_{out} = 1.6\,m^3/s$,

Assume that there is not net water exchange between the lake and the groundwater. What is the evaporation during this year?

(A) 480 mm (B) 280 mm

(C) 380 mm (D) 180 mm

14. A bridge has an expected life of 25 years and is designed for a flood magnitude of return period 100 years. What is the risk of this hydrologic design?

(A) $1-\left(\frac{100}{99}\right)^{25}$

(B) $\left(\frac{99}{100}\right)^{25}$

(C) $1-\left(\frac{99}{100}\right)^{25}$

(D) $\left(\frac{100}{99}\right)^{25}$

15. In a groundwater field test, a trace took 8 hours to travel between two observation wells which are 56m apart. The difference in water table elevations in these wells was 0.70m.The volume of the void of the aquifer is 30% of the total volume of the aquifer. What is the hydraulic conductivity of the aquifer, if the dynamic viscosity of water is $0.995\times10^{-3}\ \text{Ns/m}^2$?

(A) 4.664 cm/s

(B) 3.664 cm/hr

(C) 2.664 mm/s

(D) 1.664 cm/hr

16. Consider the following statements regarding channel routing:

1. In channel routing, the flood hydrograph at various sections of the reach is predicted by considering a channel reach and an input hydrograph at the upstream end.

2. As the flood wave moves down the river, the shape of the wave does not change.

3. Flood waves passing down a river have their peaks attenuated due to friction.

4. The addition of lateral inflows can cause an increase of attenuation.

Which of the above statements are **not** correct?

(A) 1 and 3 only

(B) 2 and 3 only

(C) 1 and 4 only

(D) 2 and 4 only

17. Consider the following statements related to water logging control:

1. It is evident that water logging can be controlled only if the quantity of water into the soil below is checked and reduced.

2. Attempts should be made to reduce the seepage of water from the canals and water courses.

3. The entire irrigable land should receive canal water in all seasons.

Which of the above statements are correct?

(A) 1 and 2 only (B) 2 and 3 only

(C) 1 and 3 only (D) 1, 2 and 3

18. If wheat requires 7.5cm of water after every 28 days and the base period for wheat is 140 days, what is the value of delta for wheat?

(A) 7.5 cm (B) 27.5 cm

(C) 37.5 cm (D) 17.5 cm

19. A tile drainage system draining 12 hectares, flows at a designed using a drainage coefficient of 1.25cm, how much of water will be removed during this period?

(A) 1500 m^3 (B) 4500 m^3

(C) 3000 m^3 (D) 3500 m^3

20. What is the hydraulic radius of a stable canal carrying a discharge of 27 m^3/s using Lacey's method? (Assume silt factor is 1.0)

(A) 1.44 m

(B) 2.67 m

(C) 3.14 m

(D) 4.28 m

21. Consider the following statements regarding loss of water in canals:

1. The water lost by evaporation is generally very small as compared to the water lost by seepage in certain channels.

2. In percolation, there exists a zone of continuous saturation from the canal to the water-table and a direct flow is established.

3. In absorption, a small saturated soil zone exists around the canal section and is surrounded by a zone of decreasing saturation.

Which of the above statements are correct?

(A) 1 and 2 only

(B) 2 and 3 only

(C) 1 and 3 only

(D) 1, 2 and 3

22. The chief aim of river training is

(A) to protect water from loss

(B) bed sourcing

(C) to achieve ultimate stability of river with the aid of river training measures

(D) pitching of banks and provision of launching aprons

23. Which one of the following conditions is correct for a channel to behave in there regime?

(A) Discharge is non-uniform

(B) Flow is non-uniform

(C) Silt grade is varying

(D) Silt charge is constant

24. What is the delta for a crop when its duty is 864 hectares/cumec on the field and the base period of this crop is 120 days?

(A) 120 cm

(B) 140 cm

(C) 160 cm

(D) 172 cm

25. Which one of the following is the merit of combined sewer system?

(A) Rain water dilutes the sewage, therefore, it can be easily and economically treated

(B) Initial cost is high as compared with separate system

(C) If the whole sewage is to be disposed off by pumping, it is uneconomical

(D) During heavy rains, the overflowing of sewers will endanger the public health

26. Which one of the following is a device used for measuring the velocity of flowing water in pipes or open channels?

(A) Pitot tube

(B) Piezometer

(C) Venturimeter

(D) Venturi tube

27. Which one of the following is the process in which ammonia is oxidized to nitrites and then to nitrates by aerobic bacteria?

(A) Nitrification

(B) Denitrification

(C) Adsorption

(D) Regeneration

28. A tank into which raw or partly treated sewage is collected, left to stay, and discharged at such a rate as may be necessary for subsequent treatment, is called

(A) Dosing tank

(B) Sedimentation tank

(C) Skimming tank

(D) Settling tank

29. In the context of sludge conditioning, Elutriation is synonymous to

(A) Washing

(B) Heating

(C) Compacting

(D) Filtering

30. Sludge thickening is commonly achieved by the following methods:

1. Gravity thickness

2. Air flotation

3. Centrifugation

Which of the above methods are correct?

(A) 2 and 3 only

(B) 1 and 2 only

(C) 1 and 3 only

(D) 1, 2 and 3

31. Which one of the following is the process whereby chemicals are added to a wastewater resulting in a reduction of the forces tending to keep suspended particles apart?

(A) Coagulation (B) Flocculation

(C) Clarification (D) Sedimentation

32. Which one of the following is a grit-removal unit which also removes silt as well as some organic matter along with grit?

(A) Detritus Tank

(B) Skimming Tank

(C) Detention Tank

(D) Suspension Tank

33. The domestic sewage of a town was tested for total solids and the following results were obtained:

Weight of sample sewage = 1000 gm

Weight of solids after evaporation liquid = 0.952 gm

Weight of dry residue after ignition = 0.516 gm

What is the value of volatile solids?

(A) 952 ppm

(B) 516 ppm

(C) 436 ppm

(D) 694 ppm

34. The quantity of nitrogen present in wastewater before the decomposition of organic matter has started, is indicated by

(A) Albuminoid Nitrogen

(B) Free Ammonia

(C) Organic Nitrogen

(D) Nitrate Nitrogen

35. Which one of the following is that (low) water content of the soil at which plants can no longer extract sufficient water for their growth?

(A) Wilting point
(B) Tail water
(C) Irrigating head
(D) Capillary water

36. Which one of the following is the advantage of using activated carbon for water treatment?
(A) When used in powdered form after coagulation, it does not aid in coagulation
(B) It increases the chlorine demand of treated water
(C) It removes organic matter present in water
(D) Its overdose is harmful

37. A soil has bulk density of 20.1 kN/m^3 and water content 15%. What is the water content if the soil partially dries to a density of 19.4 kN/m^3 and the void ratio remains unchanged?
(A) 10.86%
(B) 10.76%
(C) 10.68%
(D) 10.66%

38. A fine grained soil is found to have a liquid limit of 90% and a plasticity index of 50. The natural water content is 28%. What is the liquidity index?
(A) –0.34 (B) –0.14 (C) –0.24 (D) –2.40

39. A concentrated load of 2000 kN is applied at the ground surface. What is the vertical stress at a point 6m directly below the load?
(A) 16.42 kN/m^2 (B) 26.53 kN/m^2
(C) 36.12 kN/m^2 (D) 40.51 kN/m^2

40. Which one of the following is a characteristic of local shear failure?
(A) Failure pattern is not clearly defined
(B) Failure surfaces reach ground surfaces
(C) There is no bulging of soil around the footing
(D) Failure is not sudden and there is no tilting of footing

41. A sample of silty has a volume of 14.88 cm^3, a total mass of 28.81 gm, a dry mass of 24.83 gm and a specific gravity of solids 2.7. What is the void ratio?
(A) 0.412 (B) 0.521 (C) 0.618 (D) 0.663

42. A constant head permeability test is carried out on a cylindrical sample of sand 10 cm diameter and 15 cm height. 160 cm^3 of water is collected in 1.75 minutes, under a head of 30cm. What is the coefficient of permeability in m/year?
(A) 1257 m/year (B) 2111 m/year
(C) 3060 m/year (D) 3332 m/year

46. The void ratio of a clay sample is 0.5 and the degree of saturation is 70%. What is the bulk unit weight of the soil? (Assume G = 2.7)
(A) 10.46 kN/m^3
(B) 14.32 kN/m^3
(C) 17.77 kN/m^3
(D) 19.95 kN/m^3

47. What is the coefficient of volume change (using change in void ratio method) for pressure range 100 kN/m^2 to 200 kN/m^2? (Consider $\sigma_0' = 100\ kN/m^2$, $e_0 = 1.121$, $\sigma' = 200\ kN/m^2$, $e_0 = 0.964$, $\Delta\sigma' = 100\ kN/m^2$ and $\Delta e = -0.157$)

(A) 0.25 m^2/MN

(B) 0.48 m^2/MN

(C) 0.69 m^2/MN

(D) 0.74 m^2/MN

48. Which one of the following problems is required to be studied in the design of earth dams?

(A) The prediction of the position of the line of seepage in the longitudinal section

(B) The computation of seepage loss

(C) The seepage line should cut the down-stream slope

(D) The seepage loss through the dam should be maximum

49. Which one of the following is not an instrument for setting out right angles?

(A) Cross staff

(B) Site square

(C) Prism square

(D) Optical staff

50. Which one of the following is correct for Prismatic Compass?

(A) The graduated ring rotates with line of sight

(B) Instrument cannot be used without tripod

(C) The graduations are engraved inverted

(D) The readings can directly be taken by seeing through the top of the glass

51. Magnetic declination at a place is the horizontal angle between

(A) the true meridian and the arbitrary meridian

(B) the magnetic meridian and the arbitrary meridian

(C) the true bearing and the magnetic bearing

(D) the true meridian and the magnetic meridian

52. The magnetic bearing of a line AB is S28°30′E. What is the true bearing of line AB if the magnetic declination is 7°30′ towards west?

(A) S36°E (B) N21°W

(C) S21°E (D) N36°W

53. The Zenith is/are

(A) the point on the upper portion of the celestial sphere marked by plum line above the observer

(B) the point on the lower portion of the celestial sphere marked by plumb line below the observer

(C) the two points in which the Earth's axis of rotation meets the Earth's sphere

(D) the great circle of the Earth, the plane of which is at right angles to the axis of rotation

54. Which one of the statements is not correct for remote sensing?

(A) It requires energy source

(B) It requires propagation of energy through atmosphere

(C) It requires energy interaction with the Earth's surface features

(D) It requires absorption of energy by the Earth's surface

55. Energy in remote sensing deals with which region of electromagnetic spectrum?

(A) Ultraviolet (B) Infrared

(C) X-Ray (D) Gamma Ray

56. Consider the following statements related to the classification based upon the object of survey:

1. Archaeological surveys for unearthing relics of antiquity.

2. Geological surveys for determining different strata in the Earth's crust.

3. Mine surveys for exploring mineral wealth such as gold, coal, etc.

Which of the above statements are correct?

(A) 1 and 2 only (B) 2 and 3 only

(C) 1 and 3 only (D) 1, 2 and 3

57. In setting up of plane table at a station P, the corresponding point on the plan was not accurately centered above P. If the displacement of P was 30 cm in a direction at right angles to the ray and scale is 1 cm = 2m, how much on the plan would be the consequent displacement of point from its true position?

(A) 0.15 mm

(B) 6.0 mm

(C) 1.5 mm

(D) 0.3 mm

58. A photographic survey is carried out to a scale of 1: 20000. A camera with a wide angle lens of f = 170 mm was used with 25 cm × 25 cm plate size for a net 65% overlap along the line of flight. What is the error in height given by an error of 0.15 mm in measuring the parallax of the point?

(A) 5.15 m

(B) 5.27 m

(C) 5.83 m

(D) 6.45 m

59. What is the aeroplane flying height to obtain the average scale of the photograph equal to $\frac{1}{7200}$? (Ground surface elevations vary from 160m to 430 m and focal length of the camera lens is 153 mm)

(A) 1021 m

(B) 1145 m

(C) 1284 m

(D) 1397 m

60. Which one of the following conditions shall be fulfilled when a transition curve is inserted between the tangent and circular curve?

(A) It should not meet the original straight tangentially

(B) It should not meet the circular curve tangentially

(C) Its radius at the junction with the circular curve should be the same as that of the circular curve

(D) The rate of decrease of curvature along the transition curve should be same as that of increase in superelevation

61. Consider the following statements related to road pavements:

1. Deflections measured near cracks are normally much lower than the measurements in non-distressed areas.

2. Deflection measurements near longitudinal joints, transverse joints or corners are higher than those measured at mid-slab for concrete pavements.

3. Thermal and moisture gradient in the vertical direction of the concrete slabs does not have any influence on deflection measurements.

4. Measurements taken at night or in the early morning are considerably different from those obtained in the afternoon.

Which of the above statements are **not** correct?

(A) 1 and 2 only

(B) 1 and 3 only

(C) 2 and 4 only

(D) 1, 2 and 4 only

62. Which one of the following tunneling methods is adopted for the situations where the metro alignment passes under residential building or a canal?

(A) Earth pressure balance tunneling machine method

(B) Tunnel boring machine method

(C) Tube tunneling method

(D) Driven shield tunneling method

63. Consider the following statements related to the advantages of concrete sleepers:

1. Concrete sleepers can generally be mass produced using local resources.

2. Concrete sleepers are not suitable for beater packing.

3. Concrete sleepers have a very long lifespan.

4. Concrete sleepers have no scrap value.

Which of the above statements is/are correct?

(A) 1 only

(B) 1 and 3 only

(C) 2 only

(D) 2 and 4 only

64. Which one of the following is **not** the method of tunneling in hard rock?

(A) Full-face heading method

(B) Heading and bench method

(C) Drift method

(D) Shaft method

65. Consider the following statements related to the advantage of uniformly of rail gauges:

1. As transshipping is not required, there is breakage of goods.

2. Larger sheds to store goods are not required.

3. Labour strikes, etc. do not affect the service and operation of trains.

Which of the above statements are correct?

(A) 1 and 2 only

(B) 2 and 3 only

(C) 1 and 3 only

(D) 1, 2 and 3

66. Which one of the following are provided to give access to properties along an important highway with controlled access to expressway or freeway?

(A) Lay-bys

(B) Frontage roads

(C) Driveways

(D) Cycle tracks

67. When properly designed traffic signals are used, which one of the following is the advantages of traffic signals?

(A) The signals allow crossing of the heavy traffic flow with safety

(B) The rear-end collision may increase

(C) Improper design and location of signals may lead to violation of the control system

(D) Failure of the signal due to electric power failure may cause confusion to the road users

68. If the ruling gradient is 1 in 150 on a particular section of broad gauge and at the same time a curve of 4 degree is situated on this ruling gradient, what is the allowable ruling gradient?

(A) 1 in 10

(B) 1 in 72

(C) 1 in 196

(D) 1 in 245

69. What is the value of headlight sight distance for a highway with a design speed of 65 kmph? (Take f = 0.36 and t = 2.5 sec)

(A) 66.5 m

(B) 81.3 m

(C) 91.4 m

(D) 182.8 m

70. What is the minimum stopping sight distance on a –3.5% grade for a design speed of 110 kmph? (Consider friction coefficient f = 0.28, t = 2.5 sec and G = 0.035)

(A) 76.4 m

(B) 194.4 m

(C) 214.6 m

(D) 270.8 m

71. The free mean speed on a roadway is found to be 80 kmph. Under stopped condition, the average spacing between the vehicles is 6.9m. What is the capacity flow?

(A) 5800 Vehicles/hour (per lane)

(B) 7200 Vehicles/hour (per lane)

(C) 1450 Vehicles/hour (per lane)

(D) 2900 Vehicles/hour (per lane)

72. For a street lighting system, having the following conditions:

Street width = 15 m

Mounting height = 7.5 m

Lamp size = 6000 lumen

Luminaire type = II

Coefficient of utilization = 0.44

Maintenance factor = 0.8

What is the spacing between lighting units to produce average Lux = 6?

(A) 18 m (B) 20 m (C) 23 m (D) 27 m

73. Consider the following for the objects seasoning wood:

1. Reduce the shrinkage and warping after placement in structure

2. Increase its tendency to split and decay

3. Decrease workability

4. Reduce its weight

Which of the above objects are correct?

(A) 1, 3 and 4 only

(B) 1 and 3 only

(C) 1 and 3only

(D) 2, 3 and 4 only

74. The hardness of aggregate is tested by

(A) Impact test

(B) Crushing strength test

(C) Abrasion test

(D) Soundness test

75. Which one of the following statements is correct in respect of mild steel?

(A) It has high carbon content

(B) It is tougher than hard steel

(C) It is more elastic than hard steel

(D) It can be forged and welded easily

76. The chemical composition 'Silicates of iron and alumina' is found on which one of the following minerals?

(A) Garnet

(B) Serpentine

(C) Olivine

(D) Calcite

77. The drawback of electric seasoning of timber is

(A) Checks (B) Splitting

(C) Cracks (D) Reduced Strength

78. Which one of the following is a product obtained by distilling tar and is used largely as an effective preservative for wood?

(A) Creosote

(B) Solignum

(C) Coal tar

(D) Wax polish

79. Pozzolans are

(A) argillaceous materials

(B) calcareous materials

(C) accelerators

(D) siliceous materials

80. For better chemical resistance, proportion of which one of the following compounds in cement clinker shall be increased?

(A) Tricalcium Silicate

(B) Dicalcium Silicate

(C) Tetracalcium Aluminate

(D) Tetracalcium Alumnioferrite

81. The finishing coat in X-ray room walls is done preferably with

(A) Barium plaster

(B) Cement plaster

(C) Gypsum

(D) Plaster of Paris

82. The most suitable type of cement for mass concreting works is

(A) Rapid Hardening Cement

(B) High Alumina Cement

(C) Low Heat Portland Cement

(D) Quick Setting Cement

83. Which one of the non-destructive tests can be performed on fresh concrete?

(A) Ultrasonic test

(B) Penetration test

(C) Core test

(D) Hammer test

84. In a concrete mix, for given cement content and workability, higher proportion of fine aggregate will be required if

(A) maximum size of aggregate is larger

(B) maximum size of aggregate is small

(C) rounded aggregate is used.

(D) all in aggregate is used

85. A central steel rod 18 mm diameter passes through a copper sleeve with 24 mm inside and 39mm outside diameter. It is provided with nuts and washers at each end and the nuts are tightened until a stress of 10 N/mm^2 is set up in the steel. Then, the stress developed in copper tube is

(A) 29.1 N/mm^2, Compressive

(B) 3.4 N/mm^2, Compressive

(C) 3.4 N/mm^2, Tensile

(D) 29.1 N/mm^2, Tensile

86. A 2m long alloy bar of 1500 mm^2 cross-sectional area hangs vertically and has a collar securely fixed at its lower end. What is the stress induced in the bar when a weight of 2 kN falls from a height of 100 mm on the collar? (Take E = 120 GPa)

(A) 126.5 MPa

(B) 158.3 MPa

(C) 161.2 MPa

(D) 181.3 MPa

87. Normal stresses of 126 MN/m^2 (Tensile) and 94 MN/m^2 (Compressive) are acting at a point in an elastic material at right angles to each other. If the maximum principal stress is limited to 146 MN/m^2, the shear stress that may be allowed at that point in the same plane is

(A) 170 MN/m^2

(B) 89 MN/m^2

(C) 69 MN/m^2

(D) 96 MN/m^2

88. A plane element in a body is subjected to a tensile stress of 100 MPa and shear stress of 25MPa. What is the normal stress on a plane inclined at 15° with the tensile stress?

(A) – 5.8 MPa

(B) – 4.8 MPa

(C) – 3.8 MPa

(D) – 2.8 MPa

89. A load of 2100 N is dropped axially on a closed-coiled helical spring from a height of 240 mm. The spring has 22 coils each of mean diameter 180 mm and wire diameter is 25 mm. If modulus of rigidity $C = 84000\ N/mm^2$ and a amount of compression $\delta = 255\ mm$, what is the maximum shear stress produced in the spring?

(A) 156 N/mm^2 (B) 346 N/mm^2

(C) 239 N/mm^2 (D) 123 N/mm^2

90. An I-section purlin of span 4 m is subjected to a total uniformly distributed load of 5 kN. The purlin will be designed for maximum bending moment of

(A) 2000 Nm (B) 20 kNm

(C) 2500 Nm (D) 25 kNm

91. A 1.4 m long laminated carriage spring has leaves of 100 mm width and 10 mm thickness. The spring has to absorb 125 N-m of energy when straightened, without exceeding the bending stress of 160 MPa. What is the number of leaves? (Take the elastic modulus of material of spring as 200 GPa)

(A) 11 (B) 9 (C) 7 (D) 5

92. A wooden floor is required to carry a load of 12 kN/m^2 and is to be supported by wooden joists of 120 mm × 250 mm in section over a span of 4m. If the bending stress in these wooden joists is not to exceed 8 MPa, what is the spacing of the joists?

(A) 356 mm (B) 318 mm

(C) 432 mm (D) 417 mm

93. A motor driving a solid circular shaft transmits 30 kW at 500 r.p.m. What is the torque activity on the shaft, if allowable shear stress is 42 MPa?

(A) 427 Nm (B) 573 Nm

(C) 180 Nm (D) 219 Nm

94. An open-coiled helical spring of wire diameter 12mm, mean coil radius 84 mm, helix angle 60° carries an axial load of 480N. What is the twisting moment?

(A) 10.22 Nm

(B) 20.16 Nm

(C) 14.24 Nm

(D) 24.11 Nm

95. The stress at a point of a machine component are 150 MPa and 50 MPa, both tensile. What is the intensity of normal stress on a plane inclined at angle of 30° with the axis of major tensile stress?

(A) 25 MPa

(B) 50 MPa

(C) 75 MPa

(D) 100 MPa

96. In case of lintel design, the load enclosed in an equilateral triangle is fully transferred to the lintel provided the height of wall above lintel is

(A) not less than 1.25 times the height of the equilateral triangle

(B) less than twice the height of the equilateral triangle

(C) less than 1.25 times the height of the equilateral triangle

(D) greater than twice the height of the equilateral triangle

97. Consider the following statements for Euler's equation to find critical load of a column:

1. Critical load of a column is proportional to the flexural rigidity.

2. Critical load of a column depends upon yield stress.

3. Critical load of a column is inversely proportional to the length of column.

4. Critical load of a column is inversely proportional to the square of the length of column.

Which of the above statements are correct?

(A) 1 and 2 only

(B) 1 and 4 only

(C) 2 and 3 only

(D) 2 and 4 only

98. A steel plate 120 mm wide and 20 mm thick is bent into a circular arc of radius 10m. What is the maximum stress produced and the bending which can produce this stress respectively? (Take E = 200 GPa)

(A) 100 MPa, 32 kN-m

(B) 200 MPa, 160 N-mm

(C) 200 MPa, 1600 N-m

(D) 20 MPa, 160 kN-m

99. Consider the following statements regarding shearing force and bending moment:

1. Point of contraflexure is the point where bending moment changes its sign.

2. Shear force is the rate of change of bending moment.

3. For bending moment to be the maximum or minimum, shear force should change its sign.

4. Rate of change of loading is equal to shear force.

Which of the above statements are correct?

(A) 2 and 3 only

(B) 1 and 4 only

(C) 1, 2 and 4 only

(D) 1, 2 and 3 only

100. Consider the following statements:

Moment Area Method proves advantageous in analyzing

1. Cantilever beams.

2. Symmetrically loaded simply supported beams.

3. Fixed beams.

4. Continuous beams.

Which of the above statements are correct?

(A) 1, 2 and 4 only (B) 3 and 4 only

(C) 1, 2 and 3 only (D) 1 and 2 only

101. Consider the following statements regarding continuous beam:

1. A beam is said to be a continuous beam if it is supported on more than two supports.

2. A continuous beam is a statically indeterminate structure.

3. The degree of indeterminacy depends upon the number of supports and also on the nature of the supports.

Which of the above statements are correct?

(A) 1 and 2 only

(B) 2 and 3 only

(C) 1, 2 and 3

(D) 1 and 3 only

102. In case of flexural tension or flexural compression, the minimum length of the bar which must be embedded in concrete beyond any section to develop its full strength, is termed is

(A) Twisted length

(B) Flexural length

(C) Bond length

(D) Development length

103. It is observed experimentally that the amplitude of free vibration of a certain structure modelled as a single degree of freedom system, decreases from 1.0 to 0.4 in 10 cycles. What is the percentage of critical damping?

(Take $\ell n\ 2 = 0.693$ and $\ell n\ 10 = 2.303$)

(A) 5.21% (B) 1.46%

(C) 2.37% (D) 3.22%

104. The ultimate tensile strain in steel is in the range of

(A) 0.012–0.020

(B) 0.0012 – 0.0020

(C) 0.12 – 0.20

(D) 0.00012 – 0.00020

105. Consider the following statements regarding statically determine structure:

1. Conditions of equilibrium are sufficient to fully analyse the structure.

2. The bending moment at a section or the force in any member is independent of the material of the components of the structure.

3. The bending moment at a section or the force in any member is independent of the cross-sectional area of the components.

Which of the above statements are correct?

(A) 1 and 2 only

(B) 2 and 3 only

(C) 1, 2 and 3

(D) 1 and 3 only

106. A cantilever beam of 4m span carries a UDL of 3 kN/m over its entire span and a point load of 3 kN at the free end. If the same beam is simply supported at two ends, what point load at the centre should it carry to have same deflection as the cantilever?

(A) 60 kN (B) 120 kN

(C) 160 kN (D) 210 kN

107. A beam AB of span 5m fixed at both ends carries a UDL of 12 kN/m over the whole span. If the right end B settles down by 12mm, what are the end moments for the beam? (Take EI = 15000 kN/m^2)

(A) $M_a = 68.2\ kNm(hogging)$ and $M_b = 18.2\ kNm(sagging)$

(B) $M_a = 18.2\ kNm(hogging)$ and $M_b = 68.2\ kNm(sagging)$

(C) $M_a = 68.2\ kNm(hogging)$ and $M_b = 68.2\ kNm(sagging)$

(D) $M_a = 18.2\ kNm(hogging)$ and $M_b = 18.2\ kNm(sagging)$

108. A cable is suspended between two points, 75m apart horizontally with its left end lower than the right end by 10m. The cable supports a UDL of 5 kN/m along the horizontal span. What is the horizontal tension in the cable if central sag is 7.5m?

(A) 385.13 kN

(B) 468.75 kN

(C) 145.15 kN

(D) 528.62 kN

109. Consider the following statements related to merits of construction in structural steel:

1. Structural steel has high strength per unit weight as compared to RCC.
2. The steel members are slender or small in size as compared to RCC.
3. The steel structure are useful in construction of all buildings, long-span bridges and airplane hangars.

Which of the above statements are correct?

(A) 1 and 2 only

(B) 2 and 3 only

(C) 1, 2 and 3

(D) 1 and 3 only

110. For a laced column, the minimum width of the lacing bars when using 20 mm nominal diameter rivets is

(A) 65 mm

(B) 60 mm

(C) 55 mm

(D) 50 mm

111. A beam simply supported over an effective span of 9m, carries a uniformly distributed load of 60 kN/m, inclusive of its own weight. What is the section modulus of the beam, if $f_y = 250\ N/mm^2$ and $E = 2\times10^5\ N/mm^2$?

(Assume width of support is 200 mm)

(A) $2612\times10^3\ mm^3$

(B) $3682\times10^3\ mm^3$

(C) $4682\times10^3\ mm^3$

(D) $5124\times10^3\ mm^3$

112. Consider the following statements related to batten plates:

1. These normally consists of flat plates, connecting the components of the built-up columns in two parallel planes.
2. These are used for triaxial loading
3. The design of battened columns and the design of battens are usually governed by IS code requirements.

Which of the above statements are correct?

(A) 1 and 3 only

(B) 2 and 3 only

(C) 1, 2 and 3

(D) 1 and 2 only

113. Consider the following statements related to design of tension member with single structural shapes and plates:

1. The common single structural shapes are angle sections, tee sections and channel sections.

2. Single angles are not used for bracing, for light truss tension members.

3. Occasionally, I sections are also used as tension members as they have more rigidity.

(A) 1 and 3 only

(B) 2 and 3 only

(C) 1 and 2 only

(D) 1, 2 and 3

114. Consider the following statements regarding the advantages of a good organization:

1. It increases cooperation and a feeling of freedom.

2. It prevents duplication of work.

3. It makes communication easier.

4. It increases the likelihood of run-arounds.

Which of the above statements are correct?

(A) 1, 2 and 3 only

(B) 2, 3 and 4 only

(C) 1, 3 and 4 only

(D) 1, 2 and 4 only

115. For design of a roof truss, if the design wind velocity is 20 m/s, what is the design wind pressure?

(A) 400 N/m^2

(B) 240 N/m^2

(C) 40 N/m^2

(D) 200 N/m^2

116. Consider the following statements:

1. The working stress design is based on explicit consideration of the various conditions under which the structure may cease to fulfil its intended function.

2. In case of working stress design, structure will directly take into consideration the various relevant modes of failure.

3. In working stress method, regulatory bodies or classification societies usually specify the value of the allowable stress as some fraction of the mechanical properties of materials.

Which of the above statements is/are correct ?

(A) 1 and 2 only

(B) 2 only

(C) 2 and 3 only

(D) 3 only

117. Consider the following statements regarding the working stress design method:

1. Working stress design is based on the elastic theory.

2. The working stress in the member should be less than the permissible stress.

3. The permissible stress is the ratio of the factor of safety to the yield stress.
4. The permissible stresses for fasteners are usually based on the ultimate strength of the connection.

Which of the above statements is/are not correct?

(A) 1 and 3 only
(B) 3 only
(C) 4 only
(D) 2 and 4 only

118. A steel cantilever beam is proposed to build into a concrete wall at one end and other end is free. It supports a dead load of 20 kN/m and a live load of 10 kN/m. The length of the beam is 5m. What are the shear force and bending moment respectively? (Take yield strength of steel as 250 N/mm^2)

(A) 225 kN and 562.5 kNm
(B) 22.5 kN and 56.25 kNm
(C) 225 kN and 56.25 kNm
(D) 22.5 kN and 562.5 kNm

119. Consider the following for local capacity of section:

1. Local section failure is usually encountered in the case of short stocky beam-columns with relatively smaller axial compression ratio and beam-columns bent in reverse curvature.
2. The strength of end section reached under combined axial force and bending governs the failure.
3. The strength of the section may be governed by plastic buckling of plate elements in the case of plastic, compact and semi-compact sections.

Which of the above statements are correct?

(A) 1 and 2 only (B) 2 and 3 only
(C) 1, 2 and 3 (D) 1 and 3 only

120. A tension member of a roof truss carries a factored load of 430 kN. By considering the strength in yield, what is the gross area required to carry this load? (Consider Fe 250 grade steel)

(A) 1892 mm^2
(B) 1978 mm^2
(C) 1903 mm^2
(D) 2150 mm^2

121. Stirrup area in excess of that required for shear and torsion is provided along each terminated bar over a distance from the cut-off point equal to

(A) three-fourth the effective depth of the member
(B) one-third the effective depth of the member
(C) two-third the effective depth of the member
(D) one-fourth the effective depth of the member

122. Which one of the following is **not** a type of mortar?

(A) Lime surkhi mortar
(B) Cement sand mortar
(C) Cement stone chips mortar
(D) Cement lime mortar

123. The grade of concrete and reinforcement are M-20 and Fe-250 respectively. Consider 25mm diameter bars and τ_{bd} is 1.2. What is the development length at support for a simply supported beam of a rectangular section?

(A) 1133 mm

(B) 1033 mm

(C) 1321 mm

(D) 1232 mm

124. In a singly reinforced beam, for given grade of concrete, permissible bond stress in deformed bars

(A) is lesser than that of plain bars

(B) is equal to that of plain bars

(C) may be greater than or smaller than that of plain bars.

(D) is greater than that of plain bars

125. The safe load carried by the helically reinforced column is

(A) 1.05 times the load carried by the similar column with ties

(B) 2.15 times the load carried by the similar column with ties

(C) 1.15 times the load carried by the similar column with ties

(D) 2.05 times the load carried by the similar column with ties

126. Nominal cover to reinforcement is provided to

1. protect reinforcement against corrosion.

2. provide shear resistance.

3. protect reinforcement against fire.

4. develop sufficient bond strength along surface area of reinforcement bars.

Which of the above statements are correct?

(A) 1 and 4 only

(B) 2, 3 and 4 only

(C) 1, 3 and 4 only

(D) 1, 2 and 3 only

127. In slab design, ratio of maximum diameter of reinforcing bars to the total thickness of slab should **not** be more than

(A) 1/2

(B) 1/6

(C) 1/8

(D) 1/7

128. To prevent cracking of edges, the corners in two way slabs are provided with

(A) shear reinforcement

(B) torsion reinforcement

(C) tensile reinforcement

(D) compression reinforcement

129. Critical section for two way shear in case of isolated footing design is at

(A) the face of column

(B) effective depth from the face of column

(C) half of the effective depth from the face of column

(D) two-third of the effective depth from the face of column

130. Accepted relationship between tread and riser in case of staircase design is

(A) $\text{Riser} \times \text{Tread} = 60{,}000\ \text{mm}^2$

(B) 2 × Riser + Tread = 600 mm

(C) Riser + Tread = 600 mm

(D) 2 × Tread + Riser = 600 mm

131. Loss of pre-stress is **not** directly related to

(A) creep of concrete

(B) shrinkage of concrete

(C) grade of concrete

(D) slipping of steel tendons from concrete

132. Which one of the following statements is the disadvantage of post-tensioning method?

(A) The loss of pre-stress is less as compared to pre-tensioning system

(B) Post-tensioning method is costly as compared to pre-tensioning method

(C) Post-tensioning can be done in factories and at the site also

(D) Post-tensioning method is used for larger spans and heavily loaded structure

133. What is the main limitation of bar chart?

(A) It does not help in material and labour planning

(B) It does not show all the activities of a project

(C) It does not indicate critical activities of a project

(D) Project duration cannot be estimated

134. Graders are **not** suitable for

(A) levelling of earthwork

(B) cutting ditches

(C) working on steeper slopes

(D) heavy excavation

135. Line of Balance technique is

(A) modified bar chart

(B) planning of repetitive activities of a project

(C) modified form of PERT

(D) used for planning milestones of a project

136. Which one of the following statements is not correct in respect of drawing network?

(A) No activity can start until its tail event has occurred

(B) An event cannot occur twice

(C) Length of arrow should be in proportion to the time consumed by that activity

(D) The number of arrows should be equal to the number of activities in the project

137. A-O-N system of network

(A) completely eliminates the use of dummy activities

(B) requires judicious use of dummy activities

(C) does not distinctly show pre-operation and post-operation of the activities

(D) is not suitable for project with larger number of activities

138. Which one of the following types of cost-plus contracts allows the amount of the re-imbursements to increase if the contractor's cost increases?

(A) Cost-plus award fee contract

(B) Cost-plus incentive fee contract

(C) Cost-plus fixed fee contract

(D) Cost-plus percentage fee contract

139. Number of bricks required for 15 cu.m of brickwork is approximately

(A) 6750 (B) 7200 (C) 7500 (D) 6000

140. The plinth area of a building does not include area of

(A) the walls at the floor levels

(B) internal shaft for sanitary installations upto 2 sq.m area

(C) lifts

(D) cantilevered porches

141. Which one of the following statements is not correct?

(A) The circulation area of any floor includes entrance halls

(B) Floor area of a building includes area of sills of doors and other openings

(C) Cube rate estimate of a building is more accurate as compared to plinth area estimate

(D) The preliminary estimate for water supply and sewerage project can be prepared on the basis of per head of population served

142. Consider the following statements regarding the advantages in Line or Military Organization of management technique:

1. The command and control is very effective.

2. It is simple to work and easily understood by the employees.

3. Responsibilities in all levels are definite and fixed.

4. The organization is rigid.

Which of the above statements are correct?

(A) 1, 2 and 3 only

(B) 3, 3 and 4 only

(C) 1, 2 and 4 only

(D) 1, 3 and 4 only

143. Project management audit consists of which of the following?

1. Project work-breakdown structure verification and the relevance.

2. Risk identification, cost, levels and security.

3. Measurements of risk impacts.

Select the correct answer using the code given below:

(A) 1 and 2 only (B) 2 and 3 only

(C) 1, 2 and 3 (D) 1 and 3 only

144. Consider the following statements regarding inspection and quality control:

1. Coefficient of variation is a relative measure of dispersion.

2. Standard deviation is the root mean square of the deviation of all the results.

3. Standard deviation is relative measure of dispersion.

4. Lower value of standard deviation indicates low degree of uniformity of observations.

Which of the above statements are correct?

(A) 1 and 4 only (B) 2 and 3 only

(C) 1 and 2 only (D) 2 and 4 only

Directions: *Each of the next* ***six (06)*** *items consists of two statements, one labeled as 'Statement (I)' and the other as 'Statement (II)'. You are to examine the two statements carefully and select the answers to these items using the codes given below:*

Codes:

(A) Both Statement (I) and Statement (II) are individually true, and Statement (II) is the correct explanation of Statement (I).

(B) Both Statement (I) and Statement (II) are individually true, but Statement (II) is not the correct explanation of Statement (I).

(C) Statement (I) is true, but Statement (II) is false.

(D) Statement (I) is false, but Statement (II) is true.

145. Statement (I): The theoretical strength of concrete as per Gel-space ratio theory is less than the actual strength of concrete.

Statement (II): In the Gel-Space ration theory, it has been assumed that the concrete is perfectly homogeneous and flawless.

146. Statement (I): Spur length is kept longer than 1.5 to 2 times the depth of flow.

Statement (II): Shorter spur length in deeper rivers induces swirling motion on both the upstream and downstream sides of the spur.

147. Statement (I): Both the Empirical formulae given by American Insurance Association and Buston for the determination of fire demand of water are not suitable for Indian conditions.

Statement (II): Kuichling's formula estimates lesser value of firewater demand.

148. Statement (I): For the design of slender column, additional moments are required to be considered.

Statement (II): Lateral deflection of slender columns, under axial load, is substantial and causes additional moments.

149. Statement (I): To achieve maximum value for minimum radius of gyration of compression members, without increasing the area of the section, a number of elements are placed away from the principal axis using suitable lateral systems.

Statement (II): Batten shall be placed at 40° to 70° to the axis of built-up members.

150. Statement (I): Chain surveying is that type of surveying in which only linear measurements are made in the field.

Statement (II): Traversing is that type of survey in which a number of connected survey lines from the framework and the directions and lengths of the survey lines are measured with the help of an angle measuring instrument and a tape respectively.