DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

23-0009-AH

TEST BOOKLET
Civil Engineering
PAPER – II

Time Allowed: 3 hours

Maximum Marks: 300

INSTRUCTIONS TO CANDIDATES

Read the instructions carefully before answering the questions: -

1. This Test Booklet consists of 20 (twenty) pages and has 75 (seventy-five) items (questions).
2. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS BOOKLET *DOES NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
3. **Please note that it is the candidate's responsibility to fill in the Roll Number and other required details carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet and the Separate Answer Booklet. Any omission/discrepancy will render the OMR Answer Sheet and the Separate Answer Booklet liable for rejection.**
4. Do not write anything else on the OMR Answer Sheet except the required information. Before you proceed to mark in the OMR Answer Sheet, please ensure that you have filled in the required particulars as per given instructions.
5. Use only Black Ball Point Pen to fill the OMR Answer Sheet.
6. This Test Booklet is divided into 4 (four) parts – Part – I, Part – II, Part - III and Part – IV.
7. All three parts are Compulsory.
8. **Part-I consists of Multiple Choice-based Questions.** The answers to these questions have to be marked in the **OMR Answer Sheet** provided to you.
9. **Part-II, Part-III and Part-IV consist of Conventional Essay-type Questions.** The answers to these questions have to be written in the separate **Answer Booklet** provided to you.
10. In Part-I, each item (question) comprises of 04 (four) responses (answers). You are required to select the response which you want to mark on the OMR 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.
11. After you have completed filling in all your responses on the OMR Answer Sheet and the Answer Booklet(s) and the examination has concluded, you should hand over to the Invigilator *only the OMR Answer Sheet and the Answer Booklet(s)*. You are permitted to take the Test Booklet with you.
12. **Penalty for wrong answers in Multiple Choice-based Questions:**

THERE WIL BE **PENALTY** FOR WRONG ANSWERS MARKED BY A CANDIDATE.

(i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, one-third of the marks assigned to the 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 be correct and there will be same penalty as above to the 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.

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PART-I
(Multiple Choice-based Questions)

Instructions for Questions 1 to 50:

- *Attempt all questions. Each question carries 3 marks.*
- *No Data Books/Tables are allowed; assume the data if required anywhere.*
- *Unless otherwise mentioned, symbols and notations have their usual meaning.*

[3 x 50 = 150]

Which one of the following is associated with a critical activity in an Activity on Arrow (A-O-A) network?

(a) Maximum float
(b) Minimum float
(c) Zero float
(d) Free float

2. Construction equipment has a useful life of 5 years after which it is to be replaced by a new one. If the interest rate is 4%, what would the sinking fund factor be?

(a) 0.033
(b) 0.184
(c) 0.224
(d) 0.232

3. Sensitivity analysis is a study of which of the following?

(a) Comparison of profit and loss
(b) Comparison of assets and liabilities
(c) Change in output due to change in input
(d) Economics of costs and benefits of the project

4. What is the **w/c ratio** needed for complete hydration of cement?

(a) Less than 0.25
(b) More than 0.25 but less than 0.35
(c) More than 0.45 but less than 0.60
(d) More than 0.35 but less than 0.45

5. When the corner of a brick is removed along the line joining mid-points of adjoining sides, the portion left is called a _____

(a) Mitred closer
(b) King closer
(c) Squint brick
(d) Queen closer

6. The full amount of super elevation on a horizontal curve is provided at the _____
   (a) beginning of the transition curve
   (b) middle of the circular curve
   (c) middle of the transition curve
   (d) end of the transition curve

7. It was observed that on a section of road, the free speed was **90 *kmph*** and the jam density was **80 *vpkm***. What is the maximum flow in ***vph*** that could be expected on this road?
   (a) 1400
   (b) 1800
   (c) 2800
   (d) 800

8. Which of the following is TRUE in the case of a flexible pavement?
   (a) The vertical compressive stress is maximum at the lowest layer.
   (b) The vertical compressive stresses decrease with depth of the layer.
   (c) Tensile stress gets developed.
   (d) Traffic stress induced by a given traffic load is dependent on the location of the load on the pavement surface.

9. The magnetic bearing of a line is 10° and the magnetic declination is 2° W. What is its true bearing?
   (a) 2°
   (b) 8°
   (c) 12°
   (d) 20°

10. To calculate the amount of cut and fill
   (a) Only profile levelling is sufficient
   (b) Only cross-sectioning is required
   (c) Both profile and cross-sectioning are required
   (d) None of the above

11. If the total hardness and alkalinity of a sample of a water are **400 *mg/l*** and **100 *mg/l*** (***$CaCO_3$*** scale), then what will its carbonate and non-carbonate hardness (in units of ***mg/l***) be?
   (a) 100 *and* 300 respectively.
   (b) 400 *and* 100 respectively.
   (c) 100 *and* 400 respectively.
   (d) 300 *and* 100 respectively.

12. A sewage treatment plant mainly consists of the following operations:
    (1) Screening
    (2) Grit removal
    (3) Secondary sedimentation
    (4) Aeration
    (5) Primary sedimentation

    What is the correct sequence of operations? Select the correct answer from the codes given below:
    (a) 1-2-3-4-5
    (b) 2-1-4-3-5
    (c) 1-2-5-4-3
    (d) 2-1-4-5-3

13. The following data pertains to a sewage sample:
    (1) Initial DO = **12** $\boldsymbol{mg/l}$
    (2) Final DO = **3** $\boldsymbol{mg/l}$
    (3) Dilution to **1** %

    What is the BOD of the given sewage sample?
    (a) 900 mg/l
    (b) 90mg/l
    (c) 12mg/l
    (d) 8mg/l

14. On which of the following factors, does the population growth in a town normally depend?
    (1) Birth and death rate
    (2) Migrations
    (3) Probabilistic growth
    (4) Logistic growth

    Select the correct answer from the codes given below:
    (a) 1 and 2
    (b) 1, 2 and 3
    (c) 3 and 4
    (d) 2 and 3

15. What does the presence of excess nitrates in river water indicates?
    (a) Recent pollution of water with sewage
    (b) No pollution of water with sewage
    (c) Intermittent pollution of water with sewage
    (d) Past pollution of water with sewage

16. The area between the two isohyetes $\mathbf{50}\ \boldsymbol{cm}$ and $\mathbf{60}\ \boldsymbol{cm}$ is $\mathbf{100}\ \boldsymbol{km^2}$, and that between $\mathbf{65}\ \boldsymbol{cm}$ and $\mathbf{70}\ \boldsymbol{cm}$ is $\mathbf{200}\ \boldsymbol{km^2}$. What is the average depth of annual precipitation over the basin of $\mathbf{300}\ \boldsymbol{km^2}$?
    (a) 65.9 cm
    (b) 50.5 cm
    (c) 60.5 cm
    (d) 63.33 cm

17. The coefficient of variation of the rainfall for six gauge-stations in a catchment was found to be **40%**. The optimum number of stations in the catchment for an admissible **10%** error in the estimation of the mean rainfall will be _____
    (a) 3
    (b) 9
    (c) 16
    (d) 12

18. A $\mathbf{6-hour}$ rainstorm with hourly intensities of $\mathbf{6, 16, 25, 20, 11}$, and $\mathbf{4}\ \boldsymbol{mm/hour}$ produced a runoff of $\mathbf{39}\ \boldsymbol{mm}$. Then, what is the $\boldsymbol{\phi - index}$?
    (a) 3.2 $mm/hour$
    (b) 7.16 $mm/hour$
    (c) 8.5 $mm/hour$
    (d) 10 $mm/hour$

19. In a flow-mass curve study, the demand line drawn from a ridge in the curve does not intersect the mass curve again. What does this imply?
    (a) The reservoir was not full at the beginning
    (b) The demand cannot be met by the inflow as the reservoir will not refill
    (c) The storage is not adequate
    (d) The reservoir is wasting water by spill.

20. A catchment area of $\mathbf{100}\ \boldsymbol{hectares}$ has a runoff coefficient of $\mathbf{0.4}$. A storm of duration larger than the time of concentration of the catchment and of intensity $\mathbf{4.5}\ \boldsymbol{cm/hr}$ creates a peak discharge rate (in $\boldsymbol{m^3/s}$) of:
    (a) 0.05
    (b) 5.0
    (c) 500
    (d) 0.5

21. Which one of the following flood routing methods involves the concepts of wedge and prism storages?
    (a) Coefficient method
    (b) Pul's method
    (c) Muskingum method
    (d) Lag method

22. What is the likely Lacey's silt factor for medium silt whose average grain size is 0.25 mm?
    (a) 1.32
    (b) 0.45
    (c) 0.88
    (d) 1.73

23. Given that the base period is 120 days and the duty of the canal is 1000 hectares per cumec, what would the depth of water be?
    (a) 0.864 cm
    (b) 103.68 cm
    (c) 10.368 cm
    (d) 1036.8 cm

24. What is the time by which a particular activity can be delayed without affecting the preceding and succeeding activity known as?
    (a) Total float
    (b) Free float
    (c) Interfering float
    (d) Independent float

25. Which of the following is TRUE for Project Evaluation and Review Technique (PERT)?
    (a) It is an event-oriented tool for planning.
    (b) It is activity oriented and extensively used in construction.
    (c) It uses cost as a critical input factor.
    (d) It minimizes the importance of events.

26. The optimistic time, pessimistic time and most likely time required for completion of activity is 4, 11 and 6 days respectively. What is he expected completion time of this activity?
    (a) 5 days
    (b) 5.5 days
    (c) 6 days
    (d) 6.5 days

27. What is the unit of measurement for doors and windows for the task of estimating and costing?
    (a) Running meter
    (b) Square meter
    (c) Cubic meter
    (d) Numbers

28. Which of the following construction equipment is suitable for lifting and transportation?
    (a) Lift truck
    (b) Winch crab
    (c) Spiral chute
    (d) Both (a) and (c)

29. Consider the following oxides:
    (1) Al_2O_3
    (2) CaO_3
    (3) SiO_2

    The correct sequence in increasing order of their percentage in an ordinary Portland cement is:
    (a) 2, 1, 3
    (b) 1, 3, 2
    (c) 3, 1, 2
    (d) 1, 2, 3

30. What is the approximate value of the ratio of direct tensile strength to that of modulus of rupture of concrete?
    (a) 0.25
    (b) 0.5
    (c) 0.75
    (d) 1.0

31. What is the ratio of the elastic modulus of structural timber in longitudinal direction to that in the transverse direction?
    (a) 1/2 to 1
    (b) 1 to 2
    (c) 1/10 to 1/20
    (d) 10 to 20

32. What is the number of sleepers required for constructing a broad-gauge railway track of length 780 m, with standard rail length, for a sleeper density of (n + 5)?
    (a) 975
    (b) 1080
    (c) 918
    (d) 880

33. In a permanent way, the cement concrete sleepers of 300 mm width are placed at a spacing of 600 mm. Determine the depth of ballast.
    (a) 15 mm
    (b) 20 mm
    (c) 15 cm
    (d) 22.5 cm

34. What is the steepest gradient permissible on a 2.5° curve for Broad Gauge line having ruling gradient of 1 in 200? (Given: grade compensation is 0.04% per degree of curve)
    (a) 1 in 220
    (b) 1 in 250
    (c) 1 in 235
    (d) 1 in 275

35. Check rails are provided on inner side of inner rails, if the sharpness of a B.G. curve is more than _____
    (a) 3°
    (b) 6°
    (c) 5°
    (d) 8°

36. The movable tapered end of the tongue rail is known as _____
    (a) Stretcher bar
    (b) Toe of switch
    (c) Heel of switch
    (d) Throw of switch

37. What is the type of interchange when two high volume and high-speed roads intersect each other wherethrough traffic on both roads are unimpeded?
    (a) Diamond interchange
    (b) Clover leaf interchange
    (c) Rotary interchange
    (d) Directional interchange

38. A summit curve is formed at the intersection of a 2% up gradient and 6% down gradient. What should the length of summit curve be in order to provide a stopping distance of 128 metres?
    (a) 271 m
    (b) 298 m
    (c) 322 m
    (d) 340 m

39. In India, expansion joints in cement concrete pavements are provided at what interval?
    (a) 10 m
    (b) 15 m
    (c) 18 m to 21 m
    (d) 25 m to 30 m

40. What is the ideal method of contouring for hilly regions?
    (a) Direct method
    (b) Method of squares
    (c) Cross section method
    (d) Radial line method

41. A camera having a focal length of **10 *cm*** is used to take a vertical photograph of a terrain having an average elevation of **500 *m above m.s.l.***. What is the height above sea level at which an aircraft must fly in order to get the scale of **1: 7000**?
    (a) 4220 m
    (b) 1200 m
    (c) 24000 m
    (d) 2400 m

42. Which of the following is a method used for land filling of solid waste?
    (a) Canyon method
    (b) Bangalore method
    (c) Load count method
    (d) Indore method

43. What is a chamber made of concrete, fibre glass, PVC or plastic, through which domestic waste water (sewage) flows for primary treatment called?
    (a) Drainage tank
    (b) Septic tank
    (c) Pit latrine tank
    (d) Water harvesting tank

44. Aerosols are _____
    (a) carbon particles of microscopic size
    (b) dispersion of small solid or liquid particles in gaseous media
    (c) finely divided particles of ash
    (d) diffused liquid particles

45. When was the water (Prevention and Control of Pollution) Act enacted by the Indian Parliament?
    (a) 1970
    (b) 1974
    (c) 1980
    (d) 1985

46. Phytometer method is generally used for the measurement of which of the following?
    (a) Transpiration
    (b) Interception
    (c) Evaporation
    (d) None of the above

47. Which of the following is the most suitable method of irrigation in arid areas with uneven land surface?
    (a) Basin method
    (b) Furrow irrigation
    (c) Check flooding
    (d) Sprinkler irrigation

48. A land is said to be water logged when _____
    (a) the air circulation is stopped in the root zone due to rise in water table
    (b) it is submerged in flood
    (c) the soil pores within a depth of 40 cm are saturated
    (d) All of the above

49. The solid roller bucket is arranged at the end of a spillway to _____
    (a) measure the discharge
    (b) provide stability to the spillway
    (c) trap silt from flowing water
    (d) dissipate energy through hydraulic jump

50. A river training work is generally required when the river is _____
    (a) Aggrading type
    (b) Degrading type
    (c) Meandering type
    (d) Both (a) and (b)

PART-II
(Short Answer-type Questions)

Instructions for Questions 51 to 63:

- *Write the answers in short for any 10 (TEN) out of the thirteen questions.*
- *Each question carries 5 marks.*
- *Candidates are required to give their answers in their own words as far as practicable.*
- *No Data Books/Tables are allowed; assume the data if required anywhere.*
- *Unless otherwise mentioned, symbols and notations have their usual meaning.*

[5 x 10 = 50]

51. What are the factors affecting the strength of timber?

52. What are the different purposes of a building property?

53. Discuss the various cause of injuries in construction.

54. While levelling between two points P and Q on opposite banks of a river, the level was first set up hear point P and the staff readings observed at point P and Q were 1.385 m and 3.005 m respectively. After this, the level was set up near point Q and the observed readings on point P and Q were 0.750 m and 2.320 m respectively. If the reduced level of point Q was 120.000 m, determine the reduced level of point P.

55. Write short notes on the following construction equipment;
    (a) Hoe
    (b) Trenching machine

56. A B.G. track has a sleeper density of n + 6. If the track is laid with welded rails of 26 m length, find out the number of sleepers required for constructing a railway track of 1690 m.

57. Describe the methods of garbage disposal from a town.

58. Explain the steps involved to design a channel using Lacey's theory.

59. Enumerate the merits and demerits of rapid and slow sand filters.

60. Find the width of elementary gravity dam whose height is 100 m. Take, specific gravity of dam material = 2.2 and seepage co-efficient at the base C = 0.8.

61. Explain road camber and its necessity. Which road surface, concrete or bituminous, would need a steeper cross slope?

62. What are the uses and limitation of unit hydrograph?

63. Explain of the following:
    (i) Aquifer.
    (ii) Aquiclude.

PART-III
(Long Answer-type Questions)

Instructions for Questions 64 to 71:

- *Answer any 5 (FIVE) out of the eight questions.*
- *Each question carries 10 marks.*
- *Candidates are required to give their answers in their own words as far as practicable.*
- *No Data Books/Tables are allowed; assume the data if required anywhere.*
- *Unless otherwise mentioned, symbols and notations have their usual meaning.*

[10 x 5 = 50]

64. What are the factors to be considered by management in selection of standard and special construction equipment?

65. A road is to be constructed with a uniform rising gradient of **1 *in* 100**. Determine the staff reading required for setting the tops of the two pegs on the given gradient at **30 *meter*** interval from the last position of the instrument. The ***RL*** of the first peg is **384.500 *m***. A fly levelling was carried out from ***BM*** of ***RL* 387.000 *m***. The following observations (in ***metres***) were recorded:

Backsight	: **1.625**	**2.345**	**2.045**	**2.955**
Foresight	: **1.315**	**3.560**	**2.355**	

66. Explain the significance of Stopping Sight Distance and Overtaking Sight Distance. Calculate the values of Head Light Sight Distance and Intermediate Sight Distance for a Highway with a Design Speed of **65 *km/hr***. Assume coefficient of friction as **0.36** and Reaction Time as **2.5 sec**.

67. Discuss the need of Environmental Impact Assessment study. How do thermal power plants affect the environment?

68. During recuperation test, the water level in an open well was depressed by pumping up to **2.5 *metres***. The water level was raised by **1 *metre*** within **60 *minutes*** just after stopping the pumping. Determine the yield from the well of **2 *metres*** diameter when the depression head is **3 *metres***.

69. What should the diameter (in ***mm***) of a circular sewer be in order to carry a sewage discharge of **0.624 m^3/s** when flowing full at a slope of **1 *in* 10,000**. Assume $n = 0.012$ in the ***Manning's*** formula.

70. Describe in brief the various types of ***cross − drainage works***.

71. What is the ***equilibrium cant*** required (in ***cm***) on a **5°** curve on a B.G. track for the train speed of **60 *kmph***?

PART-IV
(Essay-type Questions)

Instructions for Questions 72 to 75:

- *Answer any 2 (TWO) out of the four questions.*
- *Each question carries 25 marks.*
- *Candidates are required to give their answers in their own words as far as practicable.*
- *No Data Books/Tables are allowed; assume the data if required anywhere.*
- *Unless otherwise mentioned, symbols and notations have their usual meaning.*

[25 x 2 = 50]

72. An area of **10 *km* × 20 *km*** is to be surveyed using aerial photogrammetry. Average scale of photograph is **1: 10000** at ground elevation of **400 *m*** above the datum. Focal length of camera used is **20 *cm*** and size of photographs are **23 *cm* × 23 *cm***. The speed of aircraft is **270 *kmph***. The forward lap in photographs is **70%** and side lap is **30%**. Determine the flying height, exposure interval and number of photographs required to complete the survey.

73. A building project comprises of seven activities and the relevant data is given below:

Activity	Optimistic time (in day(s))	Most likely time (in day(s))	Pessimistic time (in day(s))
1-2	1	1	7
1-3	1	4	7
1-4	2	2	9
2-5	1	1	1
3-5	2	5	14
4-6	2	5	8
5-6	3	6	15

(a) Develop the network and identify the critical path.
(b) Identify float and slack.
(c) Calculate variance for each activity.
(d) Calculate standard deviation of project.

74. Design a septic tank for a colony of **200 *persons*** with daily sewage flow of **135 *litres per person per day***. Assume a detention period of **24 *hours***. Draw a neat sketch of septic tank so designed.

75. In a catchment, the average rainfall for a storm at two successive $\boldsymbol{6\,hour}$ intervals was $\boldsymbol{3.0\,cm}$ and $\boldsymbol{6.0\,cm}$ respectively. The abstraction losses $\boldsymbol{\phi}$ index were estimated to be $\boldsymbol{0.20\,cm/hour}$. For the same catchment, the calculated data for a $\boldsymbol{6-hour}$ unit hydrograph is available and is given below. Find the direct run-off hydrograph due to the storm.

Time (hours)	0	6	12	18	24	30	36	42	48	54	60
Unit hydrograph ordinate (m^3/s)	0	10	25	40	100	150	100	75	25	15	0

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