## PART - II

Total Number of		
Questions : 40	Maximum Marks : 200	Time : 3 Hours

## INSTRUCTIONS (നിർദ്ദേശങ്ങൾ)

- Question cum Answer Booklets are processed by electronic means. The following instructions are to be strictly followed to avoid invalidation of answer scripts.
   (ചോദ്യവും ഉത്തരവും അടങ്ങുന്ന ഈ ബുക്ക് ലെറ്റുകൾ ഇലക്ട്രോണിക് സാങ്കേതിക വിദ്യയുടെ സഹായത്തോടുകൂടെ മൂല്യനിർണ്ണയം നടത്തുന്നതിനാൽ ഇവ അസാധുവാകാതിരിക്കുവാൻ താഴെപ്പറയുന്ന നിർദ്ദേശങ്ങൾ പൂർണ്ണമായും പാലിക്കുക.)
- The first page of this question cum Answer Booklet is an OMR data Sheet (Part I). All entries in the OMR sheet are to be made with blue or black ball point pen only.
   (ഈ പുസ്തകത്തിന്റെ ഒന്നാമത്തെ പേജ് ഒരു ഒ.എം.ആർ. ഡാറ്റാ ഷീറ്റാണ് (പാർട്ട് I). ഇത് നീലയോ, കറുപ്പോ നിറത്തിലെ ബോൾ പോയിന്റ് പേന ഉപയോഗിച്ച് മാത്രമേ പൂരിപ്പിക്കാവു.)
- Make sure that register number is bubbled correctly and completely; no correction is permitted.
  (രജിസ്റ്റർ നമ്പർ രേഖപ്പെടുത്തുന്നതിനുള്ള കുമിളകൾ കൃത്യമായും പൂർണ്ണമായും കറുപ്പിച്ചിട്ടു ണ്ടെന്ന് ഉറപ്പു വരുത്തുക. തിരുത്തലുകൾ അനുവദനീയമല്ല.)
- Do not tamper the bar code printed on the OMR sheet and subsequent pages. Tampering of bar code will result in the invalidation of this booklet.
   (ഈ പുസ്തകത്തിൽ എവിടെയും പ്രിന്റ് ചെയ്തിരിക്കുന്ന ബാർ കോഡിൽ ഒരു കാരണവശാലും തിരുത്തലുകളോ, മാർക്കുകളോ പാടില്ല. ഇതിനു വിരുദ്ധമായി ചെയ്യുന്ന പക്ഷം ഈ പുസ്തകം അസാധുവാകുന്നതാണ്.)
- Answers should be written with blue or black ball point pen only.
  (ഉത്തരങ്ങൾ നീലയോ, കറുപ്പോ നിറത്തിലെ ബോൾ പോയിന്റ് പേന ഉപയോഗിച്ച് മാത്രമേ എഴുതാവൂ.)
- Do not write anything outside the margin of space provided for writing the answer and write only one line of answer between two lines.
  (പുസ്തകത്തിൽ ഉത്തരം എഴുതുവാൻ നൽകിയിരിക്കുന്ന സ്ഥലത്തിനു വെളിയിൽ യാതൊന്നും തന്നെ എഴുതുവാൻ പാടില്ല. രണ്ടു വരകൾക്കിടയിൽ ഒരു വരി ഉത്തരം മാത്രമേ എഴുതുവാൻ പാടുള്ളൂ.)
- Rough work should be done only in the specific page provided with. (റഫ് വർക്കുകൾ ഇതിനായി നൽകിയിരിക്കുന്ന പേജിൽ മാത്രമേ ചെയ്യുവാൻ പാടുള്ളൂ.)

- 1. What are the key physical properties of building stones that influence their use in construction? (5 Marks)
- 2. Why is the water-cement ratio critical in concrete mix design? Explain its effects on concrete strength. (5 Marks)
- 3. In project management, explain the roles of PERT and CPM in planning and scheduling construction activities. (5 Marks)
- The basement of a residential building is 75 cm in height. Steps were constructed to access the Verandah from an unpaved car porch. Rise and Tread of a single step is 15 cm and 30 cm respectively. (5 Marks)
  - (a) Compute the quantity of brickwork required to construct the steps, if the length of a step is 1.2 m
  - (b) The outler surface of foundation projects to an amount of 10 cm from the outler surface of a basement. Compute the quantity of earthwork excavation for a depth of 10 cm below ground level
  - (c) If the steps are neatly plastered upto the plinth level with 20 mm thick cement plaster, compute the quantity of plastering work?
- Prepare the rate analysis for the DSR item, reinforced cement concrete (1:1<sup>1</sup>/<sub>2</sub>:3) using 3 graded stone aggregate 20 mm nominal size (Zone III), excluding the cost of centering, shuttering, finishing and reinforcement. (5 Marks)

Materials :

Stone aggregate 20 mm : 0.57 m<sup>3</sup> @ ₹ 1400/m<sup>3</sup> Stone aggregate 10 mm : 0.28 m<sup>3</sup> @ ₹ 1350/m<sup>3</sup> Coarse sand (Zone III) : 0.425 m<sup>3</sup> @ ₹ 1500/m<sup>3</sup> Portland cement : 400 kg @ ₹ 5000/tonne

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Labour :

Mason 0.17 @ ₹ 749/day

Beldar 2 @ ₹ 645/day

Bhisti0.9 @<br/> $\textcircled{\ } 714/day$ 

Carriage provisions :

Stone aggregate below 40 mm :  $0.85 \text{ m}^3 @ \notin 163.93/\text{m}^3$ Portland cement :  $0.400 \text{ tonne} @ \notin 145.72/\text{tonne}$ Coarse sand :  $0.425 \text{ m}^3 @ \notin 163.93/\text{m}^3$ Hire charges : For concrete mixer :  $0.07 @ \notin 800/\text{day}$ 

Needle type vibrator : 0.07 @ ₹ 350/day

Sundries (LS) : 14.30 @ ₹ 2.12

Add water charges, contractor profit and overheads as per DSR provisions

6. A commerical building is to produce a net income of Rs. 10 Lakh/annum as rent for the next 8 years. What is the value of the property? The owner of the building desires a return of 5% on his capital and the sinking fund to replace the capital is to accumulate at a rate of 4%. If the rate of interest on redemption of capital is 2%, calculate the value of the property?

(5 Marks)

- 7. What are the effects of water seepage in soils with high and low permeability? (5 Marks)
- 8. Explain how consolidation settlement is calculated using parameters derived from the e-log(p) curve. (5 Marks)
- 9. What is Optimum Moisture Content (OMC), and how does it influence soil compaction? How does the dry density change when the moisture content is either too low or exceeds the OMC? (5 Marks)

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- 10. A rigid retaining wall of height 4 m retains a dry cohesionless levelled backfill with angle of internal friction  $\phi = 30^{\circ}$  and unit weight =  $18 \text{ kN/m}^3$ . A support is to be provided behind the wall to prevent it from yielding. Determine the force on the support if used to prevent yielding of wall for a unit length of wall. Also determine the point of application of the support from the base of the wall. (5 Marks)
- 11. A strip footing of width 2 m is to be constructed in a  $c-\phi$  soil having dry unit weight of 18 kN/m<sup>3</sup> and c = 10 kN/m<sup>2</sup>. The depth of foundation  $(D_f)$  is 1 m. The water table is at a depth of 5 m from the ground level. Using Terzaghi's equation determine the ultimate bearing capacity. State whether the water table is having any effect on bearing capacity for the above condition. Given  $N_c = 10$ ,  $N_q = 4$  and  $N_{\gamma} = 3$ . (5 Marks)
- 12. An infinite slope (i) inclined at 14° is composed of cohesionless soil with a saturated unit weight of 20 kN/m<sup>3</sup> and an angle of internal friction (\$\phi\$) of 36.86°. Determine the factor of safety against slope failure under the following two conditions : (5 Marks)
  - (a) When the slope is fully submerged, but there is no seepage.
  - (b) When the slope is fully submerged and seepage occurs parallel to the slope surface.

Take unit weight of water  $(\gamma_w)$  as 10 kN/m<sup>3</sup>,  $\tan 14^\circ = \frac{1}{4}$  and  $\tan 36.86^\circ = \frac{3}{4}$ 

13. Explain Euler buckling load and effective length of columns. If buckling load for a strut with fixed supports at both ends is 2000kN, find out the buckling loads for similar columns if support conditions are changed to (a) both ends hinged (b) One end fixed and other end free. (5 Marks)

- 14. Show the shear force diagram and bending moment diagram for an overhanging beam with point loads 'W' at both overhanging ends. Distance between supports is 'L' and length of overhanging portions on both ends '0.25L' (5 Marks)
- 15. Define Influence lines and illustrate with two examples the uses of influence lines in Structural Analysis. (5 Marks)
- 16. Explain a typical axial load-moment interaction curve for a column and interpret if the point corresponding to a uniaxially eccentric load on a column on the interaction diagram lies marginally outside the envelope of the 'design interaction curve'. (5 Marks)
- 17. Explain the major shear transfer mechanisms by which shear is transmitted in a reinforced concrete beam. (5 Marks)
- 18. What is shape factor with regard to plastic analysis of steel structures and get the shape factor value for a rectangular section. (5 Marks)
- 19. Two points P and Q lie on opposite sides of a stream which is 800 m wide. In order to determine the level difference between the two points with great precision, the staff readings were measured keeping the level near to stations P and Q as given below. The error in collimation adjustment of the level is +0.002 m in 100 m. Determine the refraction. (5 Marks)

Level at (near to)	Level staff readings on	
	Р	Q
Р	1.650	2.900
Q	1.435	2.725

- 20. A steel tape 30 m long is suspended in catenary with its both ends level. If the tape sags 25.50 cm at the centre under a tension of 150 N, determine the weight of the tape. Make necessary assumptions. (5 Marks)
- 21. Determine the area enclosed by a chain line, boundary line and end offsets based on a series of offsets measured from a chain line at fixed interval of 15 m. The offsets measured (in m) are in the following order: 0, 3.62, 4.90, 6.15, 7.82, 8.50, 4.65, 0. Use Simpson's rule to compute the area. (5 Marks)

- 22. Explain Bowditch's method in traverse surveying.
- 23. A rectangular door covering an opening 3 m wide and 2 m high in a vertical wall of a tank is hinged at its base. The door is locked by a clamp placed at the centre of the top edge as shown in Fig.1. Determine the clamp reaction when the height of water is 1.0 m above the top edge of the opening. Take weight density of water  $w = 10 \text{ kN/m}^3$ . (5 Marks)



Fig. 1

24. A pipe of diameter 10 cm and length 50 m, has its one end connected to a tank and the other end open to the atmosphere as shown in Fig. 2. The pipe is horizontal and the height of water in tank is 4 m above the centre of the pipe. Considering the relevant minor losses and taking f = 0.001 in the formulae  $h_f = \frac{4f \ LV^2}{2gd}$ , determine the velocity of flow of water through the pipe. Take g = 10 m/s<sup>2</sup>. (5 Marks)



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25. Using Rayleigh's method of dimensional analysis, show that the resistance R to the motion of a sphere of diameter D moving with uniform velocity V through a fluid having density  $\rho$  and viscosity  $\mu$  may be expressed as

$$R = \left(\rho D^2 V^2\right) \not \phi \left(\frac{\mu}{\rho V D}\right)$$
(5 Marks)

- 26. A direct runoff hydrograph of a storm obtained from a catchment is triangular in shape and has a base period of 80 hours. The peak flow rate is 30 m<sup>3</sup>/s and it occurs at 40 hours from the start of storm. Catchment area is 50 km<sup>2</sup>. Find the rainfall excess of the storm. (5 Marks)
- 27. A canal was designed to meet the irrigation needs of 1000 ha of land growing rice of 150 days base period and having delta of 100 cm. If the same canal is used to irrigate wheat of base period 200 days having delta of 50 cm, find the area of wheat that can be irrigated. (5 Marks)
- 28. A tube well of 20 cm diameter fully penetrates a confined aquifer of infinite horizontal extent. The aquifer is 25 m uniform thickness. Steady state pumping at the rate of 100 lit/s from the well for a long time results in a steady drawdown of 4m at the face of well. The subsurface flow into the well due to pumping is steady, horizontal and Darcian and the radius of influence of the well is 100 m. Determine the permeability of aquifer material.

(5 Marks)

29. A four lane undivided carriageway caters to traffic operating at a speed of 100 kmph. Perception reaction time is 2.5 s. Distance between centre line of the alignment and centre line of inner lane is 5.25m. The radius of the curve is 200m. Calculate the setback distance required to have clear line of sight to provide stopping sight distance if (a) Length of the horizontal curve is 200 m, and (b) length of the horizontal curve is 150 m. Consider f = 0.35. (5 Marks)

- 30. A 9 degree curve diverges from a main curve of 8 degree curve in an opposite direction in the layout of a M.G. yard. Calculate the super elevation and speed on the branch line, if 10 trains at 20 kmph, 8 trains at 25 kmph, 4 trains at 38 kmph is permitted on the main line. (5 Marks)
- 31. (a) Explain curve resistance and compensation in gradient on horizontal curve.
  - (b) There is a horizontal curve of radius 60 m on a stretch of mountainous terrain with elevation of 3000 m above mean sea level, with a gradient of 6%. Determine the grade compensation.

(5 Marks)

- 32. A cement concrete pavement 20 cm thick and 7.5 m width has a longitudinal joint along the centre line. Design the diameter, length and spacing of the tie bars, if the allowable working stress in steel is 1400 kg/cm<sup>2</sup> in tension, allowed bond strength of deformed bars in concrete is 24.6 kg/cm<sup>2</sup> and coefficient of friction is 1.2. Assume unit weight of concrete a 2400 kg/m<sup>3</sup>. (5 Marks)
- 33. (a) The free mean speed on a roadway is found to be 80 kmph. Under stopped condition the average spacing between vehicles is 6.9 m. Determine the flow at capacity.
  - (b) A section of highway has the following flow-density relationship :  $q = 80 k - 0.4 k^2$ . What is the capacity of the highway section, the speed at capacity, and the density when the highway is one-quarter of its capacity? (5 Marks)
- 34. Vehicles approach a signalized intersection at a uniform flow rate of 600 vehicles/hour. Vehicles are served at the intersection during the green period at a uniform flow rate of 1800 veh/hour. The queue discipline is FIFO. The effective green time is 40 seconds while the cycle length is 60 seconds. Find time duration of queue, and number of vehicles that experience the queue. Determine the average delay per vehicle and total delay. (5 Marks)

- 35. The maximum daily demand at a water purification plant is estimated to be 18 million litres per day. Design the dimensions of a sedimentation tank for the raw water, assuming a detention period of 8 hours and the velocity of flow as 15 cm per minute. Assume water depth in the tank as 4m and freeboard as 50 cm. (5 Marks)
- 36. Chlorine usage in the treatment of 25,000 cubic metres per day is 10 kg/day. The residual chlorine after 10 minutes of contact is 0.25 mg/l. Calculate the total dosage per litre and the chlorine demand of the water. (5 Marks)
- 37. Design three slow sand filter beds from the following data : (5 Marks)

Population to be served = 3,000 persons Per capita demand = 100 litres/head/day Rate of filtration = 100 litres/hr/sq.m Length of each bed = Twice the breadth Assume: Max. daily demand is 2 times the average daily demand.

One unit out of three will be kept as a standby.

38. The change in concentration of organic matter L with time t is given by :

$$\frac{dL}{dt} = -KL$$

Compute the logarithmic value of the organic matter remaining after 4 days ( $\log_{10} L$ ) if the initial concentration was 250 mg/l and K = 0.3 per day. Given :  $\log_{10} 250 \approx 2.4$ . (5 Marks)

- 39. A BOD test is conducted on a municipal wastewater sample of volume 5 ml in 300 ml of bottle. After incubating the sample for 5 days at 20°C, the dissolved oxygen concentration drops from 9.1 mg/L to 5.3 mg/L. Estimate the BOD in 5 days and ultimate BOD of the sample assuming a K rate of 0.10 per day. Given:  $10^{-0.5} \approx 0.316$ ). (5 Marks)
- 40. A small town discharges  $12 \times 10^6$  litres of sewage per day into a treatment plant. If the 5-day BOD of the sewage is 200 mg/l, estimate the population equivalent. Assume that the domestic sewage quantity per person per day is 60 grams. (5 Marks)