

CS-19/06

CIVIL ENGINEERING

Paper—II

Time : Three Hours

Full Marks : 300

Candidates should attempt Question No. 1 from Section-A and Question No. 5 from Section-B which are compulsory, and any **THREE** of the remaining questions, selecting at least **ONE** from each Section.

All questions carry equal marks.

SECTION—A

1. Answer any **FIVE** of the following :—

(a) What are the important tests to be conducted on fresh concrete to find its properties as per BIS specifications ? 12

(b) Discuss the planning aspects of residential buildings. What are the provisions given in National Building Code for Public buildings ? 12

(Contd.)

(c) Draw the network diagram for the following logic of a construction project. Determine the Critical Path, duration of the project and various floats. Present it in a tabular form :

A = 6 days

B = 10 days

C = 4 days

D = 3 days

E = 5 days

F = 8 days

G = 4 days

H = 10 days

Activities B and C both follows A

Activity E follows C

Activity D follows B

Activity F follows E

Activity G follows D

Activity H follows F and C both. 12

(d) The following consecutive readings were taken with a dumpy level and 5-m leveling staff on continuously sloping ground at a common interval of 20 m :

0.385; 1.030; 1.925; 2.825; 3.730; 4.685; 0.625; 2.005; 3.110; 4.485.

The reduced level of the first point was 208.125 m. Rule out a page of a level field book

and enter the above readings. Calculate the reduced levels of the points by rise and fall method and also the gradient of the line joining the first and the last point. 12

(e) Briefly explain the PIEV theory. Discuss the factors that affect the distance within which a vehicle can be stopped and hence derive an expression for minimum Stopping Sight Distance. 12

(f) What are the different types of intersections ? List the objectives of Channelisation. 12

2. (a) Enumerate the advantages and disadvantages of natural seasoning of wood. What are the reasons for adopting artificial seasoning ? 20

(b) (i) Deduce expression for horizontal and vertical distances through tangential method of Tacheometry. 10

(ii) The altitudes of two proposed stations A and B 130 km apart are respectively 220 m and 1160 m. The altitudes of two points C and D on a profile

between them are respectively 3087 m and 623 m. The distance $AC = 50$ km and $AD = 90$ km. Determine whether A and B are intervisible and if necessary find the minimum height of scaffolding at B, assuming A as the ground station such that the new line of sight clears the peak at D by 1 m. 10

(c) (i) Compare the structural behaviour and design aspects of flexible and rigid pavements. 10

(ii) Describe the functions, desirable properties and suitable materials of various pavement component layers. 10

3. (a) (i) Define Scheduling. Explain in detail various methods of scheduling with merits and demerits of each of them. 10

(ii) Briefly describe how the changes in the Indian economy has influenced the construction industry in the last decade. 10

(b) (i) What is a Permanent Way ? Discuss

- briefly the requirements of an ideal Permanent Way. 10
- (ii) Explain the different systems of controlling movement of trains. 10
- (c) (i) How do you conduct Origin—Destination survey for an Indian medium city ? What are its uses ? 10
- (ii) While discussing the advantages and limitations, explain the design elements of a rotary intersections. 10
4. (a) (i) With suitable sketches explain various types of bonds used in brick masonry. 10
- (ii) Discuss the objectives and requirements of Plastering. 10
- (b) Discuss the various equipments that are used in highway construction. Explain their suitability and applications. 20
- (c) What are the purposes of providing a transition curve ? A transition curve has to be designed in a flat terrain for a highway on a horizontal curve of radius 450 m. The design speed is 100 kmph. Assume all other data as per IRC standards. Find the length of the transition curve. 20

SECTION—B

5. Answer any 5 sub-questions. All questions carry equal marks :

(i) Explain the following three techniques of evaluating mean precipitation over an area from point rainfall observations at a given number of stations :

(a) Arithmetical-Mean Method;

(b) Thiessen-Mean Method; and

(c) Isohyetal Method. 12

(ii) Explain the following terms used in irrigation engineering with appropriate formulae associated with the terms used for their evaluation :

(a) Duty of water;

(b) Gross Irrigation requirement; and

(c) Water application efficiency. 12

(iii) What are the differences between :

(a) Aqueduct and Superpassage;

(b) Weir and Barrage; and

(c) Cross Regulator and Distributary Head Regulator? 12

(iv) Suggest which type of dam from amongst Concrete Gravity, Earthen Embankment and Concrete Arch would you choose for the following three types of physical situations :

(a) Narrow valley with the valley base and sides composed of good non-fissured rocks;

(b) Wide valley with the valley base made up of good non-fissured rock but sides composed of weak fissured rock;

(c) Wide valley with the valley base and sides composed of weak fissured rocks. 12

(v) Suggest and explain what kind of energy dissipation arrangement would be suitable for adoption with a spillway for which the Jump Height Curve is always above the Tail Water Rating Curve. 12

(vi) Explain the following terms used in ground water engineering :

(a) Coefficient of Permeability;

(b) Perched Aquifer;

(c) Drawdown Curve. 12

6. Answer sub-questions, each of which carry equal marks :—

(i) The earthen embankment section of the Hirakud dam typically consists of a wide central clay core with partial cut-off. Drainage is facilitated by an inclined filter aligned along the downstream face of the core and a horizontal filter aligned along the base connected to a rock toe. Draw a neat proportionate sketch of the section, showing appropriate dam elements including upstream and downstream slope protections. Assume suitable values of shell and core slope grades and widths of top and intermediate beams. The height of the dam above the natural ground surface may be taken as 50 m. 20

(ii) Draw the seepage flow and equipotential lines below the horizontal floor of a weir equipped with only downstream sheet pile and assuming a head difference of 'H' metre between the upstream and downstream. How can the Exit Gradient (G_E) be determined in this case if the floor length is 'b' metre and the sheet pile length is 'd' metre.

How would G_c change if the sheet pile length is halved? 20

(iii) Answer the following questions: 20

(a) Explain the condition under which tension is experienced at the toe of a concrete gravity dam?

(b) Why can an earthen embankment dam collapse under sudden drawdown of the reservoir? 20

7. (a) An analysis of water from a surface stream yielded the following results: 20

$\text{Ca}^{2+} = 60 \text{ mg/L}$, $\text{Mg}^{2+} = 10 \text{ mg/L}$, $\text{Na}^+ = 7 \text{ mg/L}$,
 $\text{K}^+ = 20 \text{ mg/L}$, $\text{HCO}_3^- = 115 \text{ mg/L}$, $\text{SO}_4^{2-} = 96 \text{ mg/L}$,
 $\text{NO}_3^- = 10 \text{ mg/L}$, $\text{Cl}^- = 11 \text{ mg/L}$.

If an error of maximum 10% is acceptable, should the analysis be considered complete? 20

(b) A filtration bed of 0.67 m depth with a porosity of 0.4 is made of uniform-size sand particles. The sand grains are 0.4 mm in diameter with a shape factor of 0.85 and a specific gravity of 2.65. This bed is to be expanded to a porosity of 0.7 by hydraulic

- backwashing with stored overhead water at 20°C ($\rho_w = 998.2 \text{ kg/m}^3$, $\mu = 1.002 \times 10^{-3} \text{ N s/m}^2$). Determine the required backwash velocity and the resulting expanded bed depth. 20
- (c) Draw the breakpoint chlorination curve and explain briefly its salient features. 20
8. (a) Find out the diameter of a sewer flowing half-full at the design discharge of $5.112 \text{ m}^3/\text{min}$ while maintaining a minimum velocity of 0.6 m/s . The average ground slope is 0.0016 and Manning's $n = 0.015$. The hydraulic characteristics at half-full is $v/V_{\text{full}} = 0.8$ and $q/Q_{\text{full}} = 0.4$. 20
- (b) If the 3-day BOD of a wastewater is 155 mg/L and the 6-day BOD is 220 mg/L , determine the ultimate BOD (y_u) and reaction rate constant (k). 20
- (c) The activated-sludge process system shown below with usual notations is operating at steady state condition. The sludge wastage is being practiced from the aeration tank. All the sludge thickened in the clarifier is recycled to the aeration tank :—
- (i) Write mass balance around the entire system for biomass and food (or substrate),

- (ii) Write assumptions required to simplify the mass balance equations,
- (iii) Derive an expression for biomass concentration in the aeration tank, and
- (iv) Derive an expression for Q_R .

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