

CIVIL ENGINEERING

(Paper II)

Time Allowed : Three Hours
Maximum Marks : 250

QUESTION PAPER SPECIFIC INSTRUCTIONS

(Please read each of the following instructions carefully before attempting questions)

There are EIGHT questions divided in two Sections.

Candidate has to attempt FIVE questions in all.

Question Nos. 1 and 5 are compulsory and out of the remaining, any THREE are to be attempted choosing at least ONE question from each Section.

The number of marks carried by a question/part is indicated against it.

Wherever any assumptions are made for answering a question, they must be clearly indicated.

Word limit in questions, wherever specified, should be adhered to.

Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in the Question-cum-Answer Booklet must be clearly struck off.

SECTION 'A'

1. (a) What are the standards given in IS : 456–2000 to produce good quality concrete? Distinguish between Repair, Restoration and Rehabilitation. 10
 - (b) 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. 10
 - (c) How an area is measured using Planimeter? A rectangle has sides approximately 400 m and 250 m. If the Area is to be determined to the nearest 15 m², what will be the maximum error permitted in each line and to what accuracy should the lines be measured? Assume equal precision ratio for each length. 10
 - (d) Differentiate between Single Slip and Double Slip in Rails. If the tread diameter on both the rails is the same, then show that the slip is about 0.029 m. per degree of Central angle for Broad Gauge (B.G.). 10
 - (e) Draw the network for the following Project and indicate the event times and Critical Path. Also find the Project Duration and Total Float for all Activities: 10
- | Activity | Duration (Days) | Preceding Activities |
|----------|-----------------|----------------------|
| A | 5 | — |
| B | 3 | A |
| C | 3 | A, B, F |
| D | 7 | C, L |
| E | 7 | D, G, H |
| F | 2 | A |
| G | 2 | F |
| H | 3 | G, L |
| K | 6 | A |
| L | 3 | F, K |
2. (a) Write short notes on the following: (i) Acid Attack (ii) Sulphate Attack (iii) Alkali Attack on cement concrete. 15
 - (b) Compute the Radius of Relative Stiffness of 15 cm thick cement concrete pavement from the following data: (i) Modulus of Elasticity of Cement Concrete : 2.1×10^5 kg/cm² (ii) Poisson's Ratio for Cement Concrete : 0.13 (iii) Modulus of Subgrade Reaction : 3.0 kg/cm² and 7.5 kg/cm². 15

- (c) State the significance of 'Rate Analysis' in Estimating and Costing of Buildings. Calculate the quantities of Cement, Sand and Coarse Aggregate for preparing 1 cu.m of concrete of 1 : 2 : 4 proportion. Also calculate the no. of bricks required of size $20 \times 10 \times 10$ for constructing 1 m^2 of Brick Masonry wall. Explain any one method of Building Valuation. **20**
3. (a) What are the qualities of a good Brick? Explain the tests to be conducted to judge the quality of a Brick as per I.S. Code. **15**
- (b) The length and Bearings of a four sided traverse are as follows: AB = 320 m, BC = 440 m, CD = 390 m, DA = 513.8 m AB = N $45^\circ 15'$ E, BC = S $71^\circ 30'$ E, CD = S $30^\circ 15'$ W, DA = N $66^\circ 44'$ W Calculate the Area of the Traverse. **15**
- (c) Differentiate between Flexible Pavement and Rigid Pavement. Calculate the equivalent C-value of a three layered Flexible Pavement Section having individual C-values as given below: **20**
- | Materials | Thickness (cm) | C-value |
|---------------------|----------------|---------|
| Bituminous Concrete | 10 | 60 |
| Cement Treated Base | 20 | 225 |
| Gravel Sub-base | 10 | 15 |
4. (a) What is 'Seasoning of Timber'? Discuss the different methods of seasoning of timber. **15**
- (b) State the functions of sleepers in a Railway Track. Enlist the materials used for sleepers. For a Broad Gauge (B.G.) track in Transition zone, in order to allow locomotives with a maximum permissible speed of 100 km/hr, calculate: (i) Radius of curvature (ii) Degrees of curvature (iii) Super-elevation (iv) Length of Transition. **20**
- (c) Two points A and B having elevation of 650 m and 250 m respectively above datum, appear on a vertical photograph obtained with a camera of focal length of 250 mm and flying altitude of 2700 m above datum. Their correlated photographic coordinates are as follows: **15**
- | Point | Photographic Coordinates – X (cm) | Photographic Coordinates – Y (cm) |
|-------|-----------------------------------|-----------------------------------|
| A | + 3.65 | + 2.54 |
| B | – 2.25 | + 5.59 |
- Determine the length of the ground line AB.

SECTION 'B'

5. (a) The difference between the level of catchment and a Service Reservoir is 150 m and the distance between them is 48 km. The Reservoir was originally constructed by a single pipeline designed to carry $0.26 \text{ m}^3/\text{sec}$. It was later found necessary to increase the supply to $0.365 \text{ m}^3/\text{sec}$ and it was decided to lay another pipeline of same diameter along the first part of the length and cross connected. Calculate the diameters of the pipes and the length of second pipe. **10**
- (b) The BOD of a sewage incubated for one day at 30°C has been found to be 110 mg/l. What will be the 5 days 20°C BOD? Assume $K_1 = 0.1$ at 20°C . **10**
- (c) Define Air Pollution. Discuss the classification of Air Pollutants and effect of them on Human health. **10**
- (d) What do you understand by Capacity-Inflow Ratio in regard to Reservoir Sedimentation? How life of a Reservoir is determined from C/I Ratio and Trap Efficiency? **10**
- (e) A field test for permeability consists in observing the time required for a tracer to travel between two observation wells. The tracer was found to take 10 hrs. to travel between two wells 50 m. apart when the difference in water surface elevation in them was 0.5 m. The mean particle size of the Aquifer was 2 mm and the porosity of the medium is 0.3. If the kinematic viscosity ' ν ' = $0.01 \text{ cm}^2/\text{sec}$, estimate: (i) The Coefficient of Permeability and Intrinsic Permeability of Aquifer. (ii) The Reynolds Number of the flow. **10**
6. (a) A Small Reservoir has the following Storage-Elevation relationship: **15**

Elevation (m)	55.00	58.00	60.00	61.00	62.00	63.00
Storage ($10^3 \times m^3$)	250	650	1000	1250	1500	1800

A spillway provided with its crest at elevation 60.00 m has the discharge relationship as $Q=15 H^{3/2}$, where 'H' is the head of water over the spillway crest. Develop an Elevation v/s Storage ($S+Q.\Delta t/2$) relationship to be used for Reservoir Routing. Take $\Delta t=6$ Hrs.

- (b) What do you mean by the term Per Capita Demand? How is it estimated? The population of a locality as obtained from Census record is as follows:

YEAR	1970	1980	1990	2000	2010
POPULATION	15000	20000	24500	29500	32500

Estimate the population of the locality in 2040 by Arithmetic Increase, Geometrical Increase, Incremental Increase and Rate of Decrease Methods.

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- (c) Design an Alluvial Channel based on Lacey's theory from the following data: (i) Discharge : 25 cumecs (ii) Lacey's silt factor : 1.1 (iii) Side slopes : 1/2 H to 1 V Derive the Lacey's Waterway and Regime Scour Depth Formulae.

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7. (a) Discuss the significance of Nitrogen Content, BOD, COD, DO, Arsenic and Fluoride in Water Quality.

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- (b) Design a Rapid Sand Filter unit for 4.5 MLD, with all its principal components.

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- (c) What is Elementary Profile for a Gravity Dam? Discuss its shape and derive the expressions for its Base width and stresses in it. Design the Practical Profile of a Gravity Dam of Stone Masonry from the following data: (i) R.L. of Base of Dam : 1250 m (ii) R.L. of H.F.L. : 1280 m (iii) Specific Gravity of Masonry : 2.4 (iv) Safe Compressive Stress for Dam Material : 1200 kN/m^2 .

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8. (a) The following data pertains to the healthy growth of a Crop: (i) Field capacity of soil : 30% (ii) Permanent wilting percentage : 11% (iii) Density of soil : 1300 kg/m^3 (iv) Effective Depth of Root Zone : 700 mm (v) Daily consumptive use of water for the given crop : 12 mm For healthy growth, moisture content must not fall below 25% of Water holding Capacity between the Field Capacity and the Permanent Wilting Point. Determine the Watering Interval in days.

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- (b) An Activated Sludge Tank is 30 m long, 9 m wide and has liquid depth of 4 m. The influent sewage flow rate is 3.5 MLD. The primary effluent has BOD of 130 mg/l and suspended load of 150 mg/l. The MLSS concentration in the Aeration Tank is 1800 mg/l. Calculate: (i) BOD Loading in kg/Ha-m (ii) F/M Ratio (iii) Aeration Period (iv) Sludge Age.

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- (c) Give the classification of Energy Dissipators. State the situations in which Hydraulic Jump Type and Bucket Type Dissipators are recommended based on relative positions of Jump Height Curve and Tail Water Rating Curve.

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