

## CIVIL ENGINEERING Paper – II

Time Allowed : **Three Hours**

Maximum Marks : **200**

### Question Paper Specific Instructions

*Please read each of the following instructions carefully before attempting questions :*

*There are **EIGHT** questions in all, out of which **FIVE** are to be attempted.*

*Questions no. **1** and **5** are **compulsory**. Out of the remaining **SIX** questions, **THREE** are to be attempted selecting at least **ONE** question from each of the two Sections A and B.*

*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.*

*All questions carry equal marks. The number of marks carried by a question/part is indicated against it.*

*Answers must be written in **ENGLISH** only.*

*Unless otherwise mentioned, symbols and notations have their usual standard meanings.*

*Assume suitable data, if necessary and indicate the same clearly.*

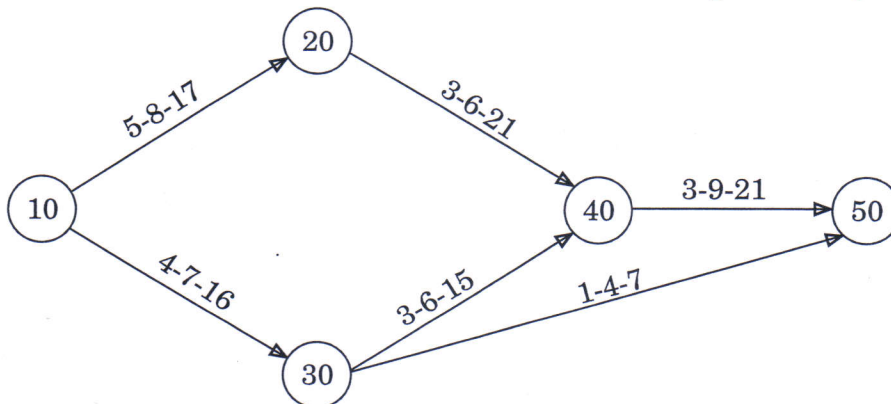
*Neat sketches may be drawn, wherever required.*

## SECTION A

- Q1.** (a) Briefly discuss the compressive strength and tensile strength properties of timber for the use of timber as a structural element of a building. 8
- (b) What are the advantages of partition walls in a building? What are the requirements of a good partition wall? 8
- (c) A 3.0 km section of the highway between two points A and B on the ground appears on an aerial photograph which was taken with a camera of focal length 15.0 mm. The photo-coordinates of point A are (20.5, 15.5) mm and point B are (-15.5, -20.5) mm with their ground height as 250 m and 210 m above mean sea level, respectively. Compute the flying height of the aircraft above mean sea level. 8
- (d) A curve of 600 m radius on a BG section has a limited transition of 50 m length. If the Maximum Sectional Speed (MSS) is 100 kmph, compute the maximum permissible speed and superelevation. Assume actual cant is equal to cant deficiency permitted at maximum speed. 8
- (e) Determine the spacing between contraction joints for 4.0 m slab width having a thickness of 25 cm and  $f = 1.5$ , for (i) Plain Cement Concrete; allowable  $S_c = 0.8 \text{ kg/cm}^2$ , and (ii) Reinforced Cement Concrete 1.0 cm dia bars at 0.30 m spacing. Assume unit weight of cement concrete  $W = 2400 \text{ kg/m}^3$ , and allowable tensile stress in steel =  $1400 \text{ kg/cm}^2$ . 8
- Q2.** (a) What are the factors affecting orientation of a building? What do you understand by horizontal circulation and vertical circulation in a building? Briefly discuss the suitability of lifts and ramps for vertical circulation in a building. 15
- (b) The speed of overtaking and overtaken vehicles are 80 and 50 kmph respectively, on a two-way traffic road. The acceleration of overtaking vehicle is  $1.11 \text{ m/sec}^2$ . Compute the (i) safe overtaking sight distance, (ii) minimum length of overtaking zone and desirable length of overtaking zone, and (iii) draw a neat sketch of the overtaking zone and show the positions of the sign post. 15
- (c) The following consecutive readings were taken with a Level Instrument and 4 m staff : 0.680, 1.455, 1.855, 2.330, 2.885, 3.380, 1.055, 1.860, 2.265, 3.540, 0.835, 0.945, 1.530 and 2.250 m, on a sloping ground. The RL of the starting point was 80.750 m. Enter the readings in a proper tabular form and find out the RLs of other points by Rise and Fall method. Compute the gradient of line joining first and last point, if all observations have been taken at a regular 30 m interval. 10

Q3. (a) A loan of ₹ 10 crores has been sanctioned for a construction project with a condition that the project will be completed in 39 weeks. Thus, the three time estimates i.e. the optimistic time estimate ( $t_o$ ), the most likely time estimate ( $t_L$ ) and the pessimistic time estimate ( $t_p$ ) (in weeks), for various activities of the project are estimated as mentioned in the project network as shown in figure below. Determine the following : 15

- (i) Critical path
- (ii) Within how many weeks the project is expected to be completed with probability of 99.38% ? The probability factor Z (normal deviate) may be considered as + 2.5 for 99.38% probability.



- (b) (i) The pavement of a NH has two lanes 7.0 m wide with a curve of radius 500 m. Determine the length of transition curve. Make suitable assumptions. Take design speed as 100 kmph. 10
- (ii) Write the requirements of a good drainage system for a highway. 5
- (c) The following latitudes and departures were obtained during a closed traverse ABCDEFA survey :

Length	Latitude (m)	Departure (m)
AB	0.00	+ 183.79
BC	+ 128.72	+ 98.05
CD	+ 177.76	- 140.85
DE	- 76.66	- 154.44
EF	- 177.09	0.00
FA	- 52.43	+ 13.08

Adjust the traverse by Bowditch method and compute corrected Latitudes and Departures. 10

**Q4.** (a) Briefly discuss the salient features and suitability of the following type of rollers for compaction of soil :

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- (i) Smooth wheeled roller
- (ii) Sheepsfoot roller
- (iii) Vibratory roller

(b) During a traffic speed survey, the following observations were recorded when a vehicle passes a 50 m long road section XY.

Vehicle	Time of Passing X (seconds)	Time of Passing Y (seconds)
1	2.0	4.5
2	3.5	5.8
3	4.0	6.1
4	4.5	6.3
5	5.5	7.5

Determine the following :

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- (i) Average time mean speed
- (ii) Average space mean speed using the above data
- (iii) Also verify the results obtained in (ii) above using relationship between the time mean speed and space mean speed.

(c) Briefly discuss how brick masonry work is advantageous as compared to stone masonry work for construction work of a building.

Also discuss how stone masonry work is advantageous as compared to brick masonry work in building construction.

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## SECTION B

- Q5.** (a) On the basis of isopluvial maps, the 50-year – 24-hr maximum rainfall at a place is found to be 16 cm. Determine the probability of a 24-hr rainfall of magnitude 16 cm occurring at the same place
- (i) Once in ten successive years.
  - (ii) Twice in ten successive years.
  - (iii) At least once in ten successive years. 8
- (b) For Border Strip method of irrigation, determine the time required to irrigate a strip of land of 0.06 hect. in area from a tubewell with a discharge of 0.025 cumec. The infiltration capacity of soil may be taken as 5 cm/hr, and the average depth of flow on the field is 8 cm. Also determine the maximum area that can be irrigated by this tubewell. 8
- (c) What are Garret's Diagrams ? How is an alluvial channel designed by using these diagrams ? Give stepwise procedure along with the data requirement. 8
- (d) A water reservoir is disinfected using a 30 mg/L chlorine dosage by applying a 2.0 percent hypochlorite solution. (i) How many kilograms of dry hypochlorite powder containing 65 percent available chlorine, must be dissolved in 100 L of water to make a 2.0 percent (20,000 mg/L) solution. (ii) At what rate should this solution be applied to the water entering the reservoir to provide a concentration of 50 mg/L ? (iii) If 36,000 L of water is used to fill the reservoir at a dosage of 50 mg/L, how many litres of hypochlorite solution are used ? 8
- (e) Design a standard egg-shaped sewer to carry a discharge of  $1.5 \text{ m}^3$  per second with a velocity of flow 1.0 metre per second. Assume sewer runs 80% full. 8
- Q6.** (a) (i) Enlist the various engineering devices that are used to control emissions of gaseous pollutants from industries. Describe any one in brief. 5

- (ii) To evaluate the efficiency of a treatment plant, the following data have been obtained in a BOD test :

Type of waste	DO initial	DO final	Vol. of wastewater (mL)	Vol. of dilution water (mL)
Untreated sewage	5.0	3.0	5	295
Treated sewage	8.5	4.5	25	275

Calculate the percentage of the BOD being removed by the treatment plant. It is assumed to be a secondary treatment plant and removes 85 percent of the BOD, whether the plant is operating properly or not.

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- (b) (i) How do air pollutants accelerate deterioration of materials in the environment ?

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- (ii) Solid waste from a park is to be collected in large containers. It is estimated that the average time to drive from the garbage to the first container  $t_1$  and from the last container  $t_2$  to the garbage each day will be 15 and 20 minutes, respectively. If the average time required to drive between the containers is 360 seconds and the two-way distance to the disposal site is 50 km (speed limit 88 km/hr), determine the number of containers that can be emptied per day, based on an 8-hour work day.

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Note : at 88 km/hr speed,  $a = 0.016$ ,  $b = 0.011$ ;  $S = 0.133$ ,  $W = 0.15$ ;  $P_c + U_c = 0.4$  h/trip.

- (c) Design a tubewell for the following data :

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- (i) Yield Required : 0.15 cumec  
(ii) Thickness of Confined Aquifer : 38 m  
(iii) Radius of Circle of Influence : 300 m  
(iv) Coefficient of Permeability : 75 m/day  
(v) Drawdown : 6 m

- Q7. (a) (i) Fix the Crest level, Pond level and determine the depths of upstream and downstream cut-off piles for a vertical drop weir from the following data : 10
- |      |                                 |   |            |
|------|---------------------------------|---|------------|
| I.   | Maximum Flood Discharge         | : | 1500 cumec |
| II.  | HFL before construction of Weir | : | 215.0 m    |
| III. | River Bed Level                 | : | 210.0 m    |
| IV.  | Allowable Afflux                | : | 1 m        |
| V.   | Full Supply Level of Canal      | : | 214.0 m    |
| VI.  | Lacey's Silt Factor             | : | 1.0        |
| VII. | Retrogression                   | : | 0.5 m      |
- (ii) Enlist the various 'Modes of Failure' of a Gravity Dam, stating their stability criteria for Safe Design of the Dam. 5
- (b) (i) An overfall spillway passes a discharge of 0.8 cumec/m width with a fall of 15 m. Depth of water available on the downstream is 2.5 m. If the pre-jump depth is 0.5 m, calculate the leading dimensions of a horizontal apron type of stilling basin for energy dissipation. 10
- (ii) A crop is to be grown in a field having a field capacity of 30% and the permanent wilting point as 16%. Find the storage capacity in 1 m depth of soil, if the dry unit weight of the soil is 1.5 gm/cc. If the irrigation water is to be supplied when the average soil moisture falls to 20%, find the water depth required to be supplied to the field if the field application efficiency is 85%. What is the amount of water needed at the canal outlet in the water course if the water lost in the water course and field channel is 15% of the outlet discharge ? 5
- (c) (i) What are the barriers in a drinking water system to prevent pathogens and other contaminants from reaching the consumers ? 5
- (ii) A city has a population of 2,00,000. It is to be supplied with water from a reservoir situated at a distance of 7 km. It is so stipulated that one-half of the daily supply of 150 litres per head should be delivered in 6 hours. If the available head is 15 m, calculate the size of the pipe required. Assume  $f' = 0.04$ . 5

- Q8. (a) (i) The ordinates of a 4-hr Unit Hydrograph at a site on a river are given below :

Time (Hrs)	0	2	4	6	8	10	12	14	16	18	20	22
Ordinates of UH (cumecs)	0	25	100	160	190	170	110	70	40	28	13	0

Develop a Summation Hydrograph for the river site. Derive the ordinates of a 2-hr Unit Hydrograph for the site. 10

- (ii) Decide the total horizontal floor length for a structure on pervious formation based on Khosla's theory from the following data : 5

I. Design Head : 6.5 m

II. Depth of D/S cut-off pile : 7.5 m

III. Safe Exit Gradient : 1/5

- (b) (i) How does carbon dioxide dissolution in lake water affect algal bloom ? 5

- (ii) Why is pH of solution an important parameter in the coagulation-flocculation process and why does it need to be maintained ? Explain the importance of the jar test in coagulation operations and describe the test. 10

- (c) (i) What are the individual unit processes within preliminary treatment, primary treatment, secondary treatment and disinfection ? 5

- (ii) Suggest the preventive measures for effective water pollution control. 5