

CIVIL ENGINEERING (Paper II)

Time Allowed : Three Hours

Maximum Marks : 300

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.

SECTION 'A'

1. Answer any five out of the following:

5×12=60

- (a)(i) What is 'pointing'? Mention any four methods of pointing.
- (a)(ii) Explain in detail the need and procedure for conducting water absorption test for coarse aggregate to be used in cement concrete.
- (b) Write short notes on any three of the following construction equipment: (i) Clamshell (ii) Hoe (iii) Tower Crane (iv) Trenching machine
- (c)(i) Briefly discuss the Fulkerson rule of numbering events in a Network.
- (c)(ii) What is the difference between CPM and PERT in network analysis?
- (d)(i) Draw a neat labelled sketch with dimensions showing the cross-section of a Broad gauge track for double line with electric-traction.
- (d)(ii) What is the intended purpose of rail? List any ten requirements to serve the intended purpose of a rail.
- (e)(i) Explain any six salient features of Nagpur Road Plan.
- (e)(ii) List the eight factors which control the conventional methods of preliminary survey. Explain any two in detail.
- (f)(i) List the ten precautions to be taken in Theodolite observations.
- (f)(ii) With a neat labelled diagram, classify the satellites depending upon the inclination of the orbital plane with the earth's equatorial plane.

- 2. (a)(i) What are the functions and limitations of Break even analysis? **10**
- (a)(ii) Discuss any five basic parts of paint used in building construction. **10**
- (b)(i) What are the five different types of plasters and indicate the purpose(s) of plastering for Civil Engineering structures? **10**
- (b)(ii) List the factors which affect the selection and use of crane in construction activity. **10**
- (c)(i) The speed of overtaking and overtaken vehicles are 80 km/h and 40 km/h respectively on a two way traffic road. If the acceleration of overtaking vehicle is 1 m/s^2 . I. calculate safe overtaking sight distance. II. mention the minimum length of overtaking zone and III. draw a neat labelled sketch of the overtaking zone and show the positions of the sign posts. • (Overtaking zone ahead) • (End of overtaking zone ahead) Assume reaction time **10**

of driver as 2 sec.

- (c)(ii) A vertical summit curve is to be designed when two grades +1/60 and -1/70 meet on a highway. The stopping sight distance and overtaking sight distance required are 200 m and 650 m respectively. But due to site conditions the length of vertical curve has to be restricted to a maximum value of 500 m if possible. Calculate the length of summit curve needed to fulfil the requirements of I. Stopping sight distance II. Overtaking sight distance or at least intermediate sight distance and discuss the results.

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3. (a) A construction machine costs Rs. 50,000/- and has an expected life of 5 years and salvage value of Rs. 7000/-. It is expected to work 2000 hours in a year. Find out the yearly depreciation for the machine using sinking fund method. Assume that the deposits draw interest @ 12% per annum.

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- (b)(i) Determine the elevation of the top of a chimney from the observations given below:

Station	Reading on BM	Angle of elevation
A	2.870	28°42'
B	3.750	18°06'

The top of chimney and the stations A and B are in the same vertical plane. AB is 100 m. If the RL of the BM is 100.000, determine the elevation of the top of the chimney.

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- (b)(ii) Write the procedure of construction of simple curve when both the points of commencement and tangency are inaccessible.

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- (b)(iii) With a neat labelled sketch define I. Angle of deflection II. Point of commencement. III. Long chord IV. Tangent distance

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- (c)(i) What would be the permissible speed on the curve, on a 8° broad gauge track? The average speed of different trains is 60 km/h and the allowable cant deficiency is half that of maximum cant deficiency. Comment on the speed limit. Assume suitable data as per Railway Board if required.

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- (c)(ii) Write step by step procedure of measuring mid-ordinates or versines for starting lining the curves.

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4. (a)(i) A cement concrete (cc) pavement slab of thickness 200 mm is constructed over a granular sub-base having modulus of reaction 15 kg/cm². The maximum temperature difference between the top and bottom of the slab during summer days and night is found to be 18°C. The spacing between the transverse contraction joint is 4.5 m and that between longitudinal joints is 3.5 m. The design wheel load is 5100 kg, radius of contact area is 15 cm, E-value of cc is 3×10⁵ kg/cm², Poissons ratio is 0.15, and the coefficient of thermal expansion of cc is 10×10⁻⁶ per °C and friction coefficient is 1.5. Using the edge and corner load stress charts given by the IRC and the chart for the warping stress coefficient find the worst combination of stresses at the edges.

[Figure: Edge Load Stress Chart (IRC) – graph of edge load stress, S_e kg/cm² (vertical axis, 0 to 50 in steps of 5) against slab thickness, h cm (horizontal axis, 14 to 25, labelled 14, 16, 18, 20, 22, 24); chart note: $P = 5100$ kg, $a = 15$ cm, $E = 3 \times 10^5$ kg/cm², $\mu = 0.15$; five falling curves for $K = 30$ kg/cm³, 15, 10, 8 and 6 ($K = 6$ the highest curve, $K = 30$ the lowest), approximate readings: at $h = 14$ cm about 39.5 ($K = 30$), 44 ($K = 15$), 47 ($K = 10$), 50 ($K = 8$) and above 50 ($K = 6$); at $h = 20$ cm roughly 24.5 ($K = 30$) to 28.5 ($K = 6$); at $h = 25$ cm about 14 to 17]

[Figure: Corner Load Stress Chart (IRC) – graph of corner load stress, S_c kg/cm² (vertical axis, 0 to 50 in steps of 5) against slab thickness, h cm (horizontal axis, 14 to 25); chart note: $P = 5100$ kg, $a = 15$ cm, $E = 3 \times 10^5$ kg/cm², $\mu = 0.15$; five falling curves for $K = 30$ kg/cm³, 15, 10, 8 and 6 ($K = 6$ the highest, $K = 30$ the lowest), approximate readings: at $h = 14$ cm about 41.5 ($K = 30$), 47.5 ($K = 15$) and above 50 for $K = 10$, 8 and 6; at $h = 20$ cm roughly 25.5 ($K = 30$) to 30 ($K = 6$); at $h = 25$ cm about 18.5 to 20]

[Figure: Warping Stress Coefficient – graph of VALUES OF C_x AND C_y (vertical axis, 0 to 1.2 in steps of 0.2) against VALUES OF L_x/l AND L_y/l (horizontal axis, 0 to 14 in steps of 2); single S-shaped curve: about 0 up to $L/l=2$, rising steeply between 3 and 4 (about 0.5 at 3.7), about 0.9 at 6, reaching 1.0 near 7.5, a peak of about 1.05 near 9, then about 1.02–1.03 from 10 to 14]

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- (a)(ii) The consolidated data collected from speed and delay studies by floating car method on a stretch of urban road of length 4 km, running North-South are given below. Determine

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the average values of volume, journey speed and running speed of traffic stream along either direction.

Trip No.	Direction	Journey time (min, sec)	Total stopped delay (min, sec)	No. of vehicles overtaking	No. of vehicles overtaken	No. of vehicles from opposite direction
1	N – S	6, 30	1, 40	4	6	270
2	S – N	7, 20	1, 50	5	3	180
3	N – S	6, 50	1, 20	4	3	280
4	S – N	7, 50	2, 10	3	2	200
5	N – S	6, 10	1, 20	2	5	240
6	S – N	8, 10	2, 20	6	2	180
7	N – S	6, 30	1, 40	4	4	300
8	S – N	7, 40	1, 50	1	2	160

(b)(i) List the major limitations of Bar Chart.

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(b)(ii) A building project comprises of seven activities and the relevant data is given below:

Activity	Estimated Duration (days) – Optimistic time	Estimated Duration (days) – Most likely time	Estimated Duration (days) – Pessimistic time
1 – 2	1	1	7
1 – 3	1	4	7
1 – 4	2	2	6
2 – 5	1	1	1
3 – 5	2	5	14
4 – 6	2	5	8
5 – 6	3	6	15

(b)(ii)(1) Develop the network and identify the critical path.

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(b)(ii)(2) Identify float and slack.

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(b)(ii)(3) Calculate variance for each activity.

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(b)(ii)(4) Calculate standard deviation of the project.

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(c)(i) For setting out a trunk sewer between station A and B, following data was made available. # Gradient of sewer 1 in 250. # Depth of invert at lower end A: 2.650 m (below peg A). # Distance between Section A and B: 75 m. # Staff reading on peg A: 1.80 m. # Staff reading on peg B: 2.30 m. # Height of collimation of the level set up nearby: 250.00 m. # The length of the staff rod: 4 m. Make necessary calculations for fixing the sight rails at A and B. Also write the procedure for fixing the sight rails to the vertical posts.

16

(c)(ii) In the year 1940, a certain line had a magnetic bearing of S 67°30'E and then the magnetic declination at that place was 8°E. In 2007, the magnetic declination was 4°W. Find the magnetic bearing of the line in 2007.

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SECTION 'B'

5. Answer any five out of the following:

5×12=60

(a) Outline briefly the concept of 'Groundwater Budgeting' and its importance in the determination of the safe yield from the basin.

(b) Illustrate with the help of diagrams the basic three types of dam. Briefly mention the general design considerations to be followed for its safety.

(c) Show with the help of a suitable diagram the component parts of an irrigation canal system and briefly mention their respective functions.

(d) What is the significance of the following substances when they exceed the permissible limit in potable water? Also mention the permissible limit for the same: Fluoride, Nitrate,

Nitrite, Chloride, Arsenic.

- (e) How is the dissolved oxygen sag curve interpreted to indicate the critical point or the point of minimum D.O.?
- (f) What do you mean by hydraulically equivalent section? What are the parameters on which the cross-section of sewer would depend upon?
6. (a) A trapezoidal irrigation canal with side slope of 1.5 H to 1 V is proposed to be lined with bricks to reduce seepage losses. It is required to carry a discharge of $20 \text{ m}^3/\text{s}$ of water. Find the wetted perimeter for minimum amount of lining and the required bed slope. The value of Manning's N is given as 0.015 and it is stipulated that the average velocity cannot exceed 1 m/s . 20
- (b) A crop is irrigated with reclaimed waste water whose salinity (EC_w) measured by electrical conductivity is 1.0 mmho/cm . If the crop is irrigated to achieve a leaching fraction of 0.20 i.e. (80% of water is lost through evapotranspiration) determine the following: (i) the salinity of the deep percolating water. (ii) the appropriate leaching fraction to maintain crop yield. The crop yield will suffer significant loss when TDS (total dissolved substance) of soil water exceeds 5000 mg/l . Given: $\text{TDS (mg/l)} \approx \text{EC (mmho/cm)} \times 640$. 20
- (c) Explain the term B.O.D. Derive the expression for B.O.D. reaction. 20
7. (a) The flood record for a period of 25 years of a small tributary of a main river has been analysed based on the assumption that the distribution is log-Normal. The mean ' μ ' and standard deviation σ of the distribution have been found to be $2.5 \text{ m}^3/\text{s}$ and $1.0 \text{ m}^3/\text{s}$. Find the magnitude of 100 and 1000 yr return period flood. 20
- (b) What are the various functional elements of a solid waste management system? Describe briefly the significance of each functional element. 20
- (c) 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 the septic tank so designed. 20
8. (a) Determine using the 'rational formula' with runoff coefficient equal to 0.80, the peak storm runoff to be carried out by the underground drainage pipeline AB for the drainage basin area of 0.2 ha shown in the above figure. Take the length of pipeline as 100 m and the level difference between A and B as 0.5 m. Assume initially a pipe diameter of 250 mm. Consider Darcy-Weisbach friction factor $f=0.015$. The rainfall duration and rainfall intensity is furnished in tabular form below. Consider time of entry at end A as 2 min. Check whether the pipe size is adequate or not.
- [Figure (printed above the text of 8(a)): Pear-shaped drainage basin (outline labelled "Drainage basin"), rounded at the left and tapering to a point B at its right-hand end; point A lies inside the basin towards its rounded end; a straight pipeline (labelled "Pipeline") runs from A to the outlet B]
- | Duration (mins) | Rainfall intensity (mm/hr) |
|-----------------|----------------------------|
| 2.0 | 122 |
| 2.5 | 108 |
| 3.0 | 97 |
| 3.5 | 89 |
| 4.0 | 82 |
| 4.5 | 77 |
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- (b) Table below furnishes the kind of crop irrigated from the water of a reservoir by means of the canal system. The data about these crops are also furnished in the table.
- | Kind of crop | Crop period in days | Area under crops in ha | Duty of water in the field in ha/cumec |
|--------------|---------------------|------------------------|--|
| Cotton | 240 | 3000 | 1430 |
| Sugarcane | 365 | 2000 | 860 |
| Wheat | 120 | 4000 | 2150 |
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Rice	120	2000	860
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Assume 30% losses of water in the entire canal system and 15% losses in the reservoir. Find the live storage of the reservoir in ha/m.

- (c) Design a plain sedimentation tank to treat 4 million litres water per day. The detention period may be assumed as 6 hours and the depth may be assumed as 3.5 m. Assume velocity of flow as 10 cm/minute.

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