JHGT-B-CVLE

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.

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.

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

SECTION A

Q1. (a) What are the different types of deterioration of concrete ? How can it be prevented ? *8*

(b) Differentiate between PERT and CPM. Define slack of an event and float of an activity. Define three time estimates of an activity. *8*

(c) A section line AB 310 m long on a flat terrain measures 102·5 mm on the vertical photograph. A radio tower also appears on the photograph. The distance measured from the principal point to the image of the bottom and top of the radio tower were found to be 7·5 cm and 8·5 cm respectively. The average elevation of terrain was 550 m. Determine the height of the tower. Take focal length (f) of the camera as 152·4 mm. *8*

(d) A two-lane two-way road is at present carrying a traffic of 1200 commercial vehicles per day. It is to be strengthened for the growing traffic needs. The vehicle damage factor has been found to be 3. The rate of growth of traffic is 12% per annum. The period of construction is 5 years. The pavement is to be designed for 15 years after completion. Calculate the cumulative standard axles to be used in design. *8*

(e) If an 8° curve track diverges from a main curve of 5° in an opposite direction in the layout of a B.G. yard, calculate the super-elevation and the speed on the branch line, if the maximum speed on the main line is 50 km/hr. Use Cant deficiency as 7·6 cm. *8*

Q2. (a) The details of a network are given below and the duration is in days. Draw the project network and identify critical path. Calculate float for each activity and identify the project duration. *15*

Activity	t_o	t_m	t_p
1 – 2	2	5	8
1 – 3	1	4	7
2 – 3	0	0	0
2 – 4	2	4	6
2 – 6	5	7	9
3 – 4	3	5	7
3 – 5	3	6	9
4 – 5	4	6	9
4 – 6	2	5	8
5 – 6	2	4	6

(b) A vehicle of weight 2·5 tonnes skids through a distance of 50 m before colliding with another parked vehicle of 1·5 tonnes. After collision both the vehicles skid through a distance of 15 m before stopping. Calculate the

(i) original speed of the vehicle.

(ii) speed at the time of applying brakes and skidding through 50 m.

(iii) speed at the time of collision after skidding through 15 m. *15*

Assume average coefficient of friction as 0·5.

(c) A traverse is run to set out a line AE 2200 m at right angles to a given line AB. The lengths and bearings of traverse legs are observed as follows :

Line	Length (m)	Bearings
AB	—	360° 00′
AC	900	120° 30′
CD	1200	86° 30′
DE	?	?

Compute the length and bearing of line DE. *10*

Q3. (a) The following data refers to a construction project. Indirect cost of the project is ₹ 3,500 per week. Determine optimum cost and duration of the project. *15*

Activity	Normal Duration (weeks)	Normal Cost (₹)	Crash Duration (weeks)	Crash Cost (₹)
1 – 2	6	7,000	3	14,500
1 – 3	8	4,000	5	8,500
2 – 3	4	6,000	1	9,000
2 – 4	5	8,000	3	16,000
3 – 4	5	5,000	3	11,000

(b) Determine the warping stresses at interior, edge and corner of a 30 cm thick cement concrete pavement with transverse joints at 5·5 m intervals and longitudinal joints at 3·8 m intervals. The modulus of subgrade reaction, k is 6·9 kg/cm^3 and radius of loaded area is 16 cm. Assume maximum temperature differential during day to be 0·6°C per cm slab thickness (for warping stresses at interior and edge) and maximum temperature differential of 0·4°C per cm slab thickness during the night (for warping stresses at corner). The following additional data are given : *15*

Coefficient of thermal expansion (α) = 10×10^{-6} per °C

$E = 3 \times 10^5$ kg/cm^2

$\mu = 0{\cdot}15$

$$\left[\begin{array}{l} \text{For } \frac{L_X}{l} \text{ or } \frac{L_Y}{l} = 4;\ C_X \text{ or } C_Y = 0{\cdot}5 \\ \text{For } \frac{L_X}{l} \text{ or } \frac{L_Y}{l} = 6;\ C_X \text{ or } C_Y = 0{\cdot}9 \end{array}\right]$$

Assume linear interpolation for remaining values.

(c) In triangulation survey, prove that the best shape of a triangle is an isosceles triangle whose base angles are 56° 14′ (approx) each. *10*

Q4. (a) (i) What are the arrangements needed at a typical concrete plant ? List the typical activities in such plants. *8*

(ii) What are the various ways by which concrete can be transferred from the central batch and mixing plant to work site ? *7*

(b) (i) Draw cross-section of railway track for the following : *8*

B.G. track in embankment for single line (on straight track)

B.G. track in cutting for double line (on straight track)

(ii) If a cross-over occurs between two B.G. parallel tracks of the same crossing number 1 in 8·5, with reverse curves of equal radii of 450 m and the distance between the tracks is 4·5 m, find out the overall length of the crossing and the intermediate curved length of cross-over. *7*

(c) Discuss in brief, various types of thermal insulating materials. Explain how thermal insulation of roofs and walls are achieved. *10*

SECTION B

Q5. (a) Compute the mean daily evaporation loss for the month of August, in hectare-metres, from a stream which has an average width of 50 m along its total stretch of 100 km. The mean daily evaporation measured by a Class A evaporation pan for the month of August is 0·55 cm. Assume a pan-coefficient of 0·75. *8*

(b) In a particular region, the transplantation of rice crop takes 12 days and the daily water requirement during this period is 50 mm. During this period, the region experiences a rainfall of 50 mm. Determine the discharge from the head regulator to supply water for 2080 ha of rice field, assuming 20% loss during conveyance. *8*

(c) Design a channel in alluvial soil region to carry a discharge of 50 m^3/s. The Manning's roughness coefficient (n) can be taken as 0·023 and the critical velocity ratio (m) = 1·0. Use Kennedy's silt theory approach. Assume a side slope of 1H : 2V and bed width-to-depth ratio of 5·5. *8*

(d) Explain clearly how you would take into account the effect of variations in water demand in the design of the following units : *8*

(i) Filters
(ii) Pumps
(iii) Distribution mains
(iv) Sedimentation tanks
(v) Clear water reservoir

(e) Explain the term "Relative Stability" used for wastewater. How would you carry out the test for relative stability ? How would you determine it and what is the significance of the determined value ? *8*

Q6. (a) Determine the diameter of a circular storm sewer based on the following data : *15*

(i) Sewer length = 1·2 kilometres to be laid at a slope of 0·002

(ii) Catchment area of sewer = 60 hectares, of which the coefficient of runoff is 0·90, 0·80 and 0·20 for 30% (roof area), 20% (pavements) and 50% (open land) of the area respectively

(iii) Velocity of full flow = 1·2 metres per second

(iv) Manning's coefficient = 0·013

(v) Time of entry = 2·34 minutes

(vi) Intensity of rainfall in cm/hour is given by = $\dfrac{75}{6 + \text{Time of concentration in minutes}}$

(b) A coagulation-sedimentation water treatment plant clarifies 60 million litres of water per day. The raw water has an alkalinity equivalent of 5 mg/litre of calcium carbonate. The filter alum required at the plant is 20 mg/litre. Determine the filter alum and the quick lime (containing 88% of calcium oxide) required per year by the plant. *15*

(c) An unconfined aquifer is spread over an area of 7·8 km^2. 4·2 million m^3 of water was pumped out from this aquifer to meet the water requirement of a city which does not have a surface water source. It was observed that due to this pumping, the water table got lowered by 3·2 m.

(i) Determine the specific yield of the aquifer.

(ii) Determine the volume of recharge if it was observed that the water table in the aquifer went up by 9·2 m due to rainfall.

(iii) If this volume of discharge is used to serve the population of the city for a period of 200 days at the rate of 150 lpcd, determine the population that can be served with water, assuming 80% of water will be pumped out. *10*

Q7. (a) A 3·5 m wide and 0·9 m high siphon spillway has been provided for a dam. The tail water elevation is kept 6·5 m below the crest of the siphon while the head water elevation is 1·5 m above the crest.

(i) Calculate the discharge capacity of the siphon spillway assuming a coefficient of discharge of 0·62.

(ii) In case it is decided to provide an ogee spillway (C = 2·25) of length 3·5 m to discharge this flow, what would be the head required ?

(iii) What would be the length of an ogee weir required to discharge the same flow as that of a siphon spillway with a head of 1·5 m ? *15*

(b) (i) The Field Capacity (FC) and the Permanent Wilting Point (PWP) for the soil in an agricultural field having a root zone depth of 0·9 m are 0·32 and 0·12 respectively. The farmer irrigates the field with 225 mm depth of water when the soil moisture in the soil was 25%. The soil has a specific gravity of 1·6. From the viewpoint of irrigation, calculate the amount of water wasted due to the application of water. *7*

(ii) It is desired to raise the water level in a stream by 1·2 m by constructing a weir across the stream. The average width of the stream, mean depth of flow and mean velocity of flow are 45·0 m, 3·2 m and 1·5 m/s respectively. Assuming a coefficient of discharge of 0·92, determine the height of the weir to be built. *8*

(c) (i) A sample of air analyzed at 0°C and 1 atm pressure is reported to contain 10 ppm of carbon monoxide (CO). Determine equivalent CO concentration in microgram per cubic meter ($\mu g/m^3$) and milligram per cubic meter (mg/m^3). If sample of air is analyzed at 25°C at 1 atm pressure, what is CO concentration in $\mu g/m^3$ and mg/m^3 for this same 10 ppm of CO ? *5*

(ii) What do you understand by the term "economical diameter of pumping mains" ? Explain it with the help of graph and empirical formula also. *5*

Q8. (a) The inflow hydrograph of a river at a section is given below. Assuming k = 8 h, x = 0·15 and Δt = 6 h, route the hydrograph using Muskingum method. Determine the lag in peak and flow attenuation. *15*

Time (h)	0	6	12	18	24	30	36	42	48	54	60	66
Inflow (m^3/s)	20	80	210	240	215	170	130	90	60	40	28	20

(b) (i) A town of 40,000 population with dry weather flow of 220 litres per capita per day with 250 mg/litre of BOD has to be treated with two options, trickling filter and activated sludge process, having BOD removal rates 0·15 kg $BOD/m^3.d$ and 0·64 kg $BOD/m^3.d$ respectively. Assuming a filter depth of 2·40 metres and aeration tank depth of 3·40 metres, find out the percentage difference in the area requirements of these two options. Primary sedimentation removes 35% of applied BOD. *10*

(ii) Explain the process of scoping used in stage 2 in the environmental clearance of new projects under EIA 2006 notification. *5*

(c) Discuss the factors which should be considered during design and operation of a sanitary landfill site for disposal of municipal solid waste. *10*