

2011

**CIVIL ENGINEERING (Paper - III)**

01052

Time allowed : 3 Hours ]

{ Maximum Marks : 200

**Note :**

- (i) Solve any one question from each section.
- (ii) Do not reproduce any question. Write only question number against the answer.
- (iii) Number of optional questions up to the prescribed number in the order in which questions have been solved, will only be assessed and excess answers of the question/s will not be assessed.
- (iv) Figures to the right indicate the number of marks for the questions.
- (v) Assume suitable data if necessary and state it clearly.
- (vi) Use of Non-programmable calculators is permitted.
- (vii) Use of I.S. Codes and Steel Table, is not permitted.
- (viii) Candidate should not write roll number, any name (including his/her own), signature, address or any indication of his/her identity anywhere inside the answer book otherwise the candidate will be penalised.

**SECTION - A**

1. (a) Define and briefly explain Newton's Law of Viscosity. Also differentiate between kinematic and dynamic viscosity. 10

The surface tension of water in contact with air at 20°C is given as 0.0716 N/m. The pressure inside a droplet of water is to be 0.0147 N/cm<sup>2</sup> greater than the outside pressure. Calculate the diameter of droplet of water.

- (b) Explain the condition of equilibrium for a floating body and submerged body. 10

The velocity vector in a fluid flow is given by,  $V = 2x^3 i - 5x^2 y j + 4 tk$ . Find the velocity and acceleration of a fluid particle (1, 2, 3) at time t=1.

- (c) What do you understand by most economical section of a channel. Also derive the conditions for rectangular channel of most economical section. 10

A siphon of diameter 150 mm connects two reservoirs having a difference in elevation of 15 m. The length of the siphon is 400 m and summit is 4 m above the water level in the upper reservoir. The length of the pipe from upper reservoir to summit is 80 m. Determine the discharge through siphon. Also determine the pressure at summit, consider coefficient of friction as 0.020 and neglect minor losses.

- (d) Describe the functions of main components of Pelton turbine with neat sketch. 10

Find the power required to drive a centrifugal pump which delivers 0.04 cubic metre per second of water to a height of 20 m through a 15 cm diameter pipe and 100 m long. The overall efficiency of the pump is 70%. Consider coefficient of friction as 0.06.

2. (a) Explain the phenomenon of capillarity and obtain an expression for capillary rise of a liquid. 10

A rectangular tank 4 m long, 1.5 m wide contains water upto a height of 2 m. Calculate the force due to water pressure on the base of the tank. Also find the direction of this force and depth of centre of pressure from free surface.

- (b) Distinguish between following : 10

- (i) Uniform flow and non uniform flow
- (ii) Steady flow and unsteady flow
- (iii) Rotational flow and irrotational flow

What are the limitations of Bernoulli's theorem ? Water is flowing through a pipe having diameters 20 cm and 15 cm at sections 1 and 2 respectively. The discharge through the pipe is 0.04 cumec. The section 1 is 6 m above datum line and section 2 is 3 m above datum. If pressure at section 1 is  $29.43 \text{ N/cm}^2$ , what is the pressure at section 2 ?

- (c) A rectangular channel carries water at the rate of 0.5 cumec when bed slope is 1 in 3000. Find the most economical dimension of the channel if C is 60. 10

List any three dimensionless numbers. Also explain their significances for fluid flow problems.

- (d) Describe the working of reciprocating pump with a neat sketch. 10

Draw a typical layout of hydroelectric power house and name the components.

### SECTION - B

3. (a) Explain the terms infiltration and infiltration capacity. In a 10 Hr storm rainfall occurred over a catchment the rainfall depths are as given below : 10

Hours	1	2	3	4	5	6	7	8	9	10
Depth cm/hr	1.0	1.5	5.0	6.0	10.5	8.5	9.0	7.0	1.5	1.5

Surface runoff resulting from the storm is equivalent to 20 cm of depth over the catchment. Determine the average infiltration and average rate of infiltration.

10. (a) Give the advantages and disadvantages of 'Dead end,' and 'Grid-iron' layout of distribution system. 10

Explain the necessity, location and working of non return valve with neat sketch.

- (b) (i) Calculate the velocity of flow and discharge flowing in a sewer of circular section having diameter 1.0 m laid at a gradient of 1 in 500. Use Mannings formula taking  $N = 0.012$ . Assume that sewer is running half full. 10
- (ii) Determine the BOD reaction rate ( $K$ ) and ultimate BOD ( $L$ ) by, 'Least square method,' from the given data :

Time 't' days	2	4	6	8	10
BOD y mg/lit	11	18	22	24	26

- (c) Write short note on Anaerobic digestion process. Design an oxidation pond for the following data : 10

- (i) Location =  $24^\circ$  Latitude
- (ii) Elevation = 900 m above MSL
- (iii) Mean monthly temperature =  $30^\circ\text{C}$  max and  $10^\circ\text{C}$  min
- (iv) Population to be served = 8000
- (v) Sewage flow = 160 lpcd
- (vi) Desired treated effluent  $\text{BOD}_S$  = 30 mg/lit
- (vii) Pond Removal Constant =  $0.1/\text{d}$
- (viii) Areal BOD loading at  $24^\circ$  latitude = 225 kg/ha/day

- (d) Explain the different sources of air pollution and classify them. Explain the various techniques of noise pollution control. Give the Ambient air quality standards. 10

- (b) A 60 cm diameter well is being pumped at a rate of 1360 lit/min, measurements in the nearby test well were made at the same time as follows. 10

At a distance of 6 m from the well being pumped, the drawdown was 6 m and at 15 m the drawdown was 1.5 m. The bottom of the well is 90 m below the ground water table. Find the coefficient of permeability. If all the observation points were on the Dupuit's curve what was the drawdown in the well during pumping. What is the specific capacity of the well ?

- (c) What are the different ways by which a concrete gravity dam may fail, and how will you ensure its safety against each type of failure. 10
- (d) What are the different types of cross drainage works that are necessary on a canal alignment, state briefly the conditions under which each one is used. 10

4. (a) What is evaporation ? What factors control the process of evaporation ? Explain with sketch the method of measurement of evaporation with ISI standard pan. 10

- (b) Find the ordinates of a storm hydrograph resulting from a 3 hour storm with rainfall of 2.0, 6.75 and 3.75 cm during subsequent 3 hour intervals. The ordinates of unit hydrograph are as given below :

Hours	3	6	9	12	15	18
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U H ordinates (cumecs)	0	110	365	500	390	310
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Hours	21	24	3	6	9	12
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U H ordinates (cumecs)	250	235	175	130	95	65
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Hours	15	18	21	24
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U H ordinates (cumecs)	40	22	10	0
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Assume an initial loss of 5 mm, infiltration index of 2.5 mm/hour and baseflow of 10 cumecs.

- (c) Explain the importance of rivers and necessity of controlling them. Explain high water training, low water training and mean water training. **10**
- (d) What are the advantages of tile drains ? What are the different methods of aligning tile drains. **10**

### SECTION - C

5. (a) Explain the various factors controlling the alignment of roads. Give the details of the drawings to be prepared in a highway project. **10**
- (b) A National Highway passing through rolling terrain in heavy rainfall area has a horizontal curve of radius 500 m. Design the length of transition curve. Assume Design speed = 80 Kmph., pavement width = 7.0 m, rate of change of centrifugal acceleration 0.52 and allowable rate of introduction of superelevation 1 in 150. Pavement to be rotated about inner edge. Two lanes pavement and wheel base 6.0 m. **10**
- (c) What is a traffic rotary ? Explain with a sketch. What are its advantages and limitations with reference to traffic conditions in India ? **10**
- (d) Enlist the various plants and equipments used in the construction of cement concrete road. Enumerate the steps in the construction of cement concrete pavement. **10**
6. (a) Explain the various factors on which the stopping sight distance depends. Explain total reaction time and the PIEV theory. **10**
- (b) Explain the various factors that influence night visibility on roads. What are the various factors to be considered in the design of road lighting. **10**
- (c) Discuss the IRC recommendations for the CBR method of design of pavements. The CBR value of a subgrade soil is 8 percent, calculate the total thickness of pavement using design formula developed by US corps of Engineers. Assume 3175 kg wheel load and tyre pressure 5 kg/cm<sup>2</sup>. **10**
- (d) Explain various types of failures in rigid pavements, what are its causes ? **10**

### SECTION - D

7. (a) Enumerate the various loads and forces acting on bridge. **10**  
 Calculate the normal depth of scour in a river with alluvial bed when design discharge is 900 m<sup>3</sup>/sec. The river bed consists of coarse sand with size of particle as 0.73 mm. Also, determine the maximum depth of scour when a bridge is to be constructed in a straight reach.
- (b) What are the various erection methods for construction of superstructure of concrete and steel girder bridges ? Describe in brief the side slewing method. **10**
- (c) Explain how will you decide the size and shape of a tunnel. **10**
- (d) What are the various methods of tunnelling in hard strata ? Describe in brief the process of tunnelling by TBM (Tunnel Boring Machine). **10**

8. (a) Which factors will you consider for selection of a site for bridge construction ? **10**

The river has a slope of 1 in 700. The hydraulic mean depth for the channel is 2.8 m and the Chezy's coefficient is 30. Width of stream at HFL is 300 m and linear waterway under the bridge is 270 m. Assuming coefficient of discharge through bridge as 0.7, calculate the afflux.

- (b) What are the various methods of strengthening the steel and concrete girder bridges ? Explain in brief any two methods, through main steps. **10**
- (c) Give the sequence of operations of tunnelling by conventional drill and blast method in hard strata. Describe in brief each step. **10**
- (d) Explain the necessity of ventilation during and after construction of tunnel. How is it achieved ? **10**

What are the various methods of drainage during construction of tunnel ?

#### SECTION - E

9. (a) Compare surface water and ground water as a source of drinking water. **10**

Draw a typical flow diagram of water treatment plant for a town having population 2 lakh with water supply rate of 200 lpcd, with 'river' as source of water, also comment on changes to be made in flow diagram if source becomes 'dam reservoir', instead of river.

- (b) (i) Compare slow sand filter with rapid sand filter with reference to : **10**
- (1) Filtration rate
  - (2) Coagulation
  - (3) Efficiency
  - (4) Economy
  - (5) Loss of head
  - (6) Period of cleaning
  - (7) Method of cleaning
  - (8) Flexibility in operation
- (ii) Determine the size of flocculation tank, power requirement and area of blades of paddle for a flow 300000 litres/hour at 20°C.  
Given data  $t = 20$  minutes, Ave. G value = 40/sec, paddle speed = 4.5 rpm  
Velocity ratio = 0.25.
- (c) Explain the term 'Activated sludge process'. Explain the modifications : **10**
- (i) Tapered aeration and
  - (ii) Extended aeration
- (d) Explain the various factors affecting composting process, and also discuss the mechanical compost plant used for municipal solid waste. **10**