CIVIL ENGINEERING

Paper—VI

(SECTION—II)

(Subjective)

Time Allowed : 2 Hours]   [Maximum Marks : 100

Note :   (1) Use of standard criteria/missing data for design is allowed but shall be clearly mentioned in the Answer Book as 'Assumed'.

(2) Figures in the right-hand margin indicate marks.

(3) Parts of a question shall be answered in sequence and together.

(4) There are internal options in some questions and one must attempt all parts of such questions (i.e., a, b, c, d of that option only).

1. (a) Explain superelevation (SE). Enumerate the step for practical design of superelevation.   5

(b) Explain origin and destination study. What are various uses of origin and destination study?   5

(c) Discuss the critical combination of stresses due to wheel load and temperature effects.   5

(d) An ascending gradient of 1 in 120 meets a descending gradient of 1 in 100. A summit curve is to be designed for a speed of 80 kmph so as to have an overtaking sight distance of 470 m.   5

Or

(a) With neat sketches, show various types of traffic sign, classifying them in proper groups.   6

(b) On crossroads A and B, 15 minutes' traffic volumes during the design hour were 700 and 400 vehicles. The approach speeds were 50 kmph and 30 kmph for roads A and B. The width of road A is 16 m and road B is 10 m. Design the signal timing.   6

(c) Briefly outline the IRC recommendation for determining the thickness of cement concrete pavement.   8

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2. (a) Water from a low dam is released through a sluice gate on a horizontal rectangular channel. The depth of water upstream of the sluice gate is 16·0 m above the channel bed and the gate opening is 1·5 m. The sluice gate can be assumed to be sharp-edged. If a free hydraulic jump is formed just downstream of the gate, find the sequent depths and the percentage of the initial energy lost in the jump. **8**

(b) A two-lane single carriageway is to be designed for a design life period of 15 years. Total two-way traffic intensity in the year of completion of construction is expected to be 2000 commercial vehicles per day. Vehicle damage factor is 3·0 and lane distribution factor is 0·75. Assuming an annual rate of traffic growth as 7·5%, calculate the design traffic expressed as cumulative number of standard axles. **4**

(c) The width of a rectangular channel is reduced from 3·5 m to 2·5 m and the floor is raised by 0·25 m in elevation at a given section. If the depth upstream of the construction is 2·0 m and the drop in the water surface elevation is 0·2 m, calculate the discharge in the channel if energy loss in the channel is one-fifth of the upstream velocity head. **8**

Or

(a) An overflow spillway has its crest at elevation 125·40 and a horizontal apron at an elevation of 95·00 on the downstream side. Find the tailwater elevation required to form a hydraulic jump when the elevation of the energy line is 127·90. [The C_d for the flow can be assumed as 0·735. The energy loss for flow over the spillway face can be neglected.] **8**

(b) Describe briefly different water resources problems associated with sediments. **4**

(c) A rectangular brick-lined channel ($n = 0·016$) of 4·0 m width is laid on a bottom slope of 0·0009. It carries a discharge of 15·0 m³/s and the flow is nonuniform. If the depth at section A is 2·6 m, calculate the depth at section B, 500·0 m downstream of A, by using direct-step method. **8**

3. (a) What is canal headwork? What are the disadvantages of locating a weir in a boulder stage in comparison to an alluvial stage? **6**

(b) Define the impact of IRC class A loading of vehicles with the help of a neat sketch. **8**

(c) Discuss the mechanics involved in the sediment transport. **6**

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Or

(a) Write different steps for design of canal headwork (only design criteria).   8

(b) Based on the functions, classify highway culverts with neat sketches.   6

(c) Compare briefly the silt theories of Kennedy and Lacey.   6

4. (a) Design the approximate dimensions of a set of four rapid gravity filters for treating water required for a population of 100000; the rate of supply being 180 liters/day/person. The filters are rated to work at 5000 liters/hour/sq. m. [Assume maximum daily demand to be 1·8 times the average daily demand. Assume any other data, if needed.]   10

(b) What are septic and Imhoff tanks? Where are they used? How are their effluent disposed off?   10

Or

(a) During a recuperation test, water in an open well was depressed due to pumping by 2·5 m and it recuperated 2 m in 90 minutes. Find the diameter of a well to yield 10 liters/sec under a depression head of 2 m.   10

(b) A septic tank including effluent disposal system has to be provided for a hostel of 400 inmates. Design a suitable system adopting norms as provided by IS code. Also give a dimensional schematic sketch. [Assume average daily sewage low as 120 liters/capita/day, and any other data suitably, if needed.]   10

5. (a) What is unit hydrograph and what are the assumptions associated with it?   6

(b) Derive a 2-h unit hydrograph by s-curve method for the catchment having ordinates of one-hour unit hydrograph of a basin at one-hour intervals as 5, 8, 5, 3 and 1 m^3/s.   8

(c) Analyze the maximum discharge in a circular channel.   6

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