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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) Attempt all questions, all questions contain three parts *(a)*, *(b)* and *(c)* which are mandatory to answer and part *(c)* contains choice of answering any one part.

1. *(a)* The speeds of overtaking and over taken vehicles are 90 kmph and 50 kmph respectively on a two-way traffic road. Determine safe overtaking sight distance. The acceleration of overtaking vehicle is 0·98 m/s^2. 5

(b) Briefly answer the following : 5

(i) Write the use of the desired line diagram.

(ii) Compare substructure and superstructure of a bridge.

(c) The volume and weight of one Marshall specimen was found to be 475 cc and 1100 gm. Assuming absorption of bitumen in aggregate is zero, determine the volume of bitumen (V_b) and void in mineral aggregate (VMA). The specific gravities and weight proportions for aggregate and bitumen are as under for the preparation of specimens for Marshall mix design : 10

Material	*Aggregate–I*	*Aggregate–II*	*Aggregate–III*	*Aggregate–IV*	*Bitumen–V*
Weight	750 gm	1200 gm	350 gm	200 gm	100 gm
Specific Gravity	2·63	2·51	2·46	2·43	1·05

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Or

(c) In a rigid pavement slab of thickness 18 cm, the modulus of elasticity of concrete and Poisson's ratio are 3×10^5 kg/cm^2 and 0·15 respectively. Plate bearing test shown the pressure of 1·2 kg/cm^2 corresponding to 1·25 mm penetration. Calculate the stresses at edge and corner regions of cement concrete pavement using Westergaard's stress equations for wheel load of 4100 kg and radius of contact area 12 cm. 10

2. (a) Water flows below a sluice gate into a rectangular channel at a velocity of 0·6 m/s and a depth of 1·0 m. The discharge is suddenly increased to 3 times to its original value by opening the gate. Find the change in depth of flow. (Assume $g = 10$ m/s^2) 5

(b) While measuring the discharge in a small stream, it was found that depth of water increases at the rate of 0·2 m/h. If the discharge at that section was 10 m^3/s and surface width of stream was 20 m, estimate the discharge at the section 2 km upstream. 5

(c) A trapezoidal channel with bottom width 3·5 m and side slopes 1 H : 1 V on the left 1·5 H : 1 V on the right, with $n = 0\cdot016$, and a bed slope of 2·6 in 10000 carries a discharge of 8 m^3/s. Determine the normal depth and the average shear stress on the channel bed. 10

Or

(c) A rectangular channel 2·4 m wide carries uniform flow of 7 cumec at a depth of 1·5 m. If there is local rise of 0·15 m in bed level, calculate the change of water surface elevation. What can be maximum rise in the bed elevation such that the upstream depth is not affected? 10

3. (a) Compare reservoir routing with channel routing. 5

(b) Briefly explain the following modes of failure in dams : 5

(i) Overturning

(ii) Sliding

(c) Determine the maximum base width of elementary profile of a gravity dam with the following data : 10

Specific gravity of dam material = 2·4

Uplift intensity factor = 1·0

Coefficient of static friction = 8·0

Height of the dam = 20·0 m

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Or

(c) For a rectangular channel section, determine the area and dimensions of a rigid boundary canal carrying 50 m^3/s. Take Manning's $n = 0{\cdot}014$ and longitudinal slope of the canal as 12 in ten thousand. 10

4. (a) From the following population data, predict the population for the year 2021 using geometric increase method and arithmetic increase method and compare the results : 5

Year	1961	1971	1981	1991	2001	2011
Population	858,500	1,015,600	1,201,000	1,691,250	2,077,000	2,585,050

(b) Briefly explain the importance of self-cleansing velocity. How does it affect the design of sewer? 5

(c) Design a sewer to serve a population of 36,000. The slope available for the sewer to be laid is 1 in 625 and the sewer should be designed to carry four times the dry weather flow when running full. The daily per capita water supply allowance is 135 liters. Assume sewage discharge is 80% of daily per capita water supply. What would be the velocity of flow in the sewer when running full? Assume $n = 0{\cdot}012$ in Manning's formula. 10

Or

(c) Using the following data, determine the dimensions of a high-rate trickling filter : 10

(i) Sewage flow = 3·0 MLD

(ii) Recirculation ratio = 1·5

(iii) BOD of raw sewage = 250 mg/L

(iv) BOD removed in primary tank = 28%

(v) Final effluent BOD desired = 30 mg/L

5. (a) Describe briefly how the evaporation from weather data can be estimated. 5

(b) Differentiate between specific yield and specific retention of an aquifer. 5

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(c) The surface runoff from a flood on a drainage basin amounted to 5 cm. The area of the basin is 250 km^2. The equivalent uniform depth of rainfall on the drainage basin was 15 cm and the time distribution of the rainfall is given as follows. Determine the ϕ index : 10

Hour	8–9	9–10	10–11	11–12	12–13	13–14	*Total*
ppt (mm)	15	20	50	20	30	20	155

Or

(c) Estimate the flood magnitude in the river with a return period of 500 years through use of Gumbel's method. Peak flood and their return period for this river at 50 km upstream of a bund site are given below : 10

Return Period (Years)	Peak Flood (m^3/s)
50	20500
100	25400

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