वियोज्य *DETACHABLE*

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, **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.

Answers must be written in the medium authorized in the Admission Certificate which must be stated clearly on the cover of this Question-cum-Answer (QCA) Booklet in the space provided. No marks will be given for answers written in medium other than the authorized one.

Wherever any assumptions are made for answering a question, they must be clearly indicated. Diagrams/figures, wherever required, shall be drawn in the space provided for answering the question itself.

Unless otherwise mentioned, symbols and notations carry their usual standard meanings.

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.

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SECTION 'A'

1.(a) (i) A pipeline carrying water has surface roughness of average height 1·165 mm. If the shear stress developed is 3·6 N/m², what is the nature of the pipe surface ? **4**

(ii) The velocity of flow in a badly corroded 8·0 cm pipe is found to increase 30% as a pitot tube is moved from a point 1·0 cm from the wall to 2·0 cm from the wall. Assuming pipe to be a rough pipe, estimate the height of roughness elements. **8**

1.(b) A trapezoidal channel with side slopes of 1 : 2 has to be designed to convey 8·0 m³/s at a velocity of 1·0 m/s, so that the amount of concrete lining for the bed and sides is the minimum.

(i) Calculate the area of lining required for one metre length of the channel.

(ii) If the roughness coefficient is n = 0·015, calculate the bed slope of the channel for uniform flow. **12**

1.(c) During a major flood event, water overflows a roadway during which the roadway acts as a broad-crested weir. A vehicle stalled on the roadway will be washed off the roadway into the downstream channel when water depth exceeds 0·6 m.

(i) Determine the head (H) on the broad-crested weir for a discharge rate of 400 m³/s if the overflow section of the roadway is horizontal and 200 m long. Assume a weir coefficient of 0·33.

(ii) Also, compute the water depth and velocity on the roadway.

(iii) Will a stalled vehicle on the roadway remain on the road during the flood or get washed off ? Take g = 9·81 m/s². Give reasons for your answer. **12**

1.(d) A wastewater sample was diluted 10% with tap water for conducting BOD Test. The DO content in wastewater sample was 1·2 mg/l and water was 6 mg/l. After 5 days incubation at 20°C, the DO of the sample was 0·5 mg/l. Calculate

(i) 5 day BOD of wastewater and

(ii) ultimate BOD. Assume K_{20} = 0·12/day. **12**

1.(e) With the help of data given below, estimate the per capita solid waste generated per day in a colony with 20,000 houses.

Volume of waste/truck load = 20 m³
Volume of waste/tractor load = 2 m³
Volume of waste/small truck = 8 m³
No. of truck loads = 2/day
No. of tractor loads = 1/day
No. of small truck loads = 3/day
Avg. no. of people/house = 4

Specific weight of waste in (kg/m³) = 500 for truck;
225 for small truck;
50 for tractor. **12**

2.(a) Neglecting losses, compute the power produced by the turbine shown in figure below. Take $\eta_0 = 100\%$. **20**
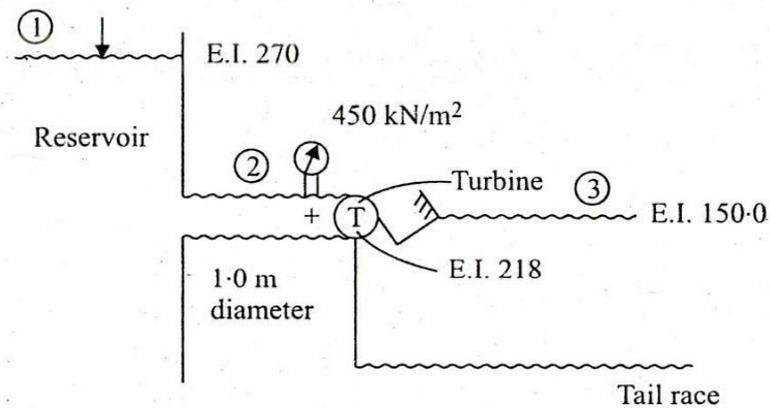
2.(b) (i) Describe briefly the following methods for estimation of evaporation :

    (a) Evaporation-Pan Method

    (b) Empirical Method

    (c) Analytical Method **10**

  (ii) A watercourse is designed to irrigate an area of 960 ha of rice. The transplantation of rice takes 15 days and during this the total depth of water required is 40 cm. Find the duty of irrigation water on the field if there is an effective rainfall of 12 cm. Also, find the duty and discharge at the head of the watercourse assuming losses of water as 20% in the watercourse. **10**

2.(c) With help of a sketch, explain the reactions that happen at different stages of the breakpoint chlorination curve. Also, state the importance of breakpoint chlorination in water treatment. **20**

3.(a) An aircraft propeller of diameter d, rotating at a speed N r.p.m. and advancing with velocity V in air of density ρ and viscosity μ, develops a thrust T. Using Buckingham's Pi theorem, show that

$$\frac{T}{\rho d^2 v^2} = f\left(\frac{Vd\rho}{\mu}, \frac{dN}{V}\right).$$ **20**

3.(b) A 0·5 m diameter well fully penetrates an unconfined aquifer whose bottom is 150 m below the undisturbed groundwater table. The water is pumped out from the well at a constant rate of 0·1 m³/s. After equilibrium is reached, the drawdown observed in two observation wells at radial distances of 10 m and 50 m are respectively 10 m and 5 m. Determine

  (i) the coefficient of permeability (in m/s)

  (ii) the drawdown in the well (in m) **20**

3.(c) Present a flow chart indicating various elements in municipal solid waste management and explain salient aspects of each element. **20**

4.(a) A pipe of diameter d and length L leads from a reservoir. At the discharge end a nozzle of diameter d_n is fitted. At the inlet of pipe head available is H. The nozzle is discharging into atmosphere. Prove that for maximum power transmitted by the nozzle $d_n = \sqrt[4]{\dfrac{d^5}{2fL}}$. Head loss in pipe is given by $h_f = \dfrac{fLV^2}{2gd}$ where f = Darcy's friction factor. **20**

4.(b) Explain the use of stilling basin as an energy dissipator and describe the various components of a stilling basin with their functions with the help of sketches. List the four types of Indian standard basins. **20**

4.(c) (i) Design a high rate trickling filter for treating wastewater with BOD of 160 mg/l. The rate of wastewater generated is 5 MLD. The effluent BOD required is 25 mg/l. Adopt recirculation ratio of 1·5. **10**

        (ii) Present classification of natural ecosystems and describe the components of ecosystem. **10**

SECTION 'B'

5.(a) A soil has a void ratio of 0·70, degree of saturation 50% and $G_S = 2·7$. Find the water content, porosity, bulk density and dry density. By how much can the water content be increased without changing γ_d? **12**

5.(b) Explain briefly the following factors associated with soil sampler

        (i) Area Ratio (Ar)

        (ii) Inside clearance

        (iii) Design of non-return valve **12**

5.(c) The speed of overtaking vehicle is 90 km/hr and acceleration is 3·0 km/hr/sec. Calculate the safe passing sight distance for one way and two way traffic. Calculate the length of overtaking zone. Also draw the same. **12**

5.(d) The maximum increase in temperature is expected to be 26°C after the construction of a *CC* pavement. If the expansion joint gap is 2·2 m, design the spacing between the expansion and contraction joints. Assume coefficient of thermal expansion as 10×10^{-6} per °C, unit wt of concrete = 2400 kg/m³, allowable stress in tension during curing = 0·8 kg/cm² and coefficient of friction of the interface = 1·4. **12**

5.(e) (i) Briefly explain the various sources of errors in Global Positioning System (GPS). **6**

(ii) While levelling between two points *P* and *Q* on opposite banks of a river, the level was first set up near point *P* and the staff readings observed at point *P* and *Q* were 1·385 m and 3·005 m respectively. After this level was set up near point *Q* and the observed readings on point *P* and *Q* were 0·750 m and 2·320 m respectively. If the reduced level of point *Q* was 120·000 m, determine the reduced level of point *P*. **6**

6.(a) How the average permeability of a soil deposit consisting of a number of layers is determined ? **20**

6.(b) A clay soil specimen 25 mm thick was tested in the laboratory allowing drainage both sides. The specimen showed a decrease in void ratio from 0·92 to 0·78 when the pressure was increased from 60 KN/m² to 120 KN/m². Calculate coefficient of compressibility, coefficient of volume change and coefficient of consolidation. If time for 50% consolidation was 5 minutes determine the soil permeability in cm/sec, and calculate final thickness of the specimen at the end of the test. **20**

6.(c) Design a flexible pavement for 7·0 m wide carriage way. Out of total present 600 CVPD, 200 CVPD have VDF of 2·5 and remaining vehicles have VDF of 3·5. Design the flexible pavement if Effective CBR of the subgrade is 6·0%. Planning and construction period is 1·5 year and design life is 15 years. Assume necessary data suitably. Design template for 6·0% of CBR value is as under :

For subgrade with Effective CBR value of 6%

Design Traffic	Wearing course (mm)	Binder course (mm)	Base (mm)	Sub base (mm)
2 msa	20 SDBC	50 DBM	225	175
5 msa	25 SDBC	50 DBM	250	210
10 msa	40 BC	65 DBM	250	260
20 msa	40 BC	90 DBM	250	260

20

7.(a)   (i)   What is negative skin friction ? What is its effect on pile capacity ?   6

         (ii)   A pile group consists of 9 piles of 30 cm diameter and 12 m long driven in clay. The centre to centre spacing of piles is 0·9 m. The clay has unconfined compressive strength of 80 KN/m² and γ = 20 KN/m³. .

              Determine the efficiency of pile group and the safe load for the pile group with factor of safety = 2·5.

              Take N_C = 9·0, Adhesion factor = 0·6.   14

7.(b)   What do you understand by wind Rose Diagram ? How it is prepared ? Discuss its significance in runway orientation.   20

7.(c)   Two straight roads intersect at chainage of 15,000 m and have external deflection angle equals to 100°. The road bend is to be designed for maximum speed of 80 kmph, maximum centrifugal ratio of $\frac{1}{4}$ and a maximum rate of the change of acceleration of 0·3 m/sec³.

         The curve consists of a circular curve and two cubical parabola.

         Calculate :   (i)   the radius of circular curve

                     (ii)   length of transition curve

                     (iii)   chainage of all junction points   20

8.(a)   (i)   A vertical wall 8·0 m high with a smooth back has sand behind it. The level of sand is horizontal. Water table is far below the ground surface. Determine the distribution of active earth pressure, total lateral force on the wall per metre length and the level at which the resultant lateral force acts.   10

         (ii)   Calculate the factors of safety with respect to average shearing strength, cohesion and internal friction of a soil whose shear strength parameters obtained from laboratory tests are $\overline{C}$ = 40 KN/m² and $\overline{\phi}$ = 28°. The expected parameters of mobilised shearing resistance are $\overline{C}_m$ = 30 KN/m² and $\overline{\phi}_m$ = 20°. The average effective pressure on the failure plane is 100 KN/m².   10

8.(b)   From a BG main line curve of 2°, a 1 : 12 turnout takes off in contrary flexure for a branch line. The speed on the branch line is restricted to 42 km/hr. Determine the speed restriction on the main line. Assume permissible deficiency in cant as 75 mm.   20

8.(c)   (i)   An area of 10 km × 20 km is to be surveyed using aerial photogrammetry. Average scale of photograph is 1 : 10,000 at ground elevation of 400 m above the datum. Focal length of camera used is 20 cm and size of photographs are 23 cm × 23 cm. The speed of aircraft is 270 kmph. The forward lap in photographs is 70% and side lap is 30%. Determine the flying height, exposure interval and number of photographs required to complete the survey.   15

         (ii)   Briefly describe various geological considerations for the site selection of the dam.   5

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