NATIONAL INSTITUTE OF TECHNOLOGY PATNA

Department of Civil Engineering

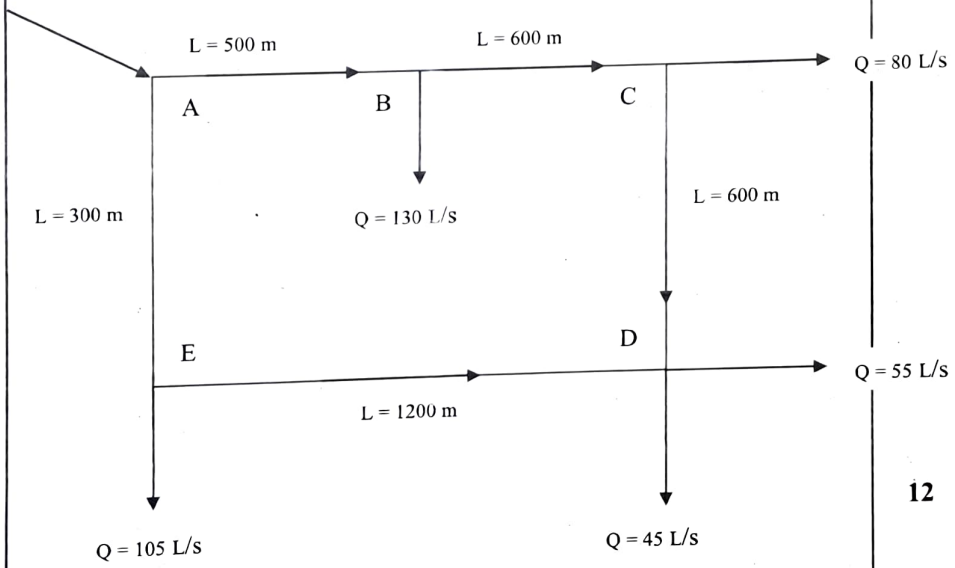
End Semester Examination, Jan- June 2024

B. Tech: Semester-4th (CED)
Course Title: Water Supply Engineering and Pollution Control **Course Code: CE43110**
Maximum Time: 3 hours **Max. Marks: 60**

Instruction:

1. Attempt **All** questions. Assume any suitable data, if necessary.
2. The Marks, Course Outcome (CO) and Bloom's Level (BL) related to questions are mentioned on the right-hand side margin. Students need not to worry about the CO and BL, they have to write answers of the given question only.

<table>
<tr><th>Q. No</th><th>Questions</th><th>Marks</th><th>CO</th><th>BL</th></tr>
<tr><td>1.</td><td>
(a) Briefly explain the mechanism of gravity sand filtration process.
(b) Briefly explain the Ion Exchange process for removal of hardness from water.
(c) With the help of neat sketch briefly explain the various types of water distribution network.
(d) Determine the initial head loss in a rapid sand filter which is 66 cm deep and has a porosity of 0.44 and specific gravity of 2.66. It has a filtration rate of 160 litre per minute/m^2. Sieve analysis of filter media having a shape factor of 0.94 is given below. Take the coefficient of kinematic viscosity as 0.014 cm^2/sec.
<table>
<tr><td>IS Sieve Size</td><td>1.4 -1.0 mm</td><td>1.0 mm - 710 µm</td><td>710-600 µm</td><td>600-500 µm</td><td>500-425 µm</td><td>425-300 µm</td><td>300-250 µm</td><td>250-212 µm</td><td>212-150 µm</td></tr>
<tr><td>% of sand retained</td><td>1.5</td><td>6.5</td><td>15.4</td><td>17.8</td><td>20.6</td><td>18.2</td><td>12.8</td><td>5.0</td><td>2.2</td></tr>
</table>
</td><td>2
2
2
6</td><td>CO2
CO2
CO1
CO3</td><td>II
II
I
IV</td></tr>
<tr><td>2.</td><td>
Water is to be treated by Soda Lime process for the supply of water at the rate of 150 lpcd, to a town having population of 80000 person. Assume that practical limit of hardness removal for $CaCO_3$ is 40 mg/L and that of $Mg(OH)_2$ is 10 mg/L as $CaCO_3$. The characteristics of raw water are as follow;
<table>
<tr><td>Components</td><td>Ca^{2+}</td><td>Mg^{2+}</td><td>Na^{+}</td><td>HCO_3^{-}</td><td>SO_4^{2-}</td><td>Cl^{-}</td></tr>
<tr><td>Conc. (meq/L)</td><td>2.8</td><td>2.0</td><td>0.8</td><td>3.2</td><td>1.2</td><td>1.2</td></tr>
</table>
(a) Draw the bar chart of hypothetical combinations of chemical compounds present in raw water and in treated water.
(b) Draw the bar chart of possible combinations of chemical compounds remaining in treated water.
(c) Calculate the Lime as CaO and Soda ash as Na_2CO_3 required in Kg/day.
(d) Calculate the total mass (kg) of sludge produced per day.
</td><td>3
3
3
3</td><td>CO4</td><td>V</td></tr>
</table>

3.	**(a)** Explain the Break point chlorination with the help of diagram. **(b)** Calculate the available chlorine in Dichloramine ($NHCl_2$) and Bleaching powder [Ca(OCl)Cl]. **(c)** A dose of 7 mg/L of disinfectant can cause a kill of 90% in 30 minutes. Find out the dose required to cause 99% kill in 30 minutes. (Assume the constant of dilution, n = 0.84).	**2** 6 4	CO1 CO2 CO3	I II III
4.	**(a)** Briefly explain the mechanism of coagulation and flocculation process. **(b)** A clariflocculation chamber clarifies 40MLD of water. The quantity of filter alum required at the plant is 18 mg/L. If the raw water is having an alkalinity equivalent to 5 mg/L of $CaCO_3$, determine the quantity of filter alum and the quick lime (containing 85% of CaO) required by the plant per year.	**6** **6**	CO3	IV
5.	The following figure shows the circuit of the distribution system along with maximum rate of demand requirements at different points. The pressure at the point A is 40 m head of water and the minimum pressure desired at the point D is 30 m head of water. Design the various pipes of this circuit by using Hardy-Cross equation.  	**12**	CO4	V

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NATIONAL INSTITUTE OF TECHNOLOGY PATNA
Department of Civil Engineering
End Semester Examination Jan-June 2024

Course: B. Tech and DD.	Subject: RCC Design
Semester: IV	Course Code: CE43108
Max. Time: 3Hrs	Max. Marks: 60

Note: *Attempt all questions. Each question carries equal marks.* ***IS 456 is allowed.***

Table 1. Stress (f_{sc}) in compression reinforcement.

Grade of steel f_y N/mm^2	d'/d			
	0.05	0.10	0.15	0.20
250	217	217	217	217
415	355	353	342	329
500	424	412	395	370

1. Design a beam 500 mm wide and 700 mm deep subjected to a bending moment of 130 kN-m, twisting moment 10 kN-m and a shear force 130 kN at ultimate. Use M25 mix and Fe 500 grade steel.

2. A simply supported beam is 250 mm wide and 500 mm deep and has 2-20 mm TOR going into the support. If the shear force at center of support is 110 kN at working load determine the anchorage length. Use M25 mix and Fe 500 grade TOR steel.

3. A T-beam floor consists of 150 mm thick RC slab monolithic with 300 mm wide beam. Centre to center spacing between the beams of the floor is 3500 mm. The effective span of the beam is 6 m. Design the intermediate beam if the superimposed load is 5 kN/m^2. Use M25 mix and Fe 500 grade steel.

4. (a) Design a slab for a room 5.5 m x 4.0 m clear in size for all edges in fixed conditions if superimposed load is 5 kN/m^2. Use M25 mix and Fe 500 grade steel.

OR

(b) Design a simply supported roof slab for a room 8 m x 3.5 m clear in size if the superimposed load is 5 kN/m^2. Use M25 mix and Fe 500 grade steel. Also check for-shear and deflection.

5. (a) A 4 m high column is effectively held in position at both ends and restrained against rotation at one end. Its diameter is restricted to 400 mm. Calculate the reinforcement if it is required to carry a factored axial load of 1500 kN. Use M25 mix and Fe 500 grade steel.

OR

(b) Design a short square column to carry an axial load of 3000 kN using Use M25 mix and Fe 500 grade steel.

NATIONAL INSTITUTE OF TECHNOLOGY PATNA
Department of Civil Engineering
END SEMESTER EXAMINATION, May 2024

B.Tech.Semester-4 | Branch: Civil Engineering
Course Name: Highways and Airport Engineering | Course Code: CE43106
Time allowed: 3 Hours | Full Marks: 60

Instructions: (i) **Answer all questions.**

(ii) All questions carry the same marks.

(iii) Answer each question in your own words.

(iv) All parts of the answer must be in the same place.

(v) Assume missing data, if any.

		Marks	CO	BL
Q1.(i)	Define the set-back distance on a horizontal curve? Why is it necessary?	2	2	I
(ii)	While aligning a two-lane, two-way highway in a built-up area of plain terrain, it was necessary to provide a horizontal curve of radius 300 metres. Consider the design speed of 80 km/h and the longest vehicle's wheelbase length of 6.1 m. Design the following geometric features: (a) Superelevation (b) Extra widening of pavements (c) Length of transition curve Draw a neat layout for the combined curve, including all possible geometric elements.	8		VI
Q2.(i)	What exactly do you mean by a ruling gradient, a limiting gradient, and an exceptional gradient for vertical curves?	4	2	I
(ii)	An ascending gradient of 1 in 60 meets a descending gradient of 1 in 40. A vertical summit curve is to be designed for a speed of 80 kmph so as to have SSD and OSD of 150m and 500m, respectively. Due to site conditions the length of vertical curve has to be restricted to less than 500m. (a) Find out the length of summit curve so as to fulfil the requirements of both SSD and OSD. (b) Distance of the highest point from the beginning of the curve. (c) If the RL at the curve's starting point is 100m, find the RL at the curve's highest point.	6		VI
Q3.(i)	What are the different traffic counting methods? State the difference between AADT and ADT.	4	1	II
(ii)	Calculate the time mean speed and space mean speed of three vehicles travelling over a 1-km length in 1.2minutes, 2.0minutes and 2.9 minutes respectively.	3		III

(iii) The following is the traffic volume data obtained in a peak hour at a location. Calculate the PHF. 3 III

Time duration within an hour	Traffic volume (number of vehicles)
18.00-18.15	959
18.15-18.30	1019
18.30-18.45	1010
18.45-19.00	989

Q4.(i) Define lane capacity and explain the different types of traffic capacities. 4 I I

(ii) The speed-density relationship for a study stretch of highway was found to be V= 42 - 0.4K, where V is speed in kmph and K is density of vehicles in vehicles per kilometre. Determine the value of maximum flow of the highway, mean density and mean speed. Sketch three plots with these traffic parameters and label the obtained values on these curves. Also write your comments. 6 VI

Q5.(i) What are the objectives of bituminous mix design by Marshall method? Draw a phase diagram of the bituminous concrete mixture. 4 I I

(ii) The volume and weight of one Marshall specimen were determined to be 475cc and 1100gm.The specific gravities and weight proportions for aggregate and bitumen are as follows for Marshall mix design. Assuming no bitumen absorption in aggregate, determine V_v, V_b, VMA, and VFB. 6 VI

Item	Coarse Agg.-I	Coarse Agg.-II	Fine Agg.	Mineral Filler	Bitumen
Weight (gm)	825	1200	325	150	100
Sp.Gr.	2.630	2.510	2.460	2.430	1.05

Q6.(i) What do you understand by Wind Rose Diagram? Discuss its significance. 3 I II

(ii) Determine the actual length of runway after applying necessary corrections for the data given below: 7 VI

Basic runway length = 2500m
Elevation of airport = 500m
Monthly mean of average daily temperature for the hottest month of the year = 15 °C
Monthly mean of maximum daily temperature for the same month = 22 °C
Effective gradient = 2%

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NATIONAL INSTITUTE OF TECHNOLOGY, PATNA

(END SEMESTER EXAMINATION, MAY 2024)

Course Code: CE43180 **L-T-P: 3-0-0** **Time allowed: 3.00 Hrs**

Course title: Computational Methods in Civil Engineering; **Full Marks: 70**

Instructions:

1. Answer any 5 questions.
2. The missing data, if absent, may be assumed suitably.
3. Things to be supplied in the examination hall if any…NIL……

1. a) The following infinite series can be used to approximate e^x.

$$e^x = 1 + x + \frac{x^2}{2} + \frac{x^3}{3!} + \ldots\ldots\ldots + \frac{x^n}{n!}$$

Use Taylor's series to approximate $f(x) = e^{-x}$ at $x_{i+1} = 1$ with $x_i = 0.2$. Employ the zero-, first-, second-, and third-order versions and compute the $|\varepsilon_t|$ for each case. 6

b) Manning's formula for a rectangular channel can be written As

$$Q = \frac{1}{n}\frac{(BH)^{\frac{5}{3}}}{(B+2H)^{\frac{2}{3}}}\sqrt{S}$$

where Q = flow (m^3/s), n = a roughness coefficient, B = width (m), H = depth (m), and S = slope. You are applying this formula to a stream where you know that the width = 20 m and the depth = 0.3 m. Unfortunately, you know the roughness and the slope to only a ± 10% precision. That is, you know that the roughness is about 0.03 with a range from 0.027 to 0.033 and the slope is 0.0003 with a range from 0.00027 to 0.00033. Use a first-order error analysis to determine the sensitivity of the flow prediction to each of these two factors. Which one should you attempt to measure with more precision? 8

2. Use Cholesky's method to solve the following system of equations: 14

$$3x_1 - 2x_2 + x_3 = 3$$
$$-2x_1 + 3x_2 + 2x_3 = -3$$
$$x_1 + 2x_2 + 6x_3 = 2$$

3. Consider the system of equations: 14

$$16x_1 + 4x_2 + 8x_3 = 4$$
$$4x_1 + 5x_2 - 4x_3 = 2$$
$$8x_1 - 4x_2 + 22x_3 = 5$$

Perform 4 iterations each by Jacobi iteration and Gauss-Seidel Iteration method to find out the unknowns with initial guess $\{1.0\ \ 1.0\ \ 1.0\}^T$. If the correct solution is $\{-0.25\ \ 1.0\ \ 0.5\}^T$, comment on the performance of both methods in their pursuit of the actual solution.

4. Solve the equations by the Newton-Raphson method starting from $x_1 = x_2 = 1.0$ upto a tolerance of 1×10^{-3}. 14

$$2x_1^2 - 4x_1x_2 - x_2^2 = 0$$

$$2x_2^2 + 10x_1 - x_1^2 - 4x_1x_2 - 5 = 0$$

5. a) Use Lagrange polynomials to derive a polynomial passing through the points

x	1	3	6
y	1	5	10

And hence estimate the value of y when $x = 4.50$. 7

b) Starting from the Newton-Gregory forward interpolation formula, derive the expressions of first order, second order and third order differentiation formulae. 7

6. The following table gives the value of cube root of $10x$ for x=2.00(0.50)4.00.

x	2.00	2.50	3.00	3.50	4.00
$(10x)^{\frac{1}{3}}$	2.714	2.924	3.107	3.271	3.420

Find $(24)^{\frac{1}{3}}$ and $(38)^{\frac{1}{3}}$. Use first forward diagonal for estimating $(24)^{\frac{1}{3}}$ and use last backward diagonal to estimate $(38)^{\frac{1}{3}}$. 14

7. a) Use 3 point Gauss-quadrature rule to integrate 6

$$I = \int_0^1 xe^{-3x^2}\,dx$$

b) Use 2 point Gauss-quadrature rule to integrate 8

$$I = \int_{-2}^{0}\int_{0}^{1} e^x \sin y\,dx\,dy$$

DEPARTMENT OF CIVIL ENGINEERING, NITP

Examination: B.Tech. End Semester, May, 2024

Course: Hydrology and Irrigation Engineering | Course Code: CE43112
Date of examination: 18-05-2024 | Session: FN (10.00 AM-1.00 PM)
Full Mark: 60 | Semester: 4th | Time Allowed: 3 hrs.

Note: Answer all the questions in the sequential order based on the given number and letter.

<table>
<tr><th>Q. No</th><th>Question descriptions</th><th>Marks</th><th>CO</th><th>BL</th></tr>
<tr><td>1</td><td>(a). List out the direct and indirect method of finding stream flow measurement.

(b). Explain the area velocity method through numerical equations to determine total average discharge of a river section.
Or
Explain in details the various methods of averaging rainfall data over an area.</td><td>15</td><td>I, VI</td><td>I, II</td></tr>
<tr><td>2</td><td>Rainfall of magnitude 3.8 cm and 2.8 cm occurring on two consecutive 4-hr durations on catchment of area 27 km^2 produced the following hydrograph of flow at the outlet of the catchment.
<table>
<tr><td>Time (hr.)</td><td>0</td><td>3</td><td>6</td><td>9</td><td>12</td><td>15</td><td>18</td><td>24</td><td>30</td><td>36</td><td>42</td><td>48</td><td>54</td><td>60</td><td>69</td></tr>
<tr><td>UH ordinate (m^3/s)</td><td>0</td><td>25</td><td>50</td><td>85</td><td>125</td><td>160</td><td>185</td><td>160</td><td>110</td><td>60</td><td>36</td><td>25</td><td>16</td><td>8</td><td>0</td></tr>
</table>
(a). Estimate the excess rainfall and Ø index
(b). Draw the complete diagram of resulting hydrograph indication Ø index and excess rainfall.</td><td>15</td><td>IV</td><td>III</td></tr>
<tr><td>3</td><td>(a). Define unit hydrograph (UH). Write short notes on any two special case of UH.
(b). Derive the expression for D-hour UH from Instantaneous Unit Hydrograph.</td><td>5+10</td><td>IV</td><td>I, II</td></tr>
<tr><td>4</td><td>Define Darcy's Law? Write down four assumptions of Darcy's law. Derive the expression for 3D governing equation for groundwater flow using principle of conservation of mass and darcy's law.
Or
Explain in details sprinkler irrigation method along with its advantage and disadvantages. Derive the relation between Duty, Delta and Base Period.</td><td>15</td><td>V</td><td>I, II</td></tr>
</table>

All the best