Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. / B. Tech. / B. Arch. (Full Time) - END SEMESTER EXAMINATIONS, APRIL / MAY 2024

CIVIL ENGINEERING

Sixth Semester

CE 5071 – Hydrology and Water Resources Engineering

(Regulation 2019)

Time: 3hrs

Max. Marks: 100

CO1	Define the key drivers on water resources, hydrological processes and their integrated behaviour in catchments
CO2	Apply the knowledge of hydrological models to surface water problems including basin characteristics, runoff and hydrograph
CO3	Explain the concept of hydrological extremes such as Flood and Drought and management strategies
CO4	Describe the importance of spatial analysis of rainfall and design water storage reservoirs
CO5	Apply the concepts of groundwater for water resources management

BL – Bloom's Taxonomy Levels
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A (10x2 = 20 Marks)
(Answer all Questions)

Q. No.	Questions	Marks	CO	BL
1	When a rain shadow region is formed? Give an example.	2	1	1
2	State the types of raingauges with one example for each.	2	1	1
3	If the compactness coefficient of a basin is 2.07, find out the circularity ratio.	2	2	2
4	For a daily rainfall of 25 mm, in a damp basin, the strange table gives a yield of 2.75 mm. What will be the value of the yield for a good basin, which has received the same amount of rainfall?	2	2	2
5	Define Probable Maximum Flood.	2	3	1
6	State the application of NDVI in drought analysis.	2	3	1
7	A catchment has a slope of 0.004 and the length of travel for water is 1,150 m. Find out the time of concentration.	2	4	2
8	Differentiate between dead and live storage.	2	4	2
9	The water table levels in two observation wells 300 m apart are +240.35 m and +236.15m. respectively. If the hydraulic conductivity of the aquifer is 12 m/day, what is the velocity of flow in the aquifer?	2	5	2
10	The diameter of an open well is given as 3 m. The safe yield is given as 4.7 lit/s. Find out the working head, if the specific yield is 0.5 h^{-1}.	2	5	2

PART- B (5x 13 = 65 Marks)

<table>
<tr><th>Q. No.</th><th>Questions</th><th>Marks</th><th>CO</th><th>BL</th></tr>
<tr><td rowspan="2">11 (a)</td><td>(i) Describe the working of a recording rainguage with a neat sketch.</td><td>7</td><td>1</td><td>3</td></tr>
<tr><td>(ii) The normal annual rainfall depths received in the five existing stations located over a basin are tabulated below. Determine the optimum number of rainguage stations to be established in this basin, if it is desired to limit the error as 10%.
<table>
<tr><td>Station</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Normal annual rainfall (cm)</td><td>85</td><td>100</td><td>135</td><td>79</td><td>58</td></tr>
</table></td><td>6</td><td>1</td><td>4</td></tr>
<tr><td colspan="5">OR</td></tr>
<tr><td rowspan="2">11(b)</td><td>(i) Explain the different evaporation suppression methods.</td><td>7</td><td>1</td><td>3</td></tr>
<tr><td>(ii) The total observed runoff volume during a 6-hour storm with a uniform intensity of 1.6 cm/h is 23.6X 10^6 m^3. If the area of the basin is 305 km^2, find the average infiltration rate of the basin.</td><td>6</td><td>1</td><td>4</td></tr>
<tr><td rowspan="2">12 (a)</td><td>The ordinates of a 4-hr unit hydrograph (UH) are given below. Derive the 8-hr and the 12-hr unit hydrographs. Plot all the three graphs and interpret the results.
<table>
<tr><td>Time (hrs)</td><td>0</td><td>2</td><td>4</td><td>6</td><td>8</td><td>10</td><td>12</td></tr>
<tr><td>Ordinates of 4-hr UH (m^3/s)</td><td>0</td><td>12.52</td><td>21.32</td><td>23.54</td><td>17.84</td><td>14.79</td><td>12.18</td></tr>
</table>
<table>
<tr><td>Time (hrs)</td><td>14</td><td>16</td><td>18</td><td>20</td><td>22</td><td>24</td><td>26</td></tr>
<tr><td>Ordinates of 4-hr UH (m^3/s)</td><td>10.04</td><td>8.26</td><td>6.51</td><td>4.98</td><td>3.95</td><td>3.05</td><td>2.26</td></tr>
</table>
<table>
<tr><td>Time (hrs)</td><td>28</td><td>30</td><td>32</td><td>34</td></tr>
<tr><td>Ordinates of 4-hr UH (m^3/s)</td><td>1.60</td><td>1.07</td><td>0.53</td><td>0</td></tr>
</table></td><td>13</td><td>2</td><td>4</td></tr>
<tr><td colspan="5">OR</td></tr>
</table>

12 (b)	The current meter observations taken during the gauging of a stream are given below. The current meter rating may be taken as V = 0.05 + 0.4 N; where V is the velocity in m/s and N is the number of revolutions per second. Compute the discharge in the stream.	**13**	2	4

Distance from the bank (m)	Depth of float (m)	Current meter depth (m)	Number of revolutions	Time (s)
0.8	0.5	0.3	11	45
1.6	1.0	0.8	23	52
		0.2	35	50
2.4	1.6	1.28	27	54
		0.32	41	60
3.0	2.0	1.60	33	58
		0.40	44	60
3.6	2.0	1.60	32	58
		0.40	44	60
4.2	1.8	1.44	48	53
		0.36	24	58
5.0	1.2	0.96	42	50
		0.24	35	50
5.8	0.6	0.36	14	45
6.6	0.0	-	-	-

13 (a)	(i) Explain the structural means of flood management.	**7**	3	3
	(ii) An urban area has the following data on catchment and rainfall. Catchment area is 1 km^2; average slope is 0.006; length of the basin measured along the water course is 490 m and the coefficient of runoff is 0.40. Maximum rainfall depth for 20-year frequency is as given below:	**6**	3	3

t_c (mts)	Rainfall (cm)
10	4.2
15	5.3
20	6.0

Find out the peak flood discharge.

OR

13 (b)	(i) Elaborate on the drought mitigation measures.	**7**	3	3
	(ii) Discuss on the drought estimation methods.	**6**	3	3
14 (a)	(i) With the help of a neat sketch describe the different zones of a reservoir.	**7**	4	3
	(ii) A proposed reservoir has a capacity of 400 ha-m. The catchment area is 120 km^2 and the annual stream flow averages 12.30 cm of runoff. If the annual sediment production is 0.03 ha-m/km^2, what is the probable life of the reservoir, before its capacity is reduced to 20% of its initial capacity by	**6**	4	4

	sediment deposition. The relation between trap efficiency and capacity inflow ratio is given below:											
	Capacity Inflow Ratio	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	1.0		
	Trap Efficiency	75	85	93	95	95.5	96	96.5	97	97.5		
	OR											
14 (b)	(i) Elaborate on the sediment management methods with neat sketches.										**7**	4	3
	(ii) The average daily inflow from a certain river in each successive month (each assumed as 30 days) are given in the table below:										**6**	4	4
	Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug				
	Inflow (Mm^3)	3.1	3.5	6.2	19.4	24.2	23.2	21.6	9.6				
	Month	Sep	Oct	Nov	Dec								
	Flow (Mm^3)	7.8	7.2	6.8	6.5								
	Determine analytically the minimum storage capacity of the reservoir for full utilization, if the above water is to be drawn off at a uniform rate and none is lost by flow over the spillway.												
15 (a)	(i) Describe the types of aquifers with neat sketches.										**7**	5	3
	(ii) A well of 0.55 m diameter penetrates fully into a confined aquifer of thickness 20 m and K = 8.1 $X10^{-4}$ m/s. What is the maximum yield expected from this well, if the drawdown in the well is not to exceed 3m? The radius of influence may be taken as 250 m.										**6**	5	4
	OR												
15 (b)	(i) State the assumptions of steady state flow condition.										**7**	5	3
	(ii) An unconfined aquifer has a thickness of 30 m. A fully penetrating 21 cm diameter well in this aquifer is pumped at a rate of 30 lit/s. The drawdown measured in two observation wells located at distances of 10 m and 100 m from the wells are 7.8 m and 0.5 m respectively. (a) Determine the average hydraulic conductivity of the aquifer. (b) At what distance from the well the drawdown is significant?										**6**	5	4

PART- C (1x 15 = 15 Marks)

(Q.No.16 is compulsory)

Q. No.	Questions	Marks	CO	BL
16.	"*The hydrological cycle is endless and finite*" – Critically evaluate this statement by bringing out the quantification and inter-dependability of its different components.	**15**	1,2,3, 4,5	5