Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2018

Subject Code: 2174001 **Date: 15/11/2018**

Subject Name: Irrigation and Water Resources Engineering

Time: 10:30 AM TO 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

MARKS

Q.1 **(a)** A river reach has a flood wave passing thorugh it. At a given instant the storage of water in the reach was estimated as 15.5 ha.m. What would be the storage in the reach after an interval of 3 hours if the average inflow and outflow duirng the time period are 14.2 m^3/s and 10.6 m^3/s respectively ? **03**

(b) Prepare the flowchart for the steps followed in determining areal mean rainfall for a particular catchment using a GIS tool (QGIS), correlate with the term project carried out and present the flowchart accordingly? **04**

(c) The average monthly streamflow values in a river are 150, 200, 420, 400, 350, 290, 320, 230, 250, 210, 180 and 100 (m^3/s). Prepare a flow duration curve for this river using this data and answer the following. **07**

a). What is the value of firm power corresponding to 90% dependable flow?
b). What is the value of 75% dependable flow?
c). What is the dependability of 300 m^3/s?
Assume 80% efficiency and 100m head available for hydropower generation.

Q.2 **(a)** Distinguish between i) Field Capacity, permanent wilting point and Available water for the crop , **04**

ii) Ø-index and W-index.

(b) There are 6 raingauge stations available to calculate the rainfall characteristics of a catchment whose shape can be approximately described by straight lines joining the following coordinates (distances in kilometers): (30,0), (80,10), (110,30), (140,90), (130,115), (40,110),(15,60). Coordinates of the raingauge stations and annual rainfall recorded in them in the year 2011 are given below: **10**

Station	1	2	3	4	5	6
Co-ordinates	(40,50)	(50,0)	(90,30)	(90,90)	(90, 140)	(40,80)
Annual Rainfall (cm)	156	136	128	102	85	128

Determine the average annual rainfall (areal mean precipitation) over the catchment using i) Thiessen mean method (Thiessen polygon method), and ii) arithmetic mean method. Compare the methods based on the results obtained.

OR

(c) The mass curve of rainfall in a storm of total duration 270 minutes is given below: **10**

Time since start in Minutes	0	30	60	90	120	150	180	210	240	270
Cumulative Rainfall (mm)	0	6	18	21	36	43	49	52	53	54

i) Draw the hyetograph of the storm at 30 minutes time step.

ii) Plot the maximum intensity-duration curve for this storm.

Q.3 **(a)** List out the important assumptions made in the Unit Hydrograph (UH) Theory of modeling the effective rainfall-runoff process? **03**

(b) Enlist the various Recording types of Rain-gauges and Explain any one of them with a neat sketch? **04**

(c) The record of annual rainfall at station A covering a period of 22 years is given below: **07**

Year	Annual rainfall (mm)	Year	Annual rainfall (mm)
1960	1300	1971	900
1961	840	1972	1020
1962	760	1973	1080
1963	890	1974	600
1964	1120	1975	750
1965	960	1976	1200
1966	800	1977	1600
1967	1250	1978	850
1968	1430	1979	1060
1969	890	1980	830
1970	780	1981	950

i) Estimate the annual rainfall with return periods of 10 years and 50 years.

ii) What would be the probability of an annual rainfall of magnitude equal to or exceeding 1000 mm occurring at Station A?

iii) What is the 75% dependable annual rainfall at station A?

OR

Q.3 **(a)** Discuss the factors that affect the evaporation from a water body? Explain the methods to reduce Evaporation Losses? **03**

(b) Discuss the current practice and status of rainfall recording in India? **04**

(c) The Infiltration capacity data obtained in a flooding type double ring infiltrometer test is given below: **07**

Time since start (minutes)	5	10	15	25	45	60	75	90	110	130
Cumulative infiltration depth (cm)	1.75	3.00	3.95	5.50	7.25	8.30	9.30	10.20	11.28	12.36

i) For this data plot the curves of infiltration capacity vs time and cumulative infiltration vs time.

ii) Obtain the best values of the parameters in Green-Ampt's equation to represent this data set.

Q.4 **(a)** What is a Storm Hydrograph, mention its components with a neat sketch? **03**

(b) The infiltration capacity in a catchment is represented by Horton's equation as **04**

$f_p = 3.0 + e^{-2t}$

Where f_p is in cm/h and t is in hours. Assuming the infiltration to take place at capacity rates in a storm of 60 minutes duration. Estimate the depth of infiltration in i) the first 30 minutes and ii) the second 30 minute of the storm.

(c) Given a 2-hour Unit Hydrograph ordinates, find the 3- hour Unit Hydrograph for the catchment? Mention by which approach a 3-hour Unit Hydrograph would be constructed and what is the justification for the same? **07**

Time(Hours)	0	2	4	6	8	10	12	14	16	18	20	22
2-Hour UH(m^3/s)	0	20	60	150	120	90	70	50	32	20	10	0

OR

Q.4 **(a)** Define Perennial river, Intermittent river and Ephemeral river? **03**

(b) The infiltration capacity of soil in a small watershed was found to be 6 cm/h before a rainfall event. It was found to be 1.2 cm/h at the end of 8 hours of storm. If the total infiltration during the 8 hours period of storm was 15 cm, estimate the value of the decay coefficient K_h in Horton's infiltration capacity equation? **04**

(c) A storm with 10 cm of precipitation produced a direct runoff of 5.8 cm. The duration of the rainfall was 16 hours and its time distribution is given below. Estimate the Ø – index of the storm. **07**

Time from start (h)	0	2	4	6	8	10	12	14	16
Cumulative Rainfall (cm)	0	0.4	1.3	2.8	5.1	6.9	8.5	9.5	10

Q.5 **(a)** Define Crop Period, Duty and Delta in terms of Irrigation water demand? **03**

(b) What is Duty? Derive a relationship between Duty and Delta? **04**

(c) Wheat is sown in an area in the Indo-Gangetic plain in the beginning of December and is harvested after four months, in the beginning of April. The reference evapotranspiration for these months are estimated as: December: 2.3 mm/d, January: 2.5 mm/d, February: 3.0 mm/d, and March: 5.9 mm/d. Estimate the total water requirement (delta), using the crop factor method, and compare with the delta from Table 2 (Given in Appendix). Also compute the duty of canal water? Refer to Table 1 given in Appendix for crop factor for different stages of Wheat growth? **07**

OR

Q.5 **(a)** Define: Base Period, Kor Period and Culturable Command Area in terms of Irrigation water demand? **03**

(b) Describe the use of flow mass curve to estimate the storage requirement of a reservoir to meet a specific demand pattern. What are the limitations of flow mass curve? **04**

(c) A small catchment has an area of 68 ha and consists of Type-C soil. The land cover is 50% good condition parks, 10% commercial and business area, 30% residential, and 10% roads/paved areas. Assuming normal moisture conditions, determine the volume of direct runoff from a design storm of total rainfall of 200 mm from this catchment. What would be the values of runoff volumes if the past 5- day total rainfalls were 20mm and 60 mm, respectively, assuming growing season in the catchment? **07**

[Note: The curve numbers for Type-C soil for different land use conditions are given in brackets as follows: Good condition parks (74), Commercial and business (94), Residential (90), Paved/Roads (98). Assuming 20% of storage as abstraction]

Appendix

Table 1: Crop factor for different stages of growth

Crop→	Wheat		Potato		Tomato	
Stage ↓	Period (Days)	Crop Factor	Period (Days)	Crop Factor	Period (Days)	Crop Factor
Initial	15	0.35	25-30	0.45	30-45	0.45
Development	25-30	0.75	30-35	0.75	40-45	0.75
Mid-Season	50-65	1.15	30-50	1.15	40-70	1.15
Late-season	30-40	0.45	20-30	0.85	25-30	0.80
Total	120-150	-	105-145	-	135-180	-

Table 2:Water requirement of some crops

Crop	Base Period (days)	Delta (cm)	Kor Period (days)	Kor depth (cm)
Wheat	120	40	28	12
Rice	120	125	20	30
Potato	105	75	25	25
Sugarcane	320	200	40	35

Table 3: AMC Classification in SCS-CN Method

AMC Type	Cumulative rainfall over past five days (mm)	
	Dormant Season	Growing Season
I	<13	<36
II	13 to 28	36 to 53
III	>28	>53

Some Important relationships:

i). $S = 25.4\left\{\frac{1000}{CN} - 10\right\}$

ii). $ER = \frac{(P-I_a)^2}{(P-I_a+S)}$

iii). $CN(I) = \frac{4.2CN(II)}{10-0.058CN(II)}$

iv).$CN(III) = \frac{23CN(II)}{(10+0.13CN(II)}$

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