

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular), Nov.-Dec. 2015

B. Tech in Civil Engineering, Semester V

Roll No.....

CE510 : Hydrology and Water Resource Engineering

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10

- i. An isohyet is a line joining points of
(A) equal temperature (B) equal humidity (C) equal rainfall depth (D) equal evaporation
- ii. A watershed got transformed from rural to urban over a period of time. The effect of urbanization on storm runoff hydrograph from the watershed is to
(A) decrease the volume of run-off (B) increase the time to peak discharge
(C) decreases the time base (D) decrease the peak discharge
- iii. The correct match of **Group-I** with **Group-II** is

Group-I

P. Evapotranspiration

Q. Infiltration

R. Synthetic unit hydrograph

S. Channel Routing

Group-II

1. Penman method

2. Snyder's method

3. Muskingum method

4. Horton's method

- (A) P-1, Q-3, R-4, S-2 (B) P-1, Q-4, R-2, S-3
(C) P-3, Q-4, R-1, S-2 (D) P-4, Q-2, R-1, S-3

- iv. A flood wave with a known inflow hydrograph is routed through a large reservoir. The outflow hydrograph will have
(A) attenuated peak with reduced time-base
(B) attenuated peak with increased time-base
(C) increased peak with increased time-base
(D) increased peak with reduced time-base
 - v. An isolated 3-h rainfall event on a small catchment produces a hydrograph peak and point of inflection on the falling limb of the hydrograph at 7 hours and 8.5 hours respectively, after the start of the rainfall. Assuming, no losses and no base flow contribution, the time of concentration (in hours) for this catchment is approximately
(A) 8.5 (B) 7.0 (C) 6.5 (D) 5.5
- VI. Precipitation caused by lifting of an air mass due to the pressure difference, is called
(A) Cyclonic precipitation (B) convective precipitation
(C) Orographic precipitation (D) none of these.

vii. **Group I** contains parameters and **Group II** lists methods/instruments.

Group I

Group II

- | | |
|-----------------------------|--------------------|
| P. Streamflow velocity | 1. Anemometer |
| Q. Evapo-transpiration rate | 2. Penman's method |
| R. Infiltration rate | 3. Horton's method |
| S. Wind velocity | 4. Current meter |

The **CORRECT** match of **Group I** with **Group II** is

- (A) P - 1, Q - 2, R - 3, S - 4 (B) P - 4, Q - 3, R - 2, S - 1
(C) P - 4, Q - 2, R - 3, S - 1 (D) P - 1, Q - 3, R - 2, S - 4

- viii. The ordinates of a 3-h unit hydrograph at 1 hour intervals starting from time $t = 0$, are 0, 3, 8, 6, 3, 2 and 0 m^3/s . Use trapezoidal rule for numerical integration, if required. What is the catchment area represented by the unit hydrograph?
(A) 1.00 Km^2 (B) 2.00 Km^2 (C) 7.92 Km^2 (D) 8.64 Km^2
- ix. A small catchment of area 150ha received a rainfall of 10.5cm in 90min. due to a storm. At the outlet of the catchment. The stream draining the catchment was dry before the storm and experienced a runoff lasting for 10hours within an average discharge of 1.5 m^3/s . The stream of again dry after the runoff event. The ratio of runoff to precipitation is?
(a) 0.29 (b) 0.30 (c) 3.43 (d) 0.343
- x. Two and half centimeters of rain per day over an area 200 Km^2 is equivalent to average rate of input of how many cubic meters per second of water to that area?
a) 57.87 b) 5.787 c) 0.57 d) 0.057

Q.2 Short answer type questions (4 questions @ 2.5 marks)

10

- a. The direct runoff hydrograph of a storm obtained from a catchment is triangular in shape and has a base period of 80 hours. The peak flow rate is 30 m^2/sec and catchment area is 86.4 km^2 . determine the rainfall excess for the hydrograph.
- b. The rainfall during three successive 2 hour periods are 0.5, 2.8 and 1.6 cm. the surface runoff resulting from this storm is 3.2 cm. find out the ϕ index value for this storm.
- c. What is waterlogging? What are its ill-effects?
- d. What do you understand by meandering? What are its causes?

Q.3A What is unit hydrograph? What are the basic proposition of the unit hydrograph theory? What are the limitations of the unit hydrograph theory? 05

Q.3B What is the hydrological cycle? Give a brief description of different Components of a hydrologic cycle with neat sketch. 05

Q.4A A well penetrate into an unconfined aquifer having a saturated depth of 100 meter. The discharge is 250 liters per minute at 12 meters drawdown. Assuming Equilibrium flow condition and a homogenous aquifer, estimate the discharge at 18 meter drawdown. The distance from the well where the drawdown influence are not appreciable may be taken to be equal for both the cases. 05

Q.4B An Avg. rainfall of 16 cm occurs over a catchment during a period of 12 hours. Unit hydrograph of 6 hour duration rises linearly from 0 to 30 cumec in 6 hour and then falls from 30 to 0 in the next 12 hours. ϕ index of catchment is 0.5 cm/hr and base flow in the river is 5 cumecs. Find out the peak discharge of direct runoff hydrograph and area of the catchment. 05

- 5A Given below are the monthly rainfall & corresponding runoff value for a period of 10 months. Develop a correlation Between Runoff & rainfall (R & P). 05

Month	I	II	III	IV	V	VI	VII	VIII	IX	X
P	04	22	28	15	12	8	4	15	10	5
R	0.2	7.1	10.9	4	3	1.3	0.4	4.1	2.0	0.3

- Q.5B In a catchment, there are four rain - gauge stations, P, Q, R, and S. Normal annual precipitation values at these stations are 780 mm, 850 mm, 920 mm, and 980 mm, respectively. In the year 2013, stations Q, R, and S, were operative but P was not. Using the normal ratio method, the precipitation at station P for the year 2013 has been estimated as 860 mm. If the observed precipitation at stations Q and R for the year 2013 were 930 mm and 1010 mm, respectively, what was the observed precipitation (in mm) at station S for that year? 05

- Q.6A Tabulated below are data for a number of storm observed on a river. Compute W_{index} for all the storms. 05

Storm No.(1)	1	2	3	4	5	6	7	8	9	10
Duration of rain in hour (2)	12	18	24	72	18	24	36	12	30	18
Average rainfall in cm (3)	2.82	2.98	4.55	14.22	2.87	3.91	8.10	4.40	5.31	6.98
Runoff in cm (4)	1.32	1.02	2.46	7.42	0.43	0.48	1.93	1.67	1.98	3.15

- Q.6B Compute and draw the storm hyetograph and the intensity duration curve for the following storm (of a given frequency) on a drainage basin. 05

Duration (minute)	0	30	60	90	120
Accumulated precipitation(cm)	0	5.0	7.5	8.5	9.0

OR

- Q.6B Estimated the average depth of precipitation, from depth-area curve ,that may expected over an area of 2400 sq. km, due to the storm of 27 September 2015,lasting for 24 hours, assuming the storm center to be located at the center of the areas enclosed between different isohyets as follows : 05

Isohyet in mm	21	20	19	18	17	16	15	14	13	12
Enclosed area in sq. km	543	1345	2030	2545	2955	3280	3535	3710	3880	3915

Hence determine the depth of rainfall due to the storm that may be expected to be recorded by rain gauge placed at the storm center.

- Q.7A The intensity of rainfall and time interval are given below 05

Time interval(minute)	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Rainfall intensity(mm/minute)	0.7	1.1	2.2	1.5	1.2	1.3	0.9	0.4

Find the maximum intensity of rainfall for 20 minute duration of the storm.

- Q.7B Explain clearly, 'design flood' and 'time of concentration'. 05
On the basis of isopluvial maps, the 50 years 24 hr maximum rainfall at JAIPUR is

found to be 16 cm. determine the probability of 24 hr rainfall of magnitude equal to or greater than 16 cm occurring at JAIPUR.

- (a) atleast once in 10 successive year
(b) two times in 10 successive years

OR

Q.7B An isolated 4-hour storm occurred over a catchment as follows:

05

Time	1 st hour	2 nd hour	3 rd hour	4 th hour
Rainfall (mm)	09	28	12	07

The ϕ index for the catchment is 10 mm/h. Determine runoff depth from the catchment due to the above storm.

Q.8A The ordinates of 3 hour unit hydrograph are given below:

10

Time in hour	0	3	6	9	12	15	18	21	24	27	30
Ordinates cum/sec	0	10	25	20	16	12	9	7	5	3	0

Find the ordinates of a 6 hour unit hydrograph for the same basin analytically. Also sketch this unit hydrograph. What is the peak value of discharge in this Unit hydrograph.

Q.9A With a neat sketch, describe various zones of storage in a reservoir and density current. Also suggest measures to control reservoir sedimentation and how do you estimate the probable life of reservoir.

7+3

A reservoir has the following areas enclosed by contours at various elevations. Determine the capacity of the reservoir between elevations of 200.00 to 300.00.

Elevation	200.00	220.00	240.00	260.00	280.00	300.00
Area of contour (Km ²)	150.00	175.00	210.00	270.00	320.00	400.00

Use (a)Trapezoidal formula (b)Prismoidal formula

Q.9B Explain the use of a non-recording rain gauge in the measurement of rainfall.

3+7

The normal annual rainfall depths recorded at five rain gauge stations A,B,C,D,E are 910, 1070, 1410, 810 and 590 mm respectively. Determine the optimum number of rain gauge stations to be established in the drainage basin if it is desired to limit the error in the mean value of rainfall to 10%.what is the percentage accuracy of the exciting network in the estimation of the average depth of rainfall over a basin? If the location of five rain gauge stations and the areas of the different zones caused by the Isohyets are as given in the following table, indicate the distribution of the additional rain gage stations required if any.

Zone	I	II	III	IV	V	VI	Total
Area(Km ²)	415	905	2855	1755	725	555	7210
Rain gauge stations	1	1	1	1	1	1	5

OR

Q.9B What are "Tile drains "and how do they help in preventing water logging?

4+6

In a tile drainage system, the drains are laid with their center 1.5 m below the ground level. the impervious layer is 9.0 m below the ground level and the average annual rainfall in the area is 80 cm. if 1% of the annual rainfall is to be drained in 24 hours to keep the highest position of the water table to 1 meter below ground level, determine the spacing of the drain pipes .coefficient of permeability may be taken as 0.001 cm/sec.