

Code No: R31014

R10

Set No: 1

III B.Tech. I Semester Regular Examinations, November/December - 2012

WATER RESOURCES ENGINEERING-I

(Civil Engineering)

Time: 3 Hours**Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

- With the help of neat sketch explain various processes of hydrologic cycle and how it is useful in Water Resources Engineering?
 - A watershed has an area of 300 ha. Due to a 10cm rainfall event over the watershed, a stream flow is generated and at the outlet of the watershed it lasts for 10hours. Assuming a runoff/rainfall ratio of 0.20 for this event. Find the average stream flow rate at the outlet of the watershed.
- Explain the different methods of determining the average rainfall over a catchment due to a storm. Discuss the relative merits and demerits of the various methods?
 - A catchment area has seven rain gauge stations. In a year the annual rainfall recorded by the gauge are as follows:

Stations:	A	B	C	D	E	F	G
Rainfall	130.0	142.1	118.2	108.5	165.2	102.1	146.9

For a 5% error in the estimation of the mean rainfall, calculate the minimum number of additional stations required to be established in the catchments.

- Briefly explain the various types of rain gauges with neat sketch? Enumerates it merits and demerits.
 - In a drainage basin of 600 km², isohyets drawn for a storm gave the following data:

Isohyets Interval (cm)	15-12	12-9	9-6	6-3	3-1
Inter isohyetal area (km ²)	98	128	120	175	85

Estimate the average precipitation over the drainage basin.

- What is runoff? Discuss the factors in details that affect the runoff process.
 - How infiltration in the field is measured? What are the different infiltration indices? Explain the each of them by sketches where necessary?
 - The rate of rainfall for half an hour period of 3.5 hour storm are 3.5, 4.0, 12.0, 8.5, 4.5, 4.5, and 3.0 cm/hr. Assuming the Φ -index of 3.5 cm/hr find the net rainfall in cm, total rainfall and W - index.
- What are the elements of Unit Hydrograph? Show with a neat sketch? Enumerate the limitations and applications of Unit Hydrograph?
 - For a long record of annual peak flood of river Sankosh, a north bank tributary of the river Brahmaputra, the mean Q and standard deviation calculated by the water resource department, Govt. of Assam are 143.9 m³/s and 56.65 m³/s respectively. Using Gumbel's approach, obtain the return period of flood for a flood of 350 m³/s of this river.

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6. (a). Derive an expression for the steady state discharge of well fully penetrating into a confined aquifer?
(b). Two observation wells 15 m and 30 m away from a pumping well of 20 cm diameter record drawdowns of 3.2m and 2.2m respectively. If the well penetrates to a full static water table of 40 m, determine the transmissibility of the aquifer and drawdown at the pumping well?
7. (a). What are the different water application methods? Compare the merits and demerits of each method and explain with neat sketch the surface and sub-surface methods?
(b). Calculate the discharge required at the outlet when area to be irrigated in Rabi is 3800 hectares and in kharif is 16000 hectares, kor depth and kor period for rabi and kharif are 13.5 cm and 4.5 weeks and 19cm and 3 weeks respectively.
8. Write a short note on following:
 - (i). Differentiate between Kennedy's and Lacey's Theories
 - (ii). What are the objectives of the land drainage? And also discuss the requirements of land drainages?
 - (iii). What are the different types of soil moisture measurements?
 - (iv). Briefly explain the classification of land drainage?

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- Briefly explain the significant features of global water balance studies? Also discuss the hydrologic cycle with neat sketch?
 - A catchment has five rain-gauge stations and the annual precipitations are 900, 1100, 1750, 950, and 1250 mm respectively. Find the extra number required or not if error in estimation is limited to 10 percent.
- Discuss the current practice and status of rainfall recording in India? Discuss the types of rain gauge stations with neat sketch?
 - In a watershed, the expected one-hour rainfall intensity is 6.25 cm, the watershed area is 50 ha, of which 30 ha is pasture on 7% slope and 20 ha is cultivated on 3% slope, and the length of run is 720 m on a 4% slope. Determine the peak runoff rate for a 10-year recurrence interval, when the type of soil for cultivated crops is silt clay and for pasture it is clay and silt loam. Assuming the value of C for respective soils for cultivated crops on 3% slope is 0.5 and for pasture land on 77% slope is 0.36.
- Explain the different methods of determining the average rainfall over a catchment due to a storm and give its advantages and disadvantages?
 - In a catchment there are six rain gauge stations. The normal rainfall in the gauge stations are as follows:

Stations:	A	B	C	D	E	F
Annual Rainfall (mm)	350	650	450	781	1042	798

If the error in the estimation of catchment mean rainfall should not exceed 10%, calculate the minimum number of additional rain gauge stations required for the catchment.

- Explain the rational method for determination of peak of a catchment. Write its advantages and disadvantages? Enumerate its limitations.
 - The shape of a catchment is in the form of a pentagon ABCDE. There are 4 rain gauge stations P, Q, R & S inside the catchment. The position coordinates in km are (0,0), B(50,75), C(100,70), D(150,0), E(75,-50), P(50,25), Q(100,25), R(100,-25) & S(50,-25). If the rainfalls recorded at P, Q, R & S are 88, 102, 112, 116mm respectively, determine the average depth of rainfall over the catchment using Thiessen polygon method.

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5. (a). Briefly explain about Unit hydrograph and Synthetic Unit Hydrograph? Give its limitations and applications.
 (b). Given below are the observed flows a storm of 6 hour duration on a stream with a catchment of 600 km^2 .

Derive the ordinates of a 6 hour unit hydrograph. Assume the base flow as zero.

Time (hr)	0	6	12	18	24	30	36	48	54	60
Observed flow(m^3/s)	0	100	200	150	90	60	30	15	5	0

6. (a) Derive the equation for steady state flow of water in a homogeneous and isotropic condition?
 (b). The elevation of water table in an unconfined aquifer at two location separated by a distance of 100 m is 1026.2 m and 1025.0 m respectively. If the permeability of the aquifer is 12 m/day and porosity is 15 percent, what is the actual velocity in the aquifer?
7. (a). Briefly explain the principal crops in India? And also describe the different factors affecting the duty of a canal system?
 (b). The flood frequency for a stream has been found to be as follows;
 Return period (yrs): 10 200
 Peak discharges (m^3/s): 109.0 244.0
 Estimate the peak discharge for the return periods of 400 and 5 years by using the Gumbel's distribution method.
8. Write short note on the following:
 (i). Classification of canal system
 (ii). Briefly explain the different methods of soil moisture measurements
 (iii). Open well recuperation test
 (iv). Explain briefly the Evapo-transpiration process?

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- Explain with the help of sketch the hydrologic cycle in nature indicating its various phases? And also give an account of global water budget.
 - What are the two processes that cause precipitation? Describe the necessary conditions to produce rainfall. Describe the scope of hydrometeorology?
- Briefly explain the measurement of precipitation? Also enumerate the selection rain gauge site?
 - In a watershed, the average precipitation for four sub basins was recorded as 100.84, 112.27, 84.84, and 73.406cm. The areas of the sub basins were : 93264.3, 71243.5, 108808.2, and 168393.8 ha. Calculate the average precipitation of the total watershed using Arithmetic mean and Thiessen polygon method.
- What is infiltration? Briefly explain the measurement of infiltration and its indices?
 - the following are the monthly evaporation data (in cm) in a certain year (January to December) in the vicinity of lake.

Month	J	F	M	A	M	J	J	A	S	O	NI	D
Evaporation	15.7	14.1	16.9	24.0	27.5	21.4	15.7	16.2	16.2	20.5	19.7	15.4

The water spread area in the lake in the January was 3.2 km^2 and in December 2.6 km^2 . Calculate the loss of water due to evaporation in that year. Assume pan coefficient of 0.71.

- Explain the different methods of estimating runoff? Also discuss the runoff cycle with neat sketch.
 - The ordinates of 6-hr unit hydrograph are given as follows:

Time (hr)	0	3	6	9	12	15	18	21	24	27	30	33	36
6-hr UH ordinates	0	15	24	42	58	78	69	58	43	30	17	15	0

A storm has successive 3-hr rainfall of 3, 5, and 4 cm respectively. Φ - Index is 0.2 cm/hr, base flow is $53 \text{ m}^3/\text{s}$. Determine the resulting flow hydrograph.

- What do you understand by time of concentration of a catchment? Describe briefly methods of estimation of the time concentration?
 - Annual flood data of the river Narmada at Garudeshwar covering the period 1948 to 1979 yielded for the annual flood discharges a mean of $29,600 \text{ m}^3/\text{s}$ and a standard deviation of $14,860 \text{ m}^3/\text{s}$. For a proposed bridge on this river near this site it is decided to have an acceptable risk of 10% in its expected life of 50 years. (a). Estimate the flood discharge by Gumbel's method for use in the design of this structure (b) If the actual flood value adopted in the design is $125,000 \text{ m}^3/\text{s}$ what are the safety factor and safety margin relating to maximum flood discharge? Take $\alpha_n=0.5380$ and $\sigma_n=1.1193$.

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6. (a). Develop the equation relating the steady state discharge from a well in an unconfined aquifer and depths of water table at two known positions from the well. State clearly all the assumptions involved in the derivation.
 (b). A 30 cm well fully penetrates an unconfined aquifer of saturated depth 25m. When a discharge of 2100lpm was being pumped for a long time, observation wells at radial distances of 30 m and 90 m indicated drawdown of 5 and 4 m respectively. Estimate the coefficient of permeability and transmissibility of the aquifer. What is the drawdown at the pumping well?
7. (a). What are the different water application methods? Compare the merits and demerits of each method and explain with neat sketch the surface and sub-surface methods.
 (b). Estimate the available soil water holding capacity of a soil in centimeters in the 60 cm soil profile from the following data

Soil depth (cm)	Field capacity (%)	PWP (permanent wilting point (%))	Bulk density (g/cm)
0-15	25.1	10.8	1.51
15-30	24.8	11.1	1.52
30-45	24.4	11.4	1.54
45-60	23.9	11.3	1.55

8. Write a short note on the following:
- Explain the classification of land drainage? and also explain the requirements of drainage
 - Differentiate between field capacity and saturation capacity?
 - Causes and effects of Water logging
 - Classification of Canal system

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- (a). What is hydrologic cycle? Describe the system representation of hydrologic cycle with neat sketch?
(b). Describe the different methods of determining the average rainfall over an area?
- (a). Explain briefly the following relations relating to the precipitation over a basin:
(i) Maximum Depth-Area Duration Curves (ii) Intensity Duration Frequency Relationship
(b). There are four rain gauge stations neighboring a gauge A, which was inoperative during a storm. The records show that the storm rainfall for the four stations are 13.7, 14.1, 14.5, and 12.6 cms and the respective normal precipitation of the stations are 140, 146, 157, and 122 cms. If the normal rainfall of station A is 131 cm, calculate storm precipitation of station A.
- (a) Briefly explain the factors affecting Infiltration? Explain the terms Φ -index, W-index and infiltration Capacity.
(b). Cumulative rainfall during a storm are:

Time (hr)	0	1	2	3	4	5	6	7	8
Rainfall(mm)	0	7	16	22	32	40	52	68	70

Assume an initial abstraction loss of 10 mm and a constant infiltration loss rate of 5.0 mm/hr. Calculate the storm runoff volume from the catchment of 122 km².

- (a). Draw the unit hydrograph and explain the salient features? Also give its assumptions and limitations.
(b). A watershed of 3130 km² was subjected to a storm of 4-hr duration from which the following hydrograph resulted.

Time(hr)	3	6	9	12	15	18	21	24	3	6	9	12	15	18	21
Discharge (m ³ /s)	20	16	175	270	230	200	170	150	130	115	100	90	80	70	60

What is the rainfall excess for the storm? Obtain tan Unit Hydrograph for the watershed.

- (a). Derive an expression for unsteady flow in unconfined aquifer clearly stating the assumptions made there in?
(b). During pumping of water from a 15 cm diameter well the following information are recorded. Thickness of the aquifer is 12m, rate of pumping is 1000 lpm, drawdown at the well after 10 hr of pumping is 2.m and drawdown at the well after 20 hr of pumping is 3.0m. Determine the transmissibility, storage coefficient and coefficient of permeability of the aquifer.

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6. (a). What are the different sources of water for irrigating crops? Give an assessment of the area irrigated through different sources.
(b). Calculate the i) bulk density ii) water content on weight basis and iii) water content on volume basis of soil when a soil core of 10 cm diameter and 8 cm length weighs 1113.14g immediately after sampling and 980.57g after oven drying at 105⁰ C.
7. (a). What are the different types of soil moisture measurements? Describe in details the gravimetric method tensiometer method of soil moisture measurements?
(b). Find the following data pertaining to a cultivated land, determine irrigation interval and amount of irrigation water needed at each irrigation so that the moisture content at any stage does not fall below 40 of the maximum available moisture.
Field capacity of soil =35%
Permanent wilting point =12%
Porosity of soil =0.42
Depth of root zone soil =1.2m
Consumptive use =12mm per day
Application efficiency =60%
8. Write a short note on the following:
(i). Differentiate between commercial crops and food grain crops in India?
(ii). Explain the classification of land drainage? and also explain the requirements of drainage?
(iii). Briefly explain the classification of land drainage
(iv) Explain the design of canals by Kennedy's theory and give its limitations
