GUJARAT TECHNOLOGICAL UNIVERSITY

3rd Semester Civil Engineering – PDDC

Subject Code & Name : X30601 - Hydrology and Water Resources Engineering

Sr. No.	Course content
1.	**Introduction :** The hydrologic cycle, history of hydrology, scope and application of hydrology, importance of water resources.
2.	**Precipitation :** Types of precipitation, geographical distribution, time distribution, variability, measurement, average depth over area, depth area duration.
3.	**Evaporation and Transpiration :** Factor affecting, measurement, evaporation in reservoirs, methods of prevention.
4.	**Infiltration :** Introduction, factor affecting, measurement.
5.	**Runoff :** Runoff process; relation of storm period and rainfall, factors affecting runoff methods of computation, gauging runoff of stream, stage discharge relationships interpretation of stream flow records.
6.	**Hydrograph Analysis :** Components of the hydrograph; Separation of base flow, components unit hydrographs, S-hydrographs.
7.	**Floods :** Causes of floods, methods of estimation of floods. Design floods, damages, flood routing through reservoirs, methods of flood control, flood forecasting and warning.
8.	**Groundwater Hydrology :** Occurrence and movement of groundwater, surface and subsurface investigation of groundwater, flow through saturated porous medium.
9.	**Simulation Modelling :** Introduction, types, application in hydrology and water resources engineering.

Term Work : Term work shall be based on the above mentioned course content**.**

Field Visit : Field visits based on course content are suggested.

References Books:
1. Hydrology and Water Resources Engineering by S. K. Garg.
2. Watershed Hydrology by Peter E. Black.
3. Engineering Hydrology - K. Subramanyam.
4. Hydrology by H. M. Raghunath.
5. Hydrology and Water Resurces Engineering by James & Lee.

Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC - SEMESTER – III • EXAMINATION – SUMMER 2014

Subject Code: X30601   **Date: 18-06-2014**
Subject Name: Hydrology and Water Resources Engineering
Time:02:30 pm to 05:00 pm   **Total Marks: 70**
Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	(i) Define hydrology and give the scope of hydrology. (ii) Give as percentage of total water on earth's surface as ground water, water in glaciers and icecaps and percentage of water in lakes and rivers.	**07**
	(b)	Enlist different types of precipitations. Explain convectional precipitation. Illustrate which type of precipitations are significant to the civil engineer.	**07**
Q.2	**(a)**	Explain a method of estimating missing rainfall data and a method of checking consistency of rainfall records.	**07**
	(b)	Enlist and explain the hydrological data to be collected for hydrologic project.	**07**
		OR	
	(b)	What factors do you consider for selecting a site for rain gauge station? Explain how rainfall measurement by radar complements the rainfall records by rain gauge.	**07**
Q.3	**(a)**	Draw proportionate sketches to explain the importance of depth area duration curves. Which data are needed for preparing depth area duration curves.	**07**
	(b)	The following were the monthly pan evaporation data in certain year in the vicinity of the lake from the month of January to December: 15.7, 14.1, 16.9, 24.0, 27.5, 21.4, 15.7, 16.2, 16.2, 20.5, 15.7 and 15.4.cm The total water spread area in January is 3.2 km^2 . The water spread area in the beginning of December is 2.6 km^2. Calculate the loss of water in Mm^3 due to evaporation in that year. Take pan coefficient of 0.72.	**07**
		OR	
Q.3	**(a)**	Enlist and explain the measures to reduce lake evaporation.	**07**
	(b)	Successive hourly rainfall of 1.5 ,5 and 3 cm occur over a 25 hectare area for which 5 ha ,ø = 4 cm/hr, 12 ha , ø = 3cm/hr, 8 ha of ø = 1 cm/hr. Derive the net rain in successive hours and total net rain in 3 hours.	**07**
Q.4	**(a)**	Enlist the various methods for determination of infiltration. State the conditions under which you will use the single and double ring infiltrometer. Draw a proportionate sketch showing infiltration time curve.	**07**
	(b)	In an area of 100 ha the water table dropped by 4.5 meter due to continuous ground water pumping. If porosity is 26% and specific retention is 10% determine the specific yield of the aquifer and the decrease in the ground water storage.	**07**
		OR	
Q.4	**(a)**	Enlist the basin characteristics and the storm characteristics that affecting run off and discuss basin characteristics.	**07**
	(b)	Draw sketches to draw stage discharge curves and explain stage discharge curves during rising stage , falling stage and constant stage	**07**
Q.5	**(a)**	Define unit hydrograph. Explain clearly the assumptions made in the unit hydrograph theory and the limitations of the unit hydrograph theory	**07**

(b) (i) Define reservoir routing , the input data required for reservoir routing and the output data obtained. (ii) Explain design flood. **07**

OR

Q.5 **(a)** Define simulation. Explain different type of simulations and their uses in water resources. **07**

(b) Explain the nature of ground water flow. Explain the laws governing the ground water flow with their limitations. **07**

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GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC - SEMESTER–III • EXAMINATION – WINTER 2013

Subject Code: X30601   **Date: 18-12-2013**

Subject Name: Hydrology and Water Resources Engineering

Time: 10.30 am - 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.**

Q.1 **(a)** (i) Give the scope of hydrology. (ii) Give a quantative analysis of world water resources categorizing the available water resources into: fresh and salty water, surface water and ground water, ice caps and lake and stream water   **07**

(b) Define the following terms: apparent velocity and actual velocity of ground water; aquifer and aquifuge; permeability,transmissibility and porosity of ground water   **07**

Q.2 **(a)** The following data were collected during a stream gauging operation in a river . Compute the discharge.   **07**

Distance from left water edge (m)	Depth (m) d	Velocity at 0.6d
0	0.0	0.0
1.5	1.3	0.5
3	2.5	0.75
4.5	1.7	0.6
6	1.0	0.5
7.5	0.4	0.35
9.0	0.0	0

(b) Draw sketches to explain cyclonic and frontal precipitation   **07**

OR

(b) Explain double and single ring infiltrometer test. When is double ring infiltrometer test preferred? Draw a curve showing variation of infiltration rate with time.   **07**

Q.3 **(a)** Define reservoir routing and channel routing. Explain the data required to be given for channel and reservoir routing and clearly list the outputs obtained.   **07**

(b) The following is the observed flow for a 6 hour storm for 6 hour interval : 20, 30, 35 , 47.5 , 45, 42 ,40,35, 32, 30 ,20 cumecs find out the volume of run off obtained in cm. Take the basin area as 325 square kilometer. Find the coordinates of a 6 hour unit hydrograph for the basin   **07**

OR

Q.3 **(a)** Explain structural and non structural measures of flood control. Explain in detail the structural measures.   **07**

(b) The rate of rainfall for successive 15 minutes interval for a 90 minute rainfall are 3, 8, 6.5 1.9,3.6 and 6cm/hr If $\emptyset_{index}$ is = 3cm/hr estimate runoff and find the w_{index} **07**

Q.4 **(a)** Define stream gauging and explain the tracer method of stream gauging and its utility   **07**

(b) Draw the stage discharge curve for the rising stage, falling stage and the constant stage and explain the correction to be applied for calculation of actual discharge.   **07**

OR

| Q.4 | (a) | Explain the flood frequency analysis for estimation of floods. | 07 |
| | (b) | Enlist the factors affecting infiltration and the factors affecting run off | 07 |

| Q.5 | (a) | Define simulation. Explain calibration, testing and validation of a surface run off model. State the advantage of simulation modeling. | 07 |
| | (b) | Define evaporation and transpiration. Enlist the methods to estimate evaporation and a suitable method to estimate evaporation over a reservoir. | 07 |

OR

| Q.5 | (a) | State and explain the assumptions made in the theory of unit hydrograph and the utility and limitations of theory of unit hydrograph | 07 |
| | (b) | Explain the concept of 'S" curve and its utility | 07 |

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GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC - SEMESTER–III • EXAMINATION – SUMMER 2013

Subject Code: X30601   **Date: 09-05-2013**
Subject Name: Hydrology and Water Resources Engineering
Time: 02.30 pm - 05.00 pm   **Total Marks: 70**
Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 (a) Define hydrology and explain the importance of hydrology to engineers by discussing its scope   07

     (b) Draw sketches and discuss the hydrological cycle   07

Q.2 (a) Explain the following:(i) convective precipitation (ii)frontal precipitation   07

     (b) (i)Enlist various methods of measuring rainfall over an area and discuss which method gives the most accurate results. (ii) Given are the annual isohyets for an area find the average annual rainfall over the area for the table given below: 07

Area enclosed between isohyets km^2	220	380	250	200
Isohytes (cm)	25-50	50-75	75-100	100-125

OR

     (b) The table below contains the isohytal data for a four day storm make calculations to tabulate data for depth area curve for a four day storm: 07

Cumulative Area Enclosed Thousand Km^2	Isohytal Range (cm)	Cumulative Area Enclosed Thousand Km^2	Isohytal Range (cm)
0.5	› 50, say55	82	25-30
4	40-50	122	20-25
7	35-40	156	20-15
29	30-35	236	15-10

Q.3 (a) Explain clearly the assumptions made in the unit hydrograph theory and their importance in the development of unit hydrograph for the given catchment.   07

     (b) Given below are the ordinates of 6 hour unit hydrograph at 6 hour interval. Find the hydrograph of a runoff due to two successive storms of 6 hours duration producing2 cm and 3 cm excess run off respectively: 07

Time (hr)	0	6	12	18	24	30	36	42	48	54	60
Ordinates 6 hr UHG cumecs	0	50	125	185	160	110	60	36	25	16	0

State clearly the assumptions made in making the above derivations

OR

Q.3 (a) Explain the utility of stage discharge curves and explain stage discharge curves for falling stage and rising stage.   07

     (b) It was observed in a field test on ground water that 3 hour was required for a tracer to travel from one well to an other 20 metes apart and the difference in water level elevation was 0.5 metre. The porosity of the aquifer is 15%. Find the permeability of the aquifer and Reynolds number of flow assuming average   07

grain size 2 mm and viscosity of water 0.008 stokes

Q.4	(a)	Explain flood control by (i) construction of flood control reservoir (ii) construction of levees. Explain the interdependence between the two measures.	07
	(b)	Explain the difference between infiltration and deep percolation, explain factors affecting infiltration	07

<div align="center">OR</div>

Q.4	(a)	Explain the procedure for sub surface investigation for finding out position of water table by the use of electrical resistivity meter.	07
	(b)	Answer the following about ground water movement: (i)Darcy's law for ground water movement. (ii)Mathematical expression for Reynolds number of flow (iii) Actual and theoretical area of flow; Actual and theoretical velocity of flow	07

Q.5	(a)	Explain the utility of the 'S' curve hydrograph and explain how it is obtained by plotting and summing infinite number of 'D' hour unit hydrograph summed at a lag of D hours.	07
	(b)	Explain what you understand by reservoir routing stating the inputs to be given and the outputs obtained and the basic hydrologic equations used.	07

<div align="center">OR</div>

Q.5	(a)	Explain the factors affecting reservoir evaporation and explain how the reservoir evaporation can be controlled.	07
	(b)	Explain the measurement of soil infiltration by double ring infiltrometer stating the governing equations and explain the terms contained in the governing equation.	07

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Seat No.: _____   Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC - SEMESTER – III • EXAMINATION – WINTER 2012

Subject code: X 30601   **Date: 26/12/2012**
Subject Name: Hydrology and Water Resources Engineering
Time: 10.30 am - 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.**

Q.1	**(a)**	Define and explain Hydrological Cycle with neat sketch.	**07**
	(b)	Explain "Thiessen Polygon method for determining average rainfall of a given catchment/	**07**
Q.2	**(a)**	Discuss the factors affecting run-off from catchment area.	**07**
	(b)	What is Unit Hydrograph? What are its applications?	**07**

OR

	(b)	Define: 1) Time of Concentration(tc)	**07**
		2) Recession time (tr)	
		3) Basing Lag. (tp)	
Q.3	**(a)**	Define and explain (1) ϕ –Index (2) W-Index	**07**
	(b)	Discuss the factors affecting infiltration capacity.	**07**

OR

Q.3	**(a)**	Explain Gumbel's method in detail	**07**
	(b)	What is Evapotranpiration? Discuss factors affecting it.	**07**

OR

Q.4	**(a)**	For a storm of 2-hour durations, the rainfall rates are as follows: If ϕ-Index is 3cm/hr, estimate the surface runoff. Also determine W-Index.	**07**

Time period (minutes)	20	20	20	20	20	20
Rainfall rate (cm / hr)	2.6	2.5	10.2	7.8	5.2	1.3

	(b)	How the useful life of a reservoir can be determined?	**07**

OR

Q.4	**(a)**	What are the components of hydro electrical power project? Discuss them	**07**
Q.4	**(b)**	Describe various causes of draught.	**07**

OR

Q.5	**(a)**	Discuss the causes of sedimentation in reservoir. How will you control them?	**07**
	(b)	Define: 1) Surcharge storage	**07**
		2) Bank storage	
		3) Trap Efficiency	

OR

Q.5	**(a)**	Explain with neat sketch storage zones of a reservoir.	**07**
	(b)	What are the environmental issues in water resources project?	**07**

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GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC-Semester –III (May-2012) Examination
Subject code: X30601
Subject Name: Hydrology and water resources Engineering
Date: 14/05/2012

Time: 02.30 pm – 05.00 pm   **Total Marks: 70**

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

Q.1	**(a)**	Define and explain Hydrological Cycle with neat sketch.	**07**
	(b)	What is unit hydrograph? What are its applications?	**07**
Q.2	**(a)**	Explain 'Thiessen Polygon' Method for determining average Rainfall of a given catchment.	**07**
	(b)	Define : 1) Time of concentration (tc)	**07**
		2) Recession time (tr)	
		3) Basin Lag. (tp)	

OR

	(b)	Discuss the factors affecting run-off from catmint area.	**07**
Q.3	**(a)**	Explain the Gumbel's method.	**07**
	(b)	Write short note on rain water harvesting.	**07**

OR

Q.3	**(a)**	Discuss the causes of sedimentation in reservoir. How will you control them?	**07**
	(b)	Enumerate the components of hydroelectric power project? Discuss them.	**07**
Q.4	**(a)**	Define:1) Surcharge storage	**07**
		2) Bank storage	
		3) Trap Efficiency	
	(b)	How will you control the flood? Explain in detail.	**07**

OR

Q.4	**(a)**	A flood of certain magnitude has a return period of 50 years	**07**
		a) What is its probability of exceedance?	
		b) What is the probability that this flood may occur at least once in the next 25 years?	
	(b)	Define Darcy's law. What are its limitations?	**07**
Q.5	**(a)**	How the useful life of a reservoir can be determined?	**07**
	(b)	For a storm of 3-hour durations, the rain fall rates are as follows	**07**

Time period (minute)	30	30	30	30	30	30
Rainfall rate (cm/hr)	3.5	3.0	12.0	8.5	6.0	1.5

If φ-Index is 5cm/hr, estimate the surface run-off. Also determine W-Index.

OR

Q.5	**(a)**	Discuss the infiltration indices.	**07**
	(b)	Define: 1)Unconfined aquifer	**07**
		2) Confined aquifer	
		3) Permeability	

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GUJARAT TECHNOLOGICAL UNIVERSITY
PDDC SEM-III Examination-Dec-2011

Subject code: X30601   **Date: 13/12/2011**
Subject Name: Hydrology & Water Resources Engineering
Time: 2.30 pm -5.00 pm   **Total marks: 70**

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

Q.1	**(a)**	Define and explain hydrological cycle with neat sketch	**07**
	(b)	Explain "Arithmetic mean method" to calculate average rainfall of a catchment area	**07**
Q.2	**(a)**	How the rainfall is measured? Explain non- recording type of rain gauge with neat sketch.	**07**
	(b)	Explain the Gumbel's method.	**07**
	(b)	A flood of a certain magnitude has a return period of 50 years 1) What is its probability of exceedance? 2) What is the probability that this flood may occur at least once in the next 25 years?	**07**
Q.3	**(a)**	Explain the method of determining direct run-off from a given storm hydrograph.	**07**
	(b)	What are the factors that affect run-off from a basin area	**07**
Q.3	**(a)**	Discuss the applications of the unit hydrograph in detail.	**07**
	(b)	What is S-hydrograph? Explain the method of construction of it.	**07**
Q.4	**(a)**	Define and explain: 1) Such age storage 2) Bank storage 3) Valley storage	**07**
	(b)	Discuss the methods to control the floods.	**07**
Q.4	**(a)**	Discuss the types of aquifers with neat sketches.	**07**
	(b)	How the capacity of a reservoir is determined?	**07**
Q.5	**(a)**	Write short note on "Thiessen Polygon method".	**07**
	(b)	Define and explain Ø-Index and W-index.	**07**
Q.5	**(a)**	Discuss the "California method "of flood frequency analysis.	**07**
	(b)	Write short note on rainwater harvesting.	**07**

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GUJARAT TECHNOLOGICAL UNIVERSITY
P.D.D.C Sem-III Examination May 2011

Subject code: X30601
Subject Name: Hydrology & Water Resources Engineering

Date:18/05/2011   **Time: 10.30 am – 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.**

Q.1 **(a)** What is hydrology? Explain the hydrology cycle with neat sketch.   **07**
    (b) Define the following terms: **07**
        (i) Evaporation (ii) Depth of runoff   (iii) Infiltration   (iv) Hyetograph
        (v) Base flow   (vi) Design flood   (vii) Basin

Q.2 **(a)** Explain with neat sketch the Thiessen polygon method of computing average   **07**
        rainfall over a catchment.
    (b) Determine the optimum number of rain gauges in a catchment area from the   **07**
        following data:
        (i)Number of existing rain gauges=8
        (ii) Mean annual rainfall at the gauges
          = 1000, 950, 900, 850, 800, 700, 600, and 400 mm
        (iii) Permissible error=6%

OR

    (b) What is evaporation? Discuss the various methods of measurement of   **07**
        evaporation

Q.3 **(a)** Define the term 'runoff'. Describe the various factors affecting runoff   **07**
    (b) For a storm of 2-hour durations, the rainfall rate are as follows: **07**

Time period (minutes)	20	20	20	20	20	20
Rainfall rate (cm/hr)	2.5	2.5	10.0	7.5	5.1	1.25

        If Ø-index is 3-cm/hr, estimate the surface runoff.
        Also determine w-index.

OR
Q.3 **(a)** What is flood? What are the causes of floods?   **07**
        Discuss the various methods of flood controls.
    (b) Explain the chance flood.   **07**
        What return period you would adopt in the design of a culvert on a drain if you
        are allowed to accept only 5% risk of flooding in the 25 years of expected life
        of the culvert?

Q.4 **(a)** What is hydrograph? Draw neat sketch of a storm hydrograph and explain its components. **07**

(b) What is unit hydrograph? **07**
The ordinates of a 3-hr. unit hydrograph are given bellow: Find out the ordinates of a 6-hr. unit hydrograph for the same basin.

Time (hr.)	0	3	6	9	12	15	18	21	24	27	30
O.U.H. of 3hr (cumecs)	0	10	25	20	16	12	9	7	5	3	0

OR

Q.4 **(a)** Discuss the surface and subsurface investigation of ground water. **07**
(b) Write short notes on: **07**
(i)Flood routing (ii) Flood forecasting and warning.

Q.5 **(a)** What is unit hydrograph? Which assumptions are made in unit hydrograph theory? Explain the method to find out the ordinates of unit hydrograph from the ordinates of a storm hydrograph. **07**

(b) The following are ordinates of 4-hr. unit hydrograph. Determine ordinates of a 12-hr. unit hydrograph for the catchment by s-curve method. **07**

Time (hr.)	0	4	8	12	16	20	24	28	32	36	40
O.U.H. of 4hr (cumecs)	0	40	90	100	130	80	70	50	30	10	0

OR

Q.5 **(a)** Discuss the applications of hydrology in practice **07**
(b) Explain with neat sketch the Symon's rain gauge. **07**

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GUJARAT TECHNOLOGICAL UNIVERSITY

P.D.D.C. Sem- III Examination December 2010

Subject code: X30601

Subject Name: Hydrology & Water Resources Engineering

Date: 11 /12 /2010   Time: 10.30 am – 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.**

Q.1 **(a)** Describe various methods of computing average rainfall over a basin. **07**

(b) What is meant by stream gauging? Describe the velocity area method used for stream gauging. **07**

Q.2 **(a)** Explain : Evaporation, Infiltration, Interception, Transpiration, Percolation **07**

(b) Estimate the equivalent uniform depths of 2-day rainfall over the basin and plot D-A-D curve for the following data. **07**

Isohyets (mm)	35-40	30-35	25-30	20-25	15-20	10-15
Area between Isohyets (sqkm)	35	56	78	120	65	18

OR

(b) The following are the rates of rainfall for successive 15 minutes period of a 90 minute storm : 2.8, 8, 6.5, 1.8, 3.5, 6 cm/hr. Taking the value of Ø-index as 3.0 cm/hr, find out the net runoff in cm., total rainfall and the value of W-index. **07**

Q.3 **(a)** What do you understand by Unit hydrograph? How is it derived? What are the uses of unit hydrograph? **07**

(b) Given below are the observed flows from a storm of 6-hr duration on a stream in m^3/s at 6-hr intervals. Basin area is 320 sqkm. Assuming constant base flow of 20 cumecs. **07**

20,110,250,200,160,120,90,75,55,35,20

Derive and plot a 6-hr unit hydrograph.

OR

Q.3 **(a)** Describe various methods of estimating evaporation from water bodies. **07**

(b) Describe how infiltration capacity rate can be measured using Double ring infiltrometer. **07**

Q.4 **(a)** What is Run-off ? What are the factors that affect the run-off from a Basin. **07**

(b) What is S-curve hydrograph? How is it constructed and what is it used for? **07**

OR

Q.4 **(a)** Enumerate the various methods used for estimating design flood discharge from a basin, and discuss any one of them in details. **07**

(b) Define flood routing. What are the uses of flood routing? **07**

Q.5 **(a)** Explain any one simulation model. **07**

(b) Explain: Specific yield, Storage co-efficient, Field capacity, Perched water table. **07**

OR

Q.5 **(a)** Explain Darcy's law for determining groundwater velocity. **07**

(b) Explain confined and unconfined aquifers with neat sketch. **07**

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