

Course Code	Course Name	L-T-P-Credits	Year of Introduction
<b>CE309</b>	<b>WATER RESOURCES ENGINEERING</b>	<b>3-0-0-3</b>	<b>2016</b>

**Pre-requisite : NIL**

**Course objectives**

- To impart knowledge regarding the availability of water on hydrosphere, its distribution and quantification
- To convey the knowledge on the scientific methods for computing irrigation water requirements
- To communicate fundamental knowledge on reservoir engineering and river engineering

**Syllabus**

Hydrologic cycle, Precipitation, Infiltration and Evaporation-measurement and data analysis. Runoff-components and computation, Hydrograph, Unit Hydrograph and S-Hydrograph. Irrigation types and methods-Soil water plant relationships, Frequency of irrigation, Computation of crop water requirement. Stream flow measurement -Stage-discharge curve. Meandering of rivers, river training works. Surface water systems: diversion and storage systems, reservoir - estimation of storage capacity and yield of reservoirs - reservoir sedimentation -useful life of reservoir. Groundwater - Aquifer types and properties - Steady radial flow into a well. Estimation of yield of an open well.

**Expected Outcome**

After successful completion of this course, the students will be able to :

- i. Describe the hydrologic cycle and estimate the different components
- ii. Determine crop water requirements for design of irrigation systems
- iii. Compute the yield of aquifers and wells.
- iv. Know the features of various river training works
- v. Estimate the storage capacity of reservoirs and their useful life.

**Text Books:**

1. Arora, K.R., "Irrigation, Water Power and Water Resources Engineering", Standard Publishers Distributors, New Delhi, 2009.
2. Garg S.K, Irrigation Engineering and Hydraulic Structures Khanna Publishers New Delhi 2006.
3. Modi. P. N. Irrigation, Water Resources and Water Power Engineering, S.B.H Publishers and Distributors New Delhi 2009.
4. Punmia B.C. Ashok K Jain, Arun K Jain, B. B. L Pande, Irrigation and Water Power Engineering, Laxmi Publications (P) Ltd. 2010.

**References:**

1. Asawa. G.L. Irrigation and Water Resources Engineering, New Age International, 2000
2. Ojha.C.S.P., R.Berndtsson, P. Bhunya, Engineering Hydrology, Oxford university Press, 2015.
3. Patra. K.C., Hydrology and Water Resources Engineering, CRC Press, 2010.
4. Sahasrabudhe S.R., Irrigation Engineering & Hydraulic Structures, S.K. Kataria & Sons, 2013.
5. Subramanya. K., Engineering Hydrology, Tata Mc Graw Hill, 2011
6. Todd D. K., Ground Water Hydrology, Wiley, 2005.
7. Ven Te Chow, David R Maidment, L.W Mays., Applied Hydrology, McGraw Hill, 1988
8. Warren Viessman, G.L. Lewis, Introduction to Hydrology, Pearson Education, 2003.

<b>COURSE PLAN</b>			
<b>Module</b>	<b>Contents</b>	<b>Hours</b>	<b>Sem. Exam Marks %</b>
<b>I</b>	Hydrologic cycle-precipitation-mechanism, types and forms. Measurement of rainfall using rain gauges-optimum number of rain gauges. Estimation of missing precipitation. Representation of rainfall data-mass curve and hyetograph. Computation of mean precipitation over a catchment. Design rainfall - probable maximum rainfall. Infiltration-measurement by double ring infiltrometer. Horton's model. Evaporation-measurement by IMD land pan, control of evaporation.	8	15
<b>II</b>	Runoff-components of runoff-methods of estimation of runoff-infiltration indices, Hydrograph analysis-Hydrograph from isolated storm-Base flow separation. Unit hydrograph -uses. Assumptions and limitations of unit hydrograph theory. Computation of storm/flood hydrograph of different duration by method of superposition and by development of S- Hydrograph.	8	15
<b>FIRST INTERNAL EXAMINATION</b>			
<b>III</b>	Irrigation- Necessity, Benefits and ill effects. Types: flow and lift irrigation - perennial and inundation irrigation. Methods: flooding, furrow, sprinkler and drip irrigation (concepts only, no design aspects/problems), Soil water plant relationships, soil moisture constants, Computation of crop water requirement: depth and frequency of Irrigation, Duty and delta, relationship, variation of duty, factors. Computation of design discharge of conveyance channels, Irrigation efficiencies. Consumptive use of water: concept of Evapotranspiration. (No detailed discussion on estimation procedures)	6	15
<b>IV</b>	Stream flow measurement: methods, Estimation of stream flow by area velocity method only, Stage discharge curve. Meandering of rivers, River training - objectives and classification, description of river training works.	6	15
<b>SECOND INTERNAL EXAMINATION</b>			
<b>V</b>	Surface Water system: diversion and storage systems, necessity. River flow: Flow duration Curve, Firm yield. Reservoirs-types of reservoirs, zones of storage reservoir, reservoir planning-storage capacity and yield of reservoirs-analytical method and mass curve method. Reservoir sedimentation: trap efficiency, methods for control. Computation of useful life of reservoir.	7	20
<b>VI</b>	Ground water : vertical distribution of groundwater, classification of saturated formation, water table, Aquifer properties : Porosity, Specific yield, specific retention, Types of aquifers. Darcy's law, co-efficient of permeability, Transmissibility. Wells- Steady radial flow into a fully penetrating well in Confined and Unconfined aquifers. Estimation of yield of an open well, pumping and recuperation tests. Tube wells - types.	7	20
<b>END SEMESTER EXAMINATION</b>			

**QUESTION PAPER PATTERN (End semester exam)**

**Maximum Marks :100**

**Exam Duration: 3 Hrs**

Part A -Module I & II : 2 questions out of 3 questions carrying 15 marks each

Part B - Module III & IV: 2 questions out of 3 questions carrying 15 marks each

Part C - Module V & VI : 2 questions out of 3 questions carrying 20 marks each

**Note :** 1.Each part should have at least one question from each module

2 Each question can have a maximum of 4 subdivisions (a, b, c, d)

