**19CE3104 – WATER RESOURCES ENGINEERING**

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| **Course Category**  | Professional Core | **Credits**  | 3 |
| **Course Type**  | Theory | **Lecture - Tutorial - Practical**  | 2- 1 - 0 |
| **Prerequisite**  | Fluid mechanics | **Sessional Evaluation** | 40 |
| **Semester End Exam Evaluation** | 60 |
| **Total Marks**  | 100 |

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| **Course****Objectives** | 1. To understand the basic concept of the water resources engineering, hydrological cycle and occurrence of precipitation, runoff relationships.
2. To impart knowledge on evapotranspiration and infiltration concepts.
3. To understand the theory of developing various forms of hydrographs.
4. To study various methods to determine the frequency and intensity of floods.
5. To understand various flood control managements and national policy in India.
6. To understand the aquifer parameters and its influence on movement and occurrence of groundwater.
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| **Course Outcomes** | CO1 | Understand the theories and principles governing the hydrologic processes. |
| CO2 | Determine the loss due to evapotranspiration and infiltration.  |
| CO3 | Determine the runoff due to precipitation and develop runoff hydrographs. |
| CO4 | Develop unit hydrograph and synthetic hydrograph to estimate flood magnitude. |
| CO5 | Assess and analyze floods and flood control measures. |
| CO6 | Determine aquifer parameters and yield of wells. |
|  | **UNIT – I****INTRODUCTION:** Definition and scope; Hydrologic cycle; Sources of hydrological data. **PRECIPITATION:** Forms of precipitation; Measurement of precipitation; Rain gauge network; Preparation and presentation of rainfall data; Mean precipitation of rainfall data; Depth-Area-Duration relationship; Frequency of point rainfall Maximum Intensity/Depth-Duration-Frequency relationship; Probable maximum Precipitation (PMP). |

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| **Course Content** | **UNIT – II****ABSTRACTIONS FROM PRECIPITATION:** Evaporation process; Evaporimeters; Empirical evaporation equations; Analytical methods - estimation of evaporation and transpiration. **EVAPOTRANSPIRATION:** Measurement of evapotranspiration; Evapotranspiration equations – Potential evapotranspiration and Actual evapotranspiration; Infiltration; Factors affecting infiltration; Infiltration indices.**UNIT – III****RUNOFF:** Runoff characteristics; Factors affecting runoff – Catchment characteristics; Flow-duration curve; Flow-mass curve.**HYDROGRAPHS:** Components of hydrograph; Base flow separation; unit hydrograph – Derivation of unit hydrograph – Unit hydrograph of different durations – Uses and limitations of unit hydrograph – Duration of the unit hydrograph; S-curve hydrograph; Instantaneous unit hydrograph.**UNIT – IV****FLOODS:** Introduction– Rational method– Empirical formulae – Unit hydrograph method; Flood frequency studies – Gumbel’s method – Log-Pearson type III distribution; Partial duration series; Regional flood; Frequency analysis; Data for frequency studies; Design flood – Design storm – Risk, reliability and safety factor.**UNIT – V****FLOOD CONTROL:** Flood control – Introduction; Classification of methods for flood control or management; Flood control reservoir; Channel improvement; Floodways; Evacuation of flood-plain zoning; Land management and flood control; Flood plain management; Economic flood control; Estimating the benefits of flood control; Broad outline of the national policy on flood – India.**UNIT – VI****GROUNDWATER:** Introduction – Forms of subsurface water; Saturated formation; Aquifer properties; Geologic formations as aquifers; Equation of motion; Wells – Steady flow into a well – Open wells; Unsteady flow in a confined aquifer; Well loss – Specific capacity; Sea-water intrusion – Recharge. |
| **Textbooks****and** **References** | **TEXTBOOKS:**1. K. Subramanya, *Engineering Hydrology*, Tata McGraw-Hill Education Pvt. Ltd, 5th edition, 2017.
2. P. Jayarami Reddy, *Engineering Hydrology*, Laxmi Publications Pvt. Ltd., 3rd edition, 2016.
3. P.N. Modi, *Irrigation water resources and water power engineering,* Standard Book House publication, 11th Edition, 2019.

**REFERENCES:**1. K.N. Duggal and J.P. Soni, *Elements of water resources engineering*, New Age International Publishers, 2nd edition, 2005.
2. G.L. Asawa, *Irrigation Engineering*, New Age International Publishers, 2nd edition, 2000.
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**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|   | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO 1** | 2 | - | - | 2 | - | - | 1 | - | - | - | - | 1 |
| **CO 2** | 3 | 2 | - | 1 | 1 | - | 1 | - | 1 | - | - | 1 |
| **CO 3** | 2 | - | - | 2 | 1 | - | 1 | - | 1 | - | - | 2 |
| **CO 4** | 2 | - | - | 1 | 1 | - | 1 | - | - | - | - | 1 |
| **CO 5** | 1 | - | - | 2 | 1 | - | 1 | - | 2 | - | - | 1 |
| **CO 6** | 2 | 2 | - | 1 | - | - | 1 | - | 1 | - | - | 1 |