| Course Type | Course Code | Name of Course | L | T | P | Credit |
|---|---|---|---|---|---|---|
| OE | ESO401 | Climate Change Impacts on Water Resources | 3 | 0 | 0 | 9 |

**Course Objective**

This course has been designed to make the students conversant with the fundamental concepts of water resources and the climate system and the impact of climate change on water quantity and quality.

**Learning Outcomes**

Upon successful completion of this course, students will:

- Understand the basic concepts of the climate system, water and energy balance. Learn how hydrologic data is collected/ modelled and the impact of climate change on different components of the hydrologic cycle.
- Learn the major issues associated with climate change-related studies and climate change adaptation in water resources.

| Unit No. | Topics to be Covered | Lecture Hours | Learning Outcome |
|---|---|---|---|
| 1 | *Global Climate System*: weather and climate, climate classification, climate variability and change, drivers of change, detection and attribution of climate change. | 6 | Gain an overview of the climate system and variability. |
| 2 | *Energy Balance, and the Hydrological Cycle:* energy balance, water balance, the study of water resources, and classification of water resources in India.<br>Current Scenario: water scarcity and water stress at the global and regional scale, issues associated with water management, adaptation and mitigation measures, and climate change analysis over India. | 8 | Learn the basic concepts of different hydrologic processes and the current state of water stress and scarcity across the globe. |
| 3 | *Atmospheric and surface systems:* precipitation, abstraction - evapotranspiration, infiltration, percolation, initial losses, mechanism of flow in a watershed, surface/sub-surface flow, streamflow, stream and basin characteristics. | 9 | Learn the meteorology and climatology of primary and secondary hydrologic variables. |
| 4 | *Sub-surface systems:* soil water content, soil characteristics, groundwater flow, groundwater table and well hydraulics. | 4 | Field measurement and modelling of sub-surface systems. |
| 5 | *Impact on water quantity and quality – local and global perspective*: rainfall and temperature variability, impact of climate change on abstraction, climate and land-use change impact on surface and sub-surface flow, climate change and soil water content, impact on drought and flood, current state and future projection of extreme events, and impact on water quality. | 9 | Learn the impact of climate change and the dynamic terrestrial environment on different components of the hydrologic cycle. |

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|---|---|---|---|
| 6 | • *Major issues and adaptation in water*: uncertainty in climate change studies, vulnerability assessment, climate change adaptation in water resources, managing climate risk for the water sector with tools and decision support, and international negotiations on climate change and water. | 6 | Learn the challenges associated with climate change-related studies and effective adaptation measures in the water sector. |

**Text Books:**


1. Chow, T. V., Maidment, R. D., & Mays, L. W. (1988)., *Applied Hydrology*, McGraw-Hill, Inc., ISBN 0-07-010810-2.
2. Babel, M. S., Shrestha, S., & Pandey, V. P. (Eds.). (2014). *Climate Change and Water Resources*. CRC Press


**Reference Books:**


1. Subramanya, K. (2017). *Engineering Hydrology*, 4th Edition, McGraw Hill Education (India) Private Limited, New Delhi, ISBN (13) : 978-1-25902997-4, ISBN (10) : 1-25-902997-2.
2. Nagesh Kumar, D., & Raju, K. S. (2017). *Impact of Climate Change on Water Resources*. Springer Nature Singapore.