Pimpri Chinchwad Education Trust's

# PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

An Autonomous Institute Approved by AICTE and AffiliATed to SPPU, Pune

## Curriculum Structure and Syllabus
## Of
## Honors In
## Water Management in Changing Climate Scenario

## (Regulations 2023)

Effective from Academic Year 2026-27

## Institute Vision

To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value-Added Quality Education through a matching ecosystem for building successful careers.

## Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institute.
2. Imparting right Attitude, Skills, Knowledge for self-sustenance through Quality Education
3. Creating globally competent and Sensible engineers, researchers and entrepreneurs with ability to think and act independently in demanding situations

## EOMS Policy

“We at PCCOE are committed to offer exemplarily Ethical, Sustainable and Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders.

We shall strive for technical development of students by creating globally competent and sensible engineers, researchers and entrepreneurs through Quality Education.

We are committed for Institute’s social responsibilities and managing Intellectual property.

We shall achieve this by establishing and strengthening state-of-the-art Engineering Institute through continual improvement in effective implementation of Educational Organizations Management Systems (EOMS).”

# Course Approval Summary

**Board of Studies - Department of Civil Engineering**

| Sr. No. | Name of the Course | Course Code | Sem | Page number | Signature and stamp of BoS chairman |
|---|---|---|---|---|---|
| 1 | Water, Climate and Sustainability | BCI25HN21 | V | 10 | |
| 2 | Hydrology and Environment System Lab | BCI25HN22 | V | 12 | |
| 3 | Urban Hydrology | BCI26HN23 | VI | 14 | |
| 4 | Geographical Information System (GIS) Lab | BCI26HN24 | VI | 16 | |
| 5 | Ground Water Management | BCI27HN25 (A)/ BCI28HN29 (B) | VII/ VIII | 18 | |
| 6 | Seminar | BCI27HN26 (A)/ BCI28HN30 (B) | VII/ VIII | 20 | |
| 7 | Mini Project | BCI28HN27 (A)/ BCI27HN28 (B) | VIII / VII | 22 | |

13/6/24
Chairman
BoS, Civil Engineering
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

"Knowledge Brings Freedom"

**Approved by Academic Council:**

Chairman
Academic Council
PCET's, Pimpri Chinchwad College of Engineering
Sector No. 26, Pradhikaran, Nigdi, Pune-44

Chairman, Academic Council
Pimpri Chinchwad College of Engineering

# Preface

Looking at Global Scenario to enhance the employability skills and impart deep knowledge in emerging/ multidisciplinary areas, an additional avenue is provided to passionate learners through the Minors and Honors Degree Scheme in academic structure.

For the Honors degree program, students have to earn additional 20 credits in an emerging area of one's own domain.

**Objectives of Honors Degree**

- To enable students to pursue allied academic interest in contemporary areas.
- To provide effective yet flexible options for students to achieve basic to intermediate level competence in the contemporary area.
- To enhance the employability skills with different combinations of competencies and flavors.
- To provide an academic mechanism for fulfilling demand of specialized areas from industries for higher order skill jobs.
- To provide a strong foundation to students aiming to pursue research/ higher studies in the contemporary field of study.

# Preface of Honor in Water Management in Changing Climate Scenario

In the face of a rapidly changing climate, sustainable water management has emerged as a critical challenge and responsibility. Civil Engineering plays a pivotal role in designing resilient water infrastructure and adaptive systems. From efficient stormwater management to climate-resilient water supply networks, engineers are shaping future-ready solutions. This honor acknowledges the efforts of professionals and researchers working tirelessly to safeguard water resources. Their innovations in hydrology, wastewater treatment, and groundwater recharge reflect engineering excellence. Amid rising uncertainties, civil engineers are bridging the gap between technology and environmental stewardship. This recognition serves to inspire young engineers to embrace sustainable design and proactive planning. It is a tribute to those integrating traditional knowledge with modern engineering tools. We salute the visionaries committed to water security and climate resilience.Their dedication paves the way for a sustainable and water-sensitive future.

## Learning Objectives

This Course Aims

- Impart knowledge of climate change influences on water resources and the associated vulnerabilities and risks
- Build facts related to urban hydrology to study the impacts of urbanization on stormwater quantity and quality
- Comprehend the surface water and groundwater hydrology and chemical biological phenomena as related to water quality for drinking water, agriculture, ecosystems, and industry. (Lab)
- Impart the concept of Integrated Water Resources Planning and Management in relation to climate change.
- Enhance the knowledge of Geospatial techniques for Water Resources Management in various aspects.

## . Learning Outcomes

After the successful completion of the honor course, students will be

- Interpret the effect of climate change on water resources and sustainability
- Understand the impact of urbanization on hydrology
- Apply knowledge to adopt water management plans with respect to demand versus supply fluctuations in the future.
- Solving the problems related to the hydrological cycle, estimation of hydrological parameters and water budget with the help of RS&GIS

# INDEX

# LIST OF ABBREVIATIONS IN CURRICULUM STRUCTURE

| Sl. No | Abbreviation | Expansion |
|---|---|---|
| 1 | L | Lecture |
| 2 | P | Practical |
| 3 | T | Tutorial |
| 4 | H | Hours |
| 5 | CR | Credits |
| 6 | FA | Formative Assessment |
| 7 | SA | Summative Assessment |
| 8 | TW | Term Work |
| 9 | OR | Oral |
| 10 | PR | Practical |
| 11 | PROJ | Project |

# CURRICULUM STRUCTURE

## For Honors in Water Management in Changing Climate Scenario (Civil Engineering)

| Scheme A & B | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester | Course Codes | Course Name | Teaching Scheme | | | | CR | Evaluation Scheme and Marks | | | | | | |
| | | | L | P | T | H | | FA 1 | FA 2 | SA | TW | PR | OR | Total |
| V | BCI25HN21 | Water, Climate and Sustainability | 3 | - | - | 3 | 3 | 20 | 20 | 60 | - | - | - | 100 |
| V | BCI25HN22 | Hydrology and Environment System Lab | - | 2 | - | 2 | 1 | - | - | - | - | - | 25 | 25 |
| VI | BCI26HN23 | Urban Hydrology | 3 | - | - | 3 | 3 | 20 | 20 | 60 | - | - | - | 100 |
| VI | BCI26HN24 | Geographical Information System (GIS) Lab | - | 2 | - | 2 | 1 | - | - | - | 25 | - | - | 25 |
| VII | BCI27HN25 | Ground Water Management | 3 | - | - | 3 | 3 | 20 | 20 | 60 | - | - | - | 100 |
| VII | BCI27HN26 | Seminar | - | 4 | - | 4 | 2 | - | - | - | 30 | - | 20 | 50 |
| VIII | BCI28HN27 | Mini Project | - | 10 | - | 10 | 5 | - | - | - | 75 | - | 50 | 125 |
| | | **Total** | **9** | **18** | **-** | **27** | **18** | **60** | **60** | **180** | **105** | **-** | **95** | **525** |

| Scheme B | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester | Course Codes | Course Name | Teaching Scheme | | | | CR | Evaluation Scheme and Marks | | | | | | |
| | | | L | P | T | H | | FA 1 | FA 2 | SA | TW | PR | OR | Total |
| V | BCI25HN21 | Water, Climate and Sustainability | 3 | - | - | 3 | 3 | 20 | 20 | 60 | - | - | - | 100 |
| V | BCI25HN22 | Hydrology and Environment System Lab | - | 2 | - | 2 | 1 | - | - | - | - | - | 25 | 25 |
| VI | BCI26HN23 | Urban Hydrology | 3 | - | - | 3 | 3 | 20 | 20 | 60 | - | - | - | 100 |
| VI | BCI26HN24 | Geographical Information System (GIS) Lab | - | 2 | - | 2 | 1 | - | - | - | 25 | - | - | 25 |
| VII | BCI27HN28 | Mini Project | - | 10 | - | 10 | 5 | - | - | - | 75 | - | 50 | 125 |
| VIII | BCI28HN29 | Ground Water Management | 3 | - | - | 3 | 3 | 20 | 20 | 60 | - | - | - | 100 |
| VIII | BCI28HN30 | Seminar | - | 4 | - | 4 | 2 | - | - | - | 25 | - | 25 | 50 |
| | | **Total** | **9** | **18** | **-** | **27** | **18** | **60** | **60** | **180** | **105** | **-** | **95** | **525** |

L- Lecture, T- Tutorial, P- Practical, H-Hours, CR- Credit, FA – Formative Assessment, SA –Summative Assessment, TW – Term Work, PR- Practical Exam, OR – Oral Exam

# Course syllabus

## Semester-V

## Honors in

## Water Management in Changing Climate Scenario

| Program: | B. Tech. (Civil Engineering) - Honors Water Management in Changing Climate Scenario | | | Semester: | | V | |
|---|---|---|---|---|---|---|---|
| Course: | Water, Climate and Sustainability | | | Code: | | BCI25HN21 | |
| Credits | Teaching Scheme (Hrs/Week) | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | FA | | SA | Total |
| | | | | FA1 | FA2 | | |
| 3 | 3 | - | - | 20 | 20 | 60 | 100 |

**Prior Knowledge:**

1. Basic Environmental Science
2. Environmental Engineering

**Course Objectives:** This course aims to enable students,

1. To understand the interlinkages between the environment, climate change, and water systems.
2. To identify the causes, consequences, and global implications of climate change, particularly on water resources.
3. To explore strategies, policies, and technologies for adapting water systems to climate risks and mitigating.
4. To develop an understanding of sustainable and integrated approaches to water resource management under climate stress.
5. To familiarize students with emerging technologies for water resource monitoring, planning, and smart usage aligned with climate adaptation.
6. To highlight the role of community participation, traditional knowledge, and ethical frameworks in climate-resilient water management.

**Course Outcomes:** After learning the course, the students should be able to:

1. Explain the basic concepts of environmental systems and climate change, including natural and anthropogenic drivers.
2. Assess the impacts of climate change on water resources, such as groundwater depletion, altered precipitation, and extreme weather events.
3. Identify and recommend appropriate adaptation and mitigation techniques for climate-resilient water infrastructure and policies.
4. Apply IWRM principles and evaluate sustainable water practices, including nature-based and community-based solutions.
5. Analyze and suggest applications of tools like GIS, IoT, AI, and climate-resilient agriculture for sustainable water use.
6. Examine community-led initiatives and interdisciplinary approaches for equitable and localized water management.

**Detailed Syllabus**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Introduction to Environmental and Climate Change:** Components and types of environments, Interdependence of environment components, Causes and consequences of environmental degradation, Resource depletion, Pollution types, sources and effects, Environmental indicators and global concerns, Factors influencing climate, Global climate zones and regional climate patterns, Natural vs. anthropogenic (human-induced) causes of climate change, Role of greenhouse gases ($CO_2$, $CH_4$, $N_2O$, etc.) and greenhouse effect. | 7 |
| 2 | **Climate Change Impacts on Water Resources:** Global warming potential of various gases, melting glaciers, rising sea levels, and changing precipitation patterns, Extreme weather events (droughts, floods, hurricanes), Impact on biodiversity, agriculture, and water resources, impacts on groundwater recharge rates, Impact on surface water sources: rivers, lakes, and reservoirs, Groundwater depletion and overextraction under stress conditions, Prolonged droughts impacting agriculture and rural livelihoods with Case studies. | 8 |
| 3 | **Climate Change Adaptation and Mitigation** Climate-resilient water Infrastructure and Policy, Adaptive planning of dams, canals, storage systems, Early warning systems and climate forecasting tools, the Role of remote sensing, GIS, | 8 |

| | | |
|---|---|---|
| | and IoT in smart water management, the National Water Mission, Jal Shakti Abhiyan, AMRUT, Sustainable Development Goals, and international frameworks: UNFCCC, Paris Agreement, etc. with case studies. | |
| **4** | **Sustainable Water Management Practices:** Fundamentals of Integrated Water Resources Management (IWRM), Demand-side vs. supply-side management, Watershed management, aquifer recharge, rainwater harvesting, Urban water planning and green infrastructure, Water recycling, reuse, and circular water economy, Case study on any sustainable water management concerning climate change impacts. | 7 |
| **5** | **Application of Technology and Innovation:** Concepts and application of Remote sensing and GIS for water resource mapping and monitoring, IoT and AI for smart irrigation and water use tracking, Mobile apps for water quality monitoring and farmer advisories, Climate-resilient crop varieties to optimize water usage with real-life examples and case study. | 8 |
| **6** | **Community Engagement and Strategies:** Role of community-led water initiatives (Pani Panchayats, Jal Swaraj), Interdisciplinary approaches: engineering, economics, social sciences, Water equity, climate justice, and ethical sustainability, Participatory planning and local-level adaptation strategies, Case studies on Hiware Bazar (India), Singapore NEWater, Australia's Murray-Darling Basin. | 7 |
| | **Total** | 45 |

**Text Books:**

1. "Climate Change and Water Resources" by M. Monirul Qader Mirza, Q.K. Ahmad.
2. "Integrated Water Resources Management: Concept, Research and Implementation" by Peter P. Mollinga, Ajaya Dixit, Uschi Kelkar.
3. "Environmental Science: Toward a Sustainable Future" by Richard T. Wright & Dorothy F. Boorse

**Reference Books:**

1. "The Climate-Resilient Organization: Adaptation and Resilience in Water Resources Management" by Martin Powell
2. "Sustainable Water Management: Guidelines for Practice" by Julie R. C. Barnes

**e-Resources**

1. **https://nwm.gov.in National Water Mission (India) Portal**
2. **https://www.unwater.org/ United Nations Water Resources Portal**
3. **https://www.fao.org/climate-change/en/ Water and Climate Change Knowledge Hub**
4. **https://www.coursera.org/learn/global-warming Global Warming: The Science and Modeling of Climate Change**

| Program: | B. Tech. (Civil Engineering) - Honors Water Management in Changing Climate Scenario | | | Semester: | | | V |
|---|---|---|---|---|---|---|---|
| Course: | Hydrology and Environment Systems Lab | | | Code: | | | BCI25HN22 |
| Credits | Teaching Scheme (Hrs/Week) | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | TW | OR | PR | Total |
| 1 | - | 2 | - | 25 | - | - | 25 |

**Prior Knowledge:** Fluid mechanics

**Course Objectives :**

1. To impart knowledge to collect and analyze environmental data related to storm water, air, and water quality.
2. To provide Knowledge to apply models and design tools for runoff estimation, validation, and stormwater channel design.
3. To impart knowledge to assess environmental conditions using field measurements and quality indices.

**Course Outcomes:** After learning the course, the students should be able to:

1. Students will be able to monitor and analyze stormwater, air, and water quality data using field and lab methods.
2. Students will demonstrate the ability to model rainfall-runoff processes and design basic stormwater infrastructure.
3. Students will evaluate environmental quality using standard indices and interpret the impact of land use and climate factors.

**Detailed Syllabus**

**Term work consists of (Solve any 5)**

1. Rainfall Runoff Modeling to study Effect of Land Use Change on Runoff Volume and Peak Discharge
2. Stormwater Monitoring and Model validation using field data
3. Layout and hydraulic design of a simple storm water channel
4. Air temperature, humidity & wind speed measurement (using Portable Weather Station)
5. Measurement of Ambient Air Quality (PM2.5, PM10, SO2, NOx)
6. Water Quality Index (WQI) Calculation
7. Study of Wastewater Characterization

**Text Books:**



1. Hydrology and Water Resources Engineering by K. Subramanya, McGraw Hill Education
2. Hydrology: Principles, Analysis, and Design by H.M.Raghunath, New Age International
3. Environmental Engineering by Gerard Kiely, McGraw Hill Education

**Reference Books:**

1. Urban Hydrology, Hydraulics, and Stormwater Quality: Engineering Applications and Computer Modeling, A. Osman Akan and Robert J. Houghtalen, Wiley Publications.
2. Handbook of Hydrology by David R. Maidment, McGraw-Hill Publications.
3. Hydrologic Analysis and Design by Richard H. McCuen, Pearson Publications
3. Air Pollution: Its Origin and Control by Kenneth Wark, Cecil F. Warner, and Wayne T. Davis, Pearson Publications.
4. Standard Methods for the Examination of Water and Wastewater by APHA (American Public Health Association)
5. Water Quality Assessments - A Guide to Use of Biota, Sediments and Water in Environmental Monitoring by Deborah V. Chapman, UNESCO/WHO/UNEP Publications

**e-Resources:**

1. https://www.epa.gov/water-research/storm-water-management-model-swmm
2. https://www.who.int/publications/i/item/9789241549950

# Course syllabus

## Semester-VI

## Honors in

## Water Management in Changing Climate Scenario

| Program: | B. Tech. (Civil Engineering) - Honors Water Management in Changing Climate Scenario | | | Semester: | | VI | |
|---|---|---|---|---|---|---|---|
| Course: | Urban Hydrology | | | Code: | | BCI26HN23 | |
| Credits | Teaching Scheme (Hrs/Week) | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | FA | | SA | Total |
| | | | | FA1 | FA2 | | |
| 3 | 3 | - | - | 20 | 20 | 60 | 100 |

**Prior Knowledge:**
1. Basic Hydrology
2. Fluid Mechanics and Hydraulics
3. Environmental Engineering Principles

**Course Objectives:** This course aims at enabling students,
1. To understand the fundamentals of urban hydrology and its importance in urban water management.
2. To comprehend rainfall-runoff processes and their significance in urban catchments.
3. To learn about the design and operation of urban drainage systems.
4. To analyze the causes and impacts of urban flooding.
5. To explore sustainable urban water management practices and green infrastructure solutions.
6. To assess the effects of climate change on urban hydrology and identify adaptation strategies.

**Course Outcomes:** After learning the course, the students should be able to:
1. Explain the basic concepts, principles, and relevance of urban hydrology in the context of water management.
2. Analyze rainfall and runoff processes in urban areas using appropriate methods and tools.
3. Design and evaluate urban drainage systems considering urban infrastructure and hydrologic processes.
4. Identify and assess urban flooding issues and their causes using hydrologic data and mapping techniques.
5. Apply sustainable urban water management practices, including green infrastructure and BMPs, to mitigate flooding and enhance water quality.
6. Evaluate the impacts of climate change on urban hydrology and propose adaptation and resilience strategies for urban water systems.

**Detailed Syllabus**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Introduction to Urban Hydrology**<br>Importance and scope of urban hydrology: Definition, objectives and Role, Importance in sustainable urban planning and infrastructure ; Impact of urbanization on hydrological cycle: Impervious surfaces, reduced infiltration, surface runoff quantity and timing, Decreased groundwater recharge; Key differences between rural and urban catchments: land use and surface cover, runoff generation and flow characteristics, Influence of engineered drainage systems in urban areas, Changes in hydrograph response and lag time; Concept of runoff coefficient and imperviousness: Definition and significance of runoff coefficient, Factors affecting runoff coefficient in urban areas | 8 |
| 2 | **Rainfall and Runoff Processes:**<br>**Precipitation characteristics in urban areas:** Types of precipitation (convective, frontal, orographic), Spatial and temporal variability of rainfall, Influence of urban heat island on precipitation, Intensity-Duration-Frequency (IDF) curves Estimation of runoff using rational method and empirical equations | 7 |
| 3 | **Urban Drainage Systems**<br>**Components of urban drainage systems:** Stormwater inlets, pipes, channels, and detention basins, Combined and separate sewer systems, Outfalls and receiving water bodies; **Stormwater drainage design principles:** Hydrologic design criteria and standards, Hydraulic design and capacity analysis, Design storm selection and safety factors; Challenges in managing urban drainage | 8 |

| | | |
|---|---|---|
| **4** | **Flooding in Urban Areas**<br>**Urban flooding: causes and impacts:** Natural and anthropogenic causes of urban floods, Social, economic, and environmental impacts; Floodplain encroachment and drainage system overload**,** Land use changes affecting infiltration and runoff, Climate variability and extreme precipitation events, Flood hazard mapping and risk assessment, Case studies of urban flooding events: Examples from local and international cities, Causes, responses, and lessons learned, Flood mitigation strategies applied | 7 |
| **5** | **Sustainable Urban Water Management**<br>Best Management Practices (BMPs) and Low Impact Development (LID), Green infrastructure for stormwater management, Rainwater harvesting and reuse, Urban water sensitive design principles | 8 |
| **6** | **Urban Hydrology and Climate Change**<br>Climate change impacts on urban hydrology, Changing rainfall patterns and flood risks, Adaptation and mitigation strategies, Urban resilience in the context of climate change | 7 |
| | **Total** | 45 |

**Text Books:**

1. Urban Hydrology by Osman Akan (CRC Press, 1993)
2. Urban Stormwater Hydrology by Osman Akan and Robert Houghtalen (Technomic Publishing, 2003)
3. Stormwater Management for Smart Growth by Allen P. Davis, Richard H. McCuen (Springer, 2005)
4. Urban Water Resources by Vijay Singh and Ram Narayan Yadava (CRC Press, 2023)
5. Design of Urban Stormwater Controls by American Society of Civil Engineers (ASCE Manuals and Reports on Engineering Practice No. 77, 2012)

**Reference Books:**

1. Hydrology and Floodplain Analysis by Philip B. Bedient, Wayne C. Huber, and Baxter E. Vieux (Pearson, 2018)
2. Handbook of Hydrology by David R. Maidment (McGraw Hill, 1993)
3. Urban Water Engineering and Management by Mohammad Karamouz, Ali Moridi, and Sara Nazif (CRC Press, 2010)
4. Urban Drainage by David Butler and John Davies (CRC Press, 2017)
5. Manual on Drainage in Urbanized Areas by World Meteorological Organization (WMO, 1986, two volumes)
6. Sustainable Stormwater Management: A Landscape-Driven Approach to Planning and Design by Tom Liptan (Timber Press, 2017)
7. Sustainable Urban Drainage Systems (SUDS) Manual by CIRIA (C753, 2015)

**e-Resources**

1. US EPA Stormwater Management Resources: EPA Stormwater: Stormwater Discharges from Municipal Sources | US EPA
2. World Bank Urban Flood Risk Management: World Bank Document: https://www.gfdrr.org/en/publication/urban-flood-risk-management-toolbox
3. CIRIA SuDS (Sustainable Urban Drainage Systems) Guidance: CIRIA SuDSFEMA SuDS Manual
4. Urban Floodplain Management Resources: FEMA Floodplain Management: Floodplain Management | FEMA.gov

| Program: | B. Tech. (Civil Engineering) | | | Semester: | | | VI |
|---|---|---|---|---|---|---|---|
| Course: | Geographical Information System (GIS) Lab | | | Code: | | | BCI26HN24 |
| Credits | Teaching Scheme (Hrs/Week) | | | Evaluation Scheme and Marks | | | |
| | Lecture | Practical | Tutorial | TW | OR | PR | Total |
| 1 | - | 2 | - | 25 | - | - | 25 |

**Prior Knowledge:** Fundamentals of survey

**Course Objectives:**

1. To learn basic GIS tools for handling and mapping water-related data.
2. To understand the use of GIS in analyzing water resources under changing climate conditions.

**Course Outcomes:** After learning the course, the students should be able to:

1. Use GIS software to prepare maps related to water resources and watersheds.
2. Analyze water-related spatial data to support simple water management decisions.

**Detailed Syllabus**

**Term work consists of (any 8):**

1. Familiarization with GIS Software: Introduction to QGIS/ArcGIS interface, tools, layers, and basic map operations.
2. Assessment of Open Data Sources and Data Download: Exploring open geospatial data portals and downloading free datasets.
3. Coordinate Systems and Map Projections: Understanding coordinate reference systems and setting appropriate projections for spatial data.
4. Google Earth Data Usage for Base Map Creation: Using Google Earth imagery for base map preparation and importing into GIS.
5. Digitization of Water Features: Digitizing rivers, streams, lakes, reservoirs, and drainage networks from toposheets, base maps or satellite images.
6. Slope and Elevation Analysis: Generating slope and elevation maps from DEM data for water flow understanding.
7. Flow Direction Analysis: Determination of flow direction using DEM for surface runoff analysis.
8. Flow Accumulation Analysis: Estimation of flow accumulation to identify potential stream paths.
9. Stream Network Analysis: Extraction and analysis of stream networks from flow accumulation data.
10. Basin / Watershed Generation: Generation of drainage basins and watersheds using hydrological tools.
11. Buffer Analysis for Water Bodies: Creation of buffer zones around rivers, lakes, and reservoirs for water resource protection and management.
12. Preparation of Thematic Maps: Creation of thematic maps such as rainfall, drainage, water bodies, or elevation maps.

**Text Books:**

1. Bhatta, B. – Remote Sensing and GIS (Oxford University Press, 2011)
2. Lillesand, T., Kiefer, R., & Chipman, J. – Remote Sensing and Image Interpretation (Wiley, 7th Ed., 2015)
3. Remote Sensing & Geographical Information System, M. Anji Reddy, BS Publications, Hyderabad, 4th Edition, 2022

**Reference Books:**

1. Textbook on Remote Sensing, C. S. Agarwal and P. K. Garg, Wheeler Publishing House, 2000.
2. Campbell, J. B., & Wynne, R. H. – Introduction to Remote Sensing (Guilford Press, 5th Ed., 2011)
3. Chang, K. – Introduction to Geographic Information Systems (McGraw Hill, 9th Ed., 2019)

**e-Resources**

1. https://www.bis.gov.in/standards/technical-department/national-building-code/
2. https://mohua.gov.in/upload/uploadfiles/files/Chap-4.pdf3

# Course syllabus

## Semester-VII

## Honors in

## Water Management in Changing Climate Scenario

| Program: | B. Tech. (Civil Engineering) - Honors Water Management in Changing Climate Scenario | | | Semester: | | VII | |
|---|---|---|---|---|---|---|---|
| Course: | Ground Water Management | | | Code: | | BCI27HN25 **(A)/** BCI28HN29 **(B)** | |
| | Teaching Scheme (Hrs/Week) | | | Evaluation Scheme and Marks | | | |
| Credits | Lecture | Practical | Tutorial | FA1 | FA2 | SA | Total |
| 3 | 3 | - | - | 20 | 20 | 60 | 100 |

**Prior Knowledge: Hydrology and Water Resources Engineering**

**Course Objectives :**

1. To impart knowledge of fundamentals of groundwater and well hydraulics
2. To impart knowledge of environmental impacts on Groundwater
3. To impart knowledge on groundwater quality
4. To impart knowledge on various aspects of groundwater recharge
5. To impart knowledge on groundwater modelling techniques and ground water management.

**Course Outcomes:** After learning the course, the students should be able to:

1. Students will be able to gain knowledge on fundamentals of groundwater
2. Students will be able to evaluate yield through Aquifer.
3. Students will be able to apply the knowledge of Environment Impacts on groundwater
4. Students will be able to gain the knowledge of groundwater quality
5. Students will be able to apply various groundwater recharge techniques
6. Students will be able to apply groundwater modelling and management techniques

**Detailed Syllabus**

| Unit | Description | Duration (H) |
|---|---|---|
| 1 | **Introduction**<br>Introduction of Groundwater resources : Global and Indian Perspective , Occurrence of Groundwater Groundwater in hydrologic cycle , Groundwater utilization and historical background, Aquifers and their types and important terms related to groundwater. | 7 |
| 2 | **Groundwater Well Hydraulics**<br>Geophysical methods in groundwater exploration , Steady unidirectional flow, Steady radial flow to a well , multiple well systems , well completion / protection / rehabilitation . | 8 |
| 3 | **Environmental Impacts on Groundwater:**<br>Temporal variation of groundwater levels,groundwater-surface water interaction, evapotranspirative fluctuations,meteorological fluctuations, tidal fluctuations, impacts of urbanization,earthquakes and external loads on groundwater, land subsidence. | 7 |
| 4 | **Pollution and Groundwater Quality**<br>Sources and Causes of Pollution ,attenuation,Dissolved constituents in groundwater and their effects ,mechanism of salt water intrusion,groundwater restoration , case history | 7 |
| 5 | **Artificial Groundwater Recharge**<br>Introduction,Current trends in artificial recharge , recharge mounds and induced recharge, injection wells ,water spreading technical feasibility and economic viability. | 8 |
| 6 | **Models in Groundwater Analysis and Management**<br>Major application of Groundwater Models, Groundwater modelling through porous media , design, construction**,** operation and maintenance of injection wells and spreading basins, RS, GIS and MCDM techniques for groundwater management, selected case studies**.** | 7 |

| | | |
|---|---|---|
| | **Total** | **45** |

**Text Books:**

1. Hydrology and Water Resources Engineering by K. Subramanya, McGraw Hill Education
2. Hydrology: Principles, Analysis, and Design by H.M.Raghunath, New Age International
3 D.K. Todd, L.W. Mays, Groundwater Hydrology, Wiley, 2004.

**Reference Books**

1. F. Schwarz, H. Zhang, Fundamentals of Ground Water, Wiley, 2002.
2. C. Fitts, Groundwater Science, Academic Press, 2012.
3. J. Bear, Hydraulics of Groundwater, Dover Publications, 2007.
4. Karanth, K. R. _*Groundwater Assessment, development and Management"*, Tata Mc Graw – Hill publishing company New Delhi. 1987
5. Wang Herbert. F. and Anderson Mary. P.(), _*Introduction to groundwater modeling; FDM and FEM"*, Academic Press, New York. 1995

**e-Resources**

1. http://www.cwc.gov.in/water-resources-information-system-wris
2. http://cgwb.gov.in/

| Program: | B. Tech. (Civil Engineering) - Honors Water Management in Changing Climate Scenario | | | Semester: VII | | |
|---|---|---|---|---|---|---|
| Course : | Seminar | | | Code: BCI27HN26 (A) / BCI28HN30 (B) | | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Practical | Credit | Hours | TW | OR | Total |
| - | 4 | 2 | 4 | 25 | 25 | 50 |

**Course Objectives:**

1. To work on a specific technical topic to acquire the skills for technical communication.
2. To acquire technical writing abilities for seminars /conferences/ mini project.

**Course Outcomes:**

The Students will be able to,

1. Identify and define a problem statement.
2. Evaluate literature in the area of research and establish the scope of work.
3. Develop and suggest a solution for the problem statement defined.
4. Prepare a technical report.

**Detailed Syllabus**

| Description | Duration (H) |
|---|---|
| 1. Individual student need to study recent topics in the field of technical domain under the guidance of allocated guide.<br>2. The extensive literature survey, mathematical modeling of particular method, experimentation and valuableconclusion is expected from seminar study/ mini project.<br>3. Seminar/ Mini project report should be submitted as a compliance of term work.<br>4. Technical paper publication as an outcome of seminar is appreciated.<br>5. Total Duration: 30 Contact Hours and an additional 30 Hours should be spent by students on completion of relatedactivities and requirements | 60 |
| **Total** | **60** |

# Course syllabus

## Semester-VIII

## Honors in

## Water Management in Changing Climate Scenario

| Program: | B. Tech. (Civil Engineering) – Honors Water Management in Changing Climate Scenario | | | Semester: VIII | | |
|---|---|---|---|---|---|---|
| Course : | Mini Project | | | Code: BCI28HN27 (A)/ BCI27HN28 (B) | | |
| Teaching Scheme | | | | Evaluation Scheme | | |
| Lecture | Practical | Credit | Hours | TW | Oral | Total |
| - | 10 | 5 | 10 | 75 | 50 | 125 |

**Course Objectives:**

1. To plan for various activities of the project and channelize the work.
2. To analyze, design and implement real time application using available platforms..

**Course Outcomes:**

The students will be able to,

1. Understand, plan, and execute an Integrated Project.
2. To apply various methods, techniques, and software.
3. Prepare a technical report.

**Detailed Syllabus**

| Description | Duration (H) |
|---|---|
| 1. Individual student needs to design and demonstrate a Integrated-project under the guidance of the allocated guide.<br>2. Students can choose the project considering implementation in their career prospects.<br>3. The use of various technical methods, techniques and software is necessary<br>4. Integrated Project Report should be submitted as part of the term work.<br>5. Paper publication associated with Integrated-project as a research outcome is appreciable | 120 |
| **Total** | **120** |

## Vision of the Civil Engineering Department

To establish as a premier civil engineering department in Maharashtra in the coming five years by providing quality education, fostering innovation with ethical values to serve the society.

## Mission of the Civil Engineering Department

1. Fostering value-based education to achieve academic excellence with the right attitude and professional ethics.

2. Inculcating a culture of research and innovation, with an aim of serving society in a sustainable manner.

3. Developing skilled civil engineers with an ability to provide solutions to meet national and global challenges in accordance with the needs of the society.

## Program Specific Outcomes (PSO) of Civil Engineering Department

1. Graduates in civil Engineering will demonstrate proficiency in practical applications for quality construction work in the domain of Structural Engineering, Water Resources-Environmental Engineering, Geotechnical-Transport and Construction Management.

2. A graduate in Civil Engineering, equipped with the necessary skills and technical knowledge, can become an entrepreneur in the field, capable of identifying business opportunities, developing business plans, managing resources, designing and executing sustainable construction projects for infrastructural development.