

### **Program Outcomes (POs)**

**PO1:** An ability to independently carry out research /investigation and development work to solve practical problems

**PO2:** An ability to write and present a substantial technical report/document

**PO3:** Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

**PO4:** Students should be able to cope with changing technological environment to meet the challenges emanating out of Climate change and Environment

*Note: Program may add up to three additional POs.*

### **Program Educational Objectives (PEOs)**

The Program Educational Objectives (PEOs) are as follows:

**PEO1:** To prepare the students as one of the problems solving engineers/technologists in water, land and environmental fields.

**PEO2:** To generate technical man power at advanced level to maintain and manage the existing infrastructure of water, land and environment of the nation.

**PEO3:** To impart technical training to the students that empowers them to withstand changing technological environment in order to cope with the natural climate change and environment.

**PEO4:** To develop the students' personality in such a manner that they become responsible citizens in the society.

**Full –Time PG M.Tech.(WET) Syllabus w.e.f. 2019 Batch**

**SEMESTER-I**

**PROGRAMME CORE-I / 1WET01**

**SURFACE WATER HYDROLOGY**

**COURSE OUTCOMES**

The student is expected to

**CO1:** To learn about precipitation and its measurement, analysis and interpretation.

**CO2:** Know about abstractions to rainfall, infiltration, evaporation and transpiration along with their estimation and derivation of unit hydrograph from hydrograph.

**CO3:** Gain Knowledge about floods, its estimation, combat floods and flood routing.

**CO4:** Familiarize with surface water pollution, causes, effects and remedial measures.

**CO5:** Acquire knowledge about disasters and its management, conservation of water and climate change and its impact on water resources.

**PROGRAMME CORE-II/1WET02**

**GROUND WATER HYDROLOGY**

**COURSE OUTCOMES**

The student is expected to

**CO1:** To understanding the fundamentals concepts of groundwater for its storage movement governing laws with field and laboratory estimation of hydraulic properties.

**CO2:** Derivation of flow of Water through porous media its governing equations and estimation of aquifer parameters with various types of pumping tests in tube wells and open wells.

**CO3:** Application of ground water exploration techniques by using geophysical methods such as electrical resistivity methods and seismic refraction method to explore groundwater.

**CO4:** Practicing various groundwater management techniques such as artificial recharge, conjunctive use basin management and control of sea water intrusion.

**CO5:** To understand the groundwater pollution, remediation and modeling of the aquifer with respect to flow model and transport model.

**PROGRAMME ELECTIVE –I/ 1WETPE01**

**ADVANCED FLUID MECHANICS**

**COURSE OUTCOMES**

The student is expected to

**CO1:** Inculcate knowledge on description of fluid motion, stream and velocity potential, their properties and applications.

**CO2:** Develop understanding on the dynamics of Ideal fluids, applications to one dimension problems and evaluate the problems on pipe bend, venturimeter and orifice meter.

**CO3:** Imbibe the equations of real fluids like Navier Stokes equation, Stokes flow and Hagen Poiseuille flow.

**CO4:** Acquire knowledge on boundary layer flow for various expressions and equation on laminar and turbulent boundary, Integral momentum and boundary layer separation.

**CO5:** Grasp the basic idea of turbulence in fluid flow.

PROGRAMME ELECTIVE –I/ 1WETPE01

**WATER QUALITY MODELLING AND MANAGEMENT**

**COURSE OUTCOMES**

The student is expected to

- CO1: Become familiar with water quality standards, contamination of water along with contaminant transport mechanism.
- CO2: Know about sources of water, water quality models and eutrophication.
- CO3: Gain knowledge about solute transport models and contaminant transport in unsaturated flows.
- CO4: Learn about different mechanisms like advection, dispersion and different models like dual porosity model and numerical models.
- CO5: Acquire knowledge about water quality management, control including groundwater remediation

PROGRAMME ELECTIVE –I/ 1WETPE01

**ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY**

**COURSE OUTCOMES**

The student is expected to

- CO1: Develop an understanding of structure and formation of an ecosystem.
- CO2: Gain knowledge on energy flow and to understand biogeochemical cycles and their significance in the sustainability ecosystems.
- CO3: Gain competency and understanding of the significance of chemical and biological reactions in environmental problems.
- CO4: Identify domestic waste, household, community waste disposals and also to familiarize with chemistry of pesticides, insecticides, herbicides, detergents, and rodent control chemicals.
- CO5: Acquire knowledge on soil, air, aquatic, domestic water and sewage, foods, milk and industrial microbiology.

PROGRAMME ELECTIVE –II/ 1WETPE02

**WATER RESOURCES SYSTEMS ANALYSIS**

**COURSE OUTCOMES:**

The student is expected to

- CO1: To develop objective function and constraints for various water resources optimization problems.
- CO2: To develop linear programming models for water resources problems by using graphical and simplex and revised simplex techniques, to carry out sensitivity analysis and post optimality analysis.
- CO3: To develop and solve forward and backward recursive dynamic programming models.
- CO4: To understand optimization and simulation concepts and modeling and also apply simulation techniques in water resources problems.
- CO5: To understand the fundamentals of economic theory as applied to water resources.

PROGRAMME ELECTIVE –II/ 1WETPE02

**RIVER BASIN MANAGEMENT**

**COURSE OUTCOMES**

The student is expected to

- CO1:** To learn know about forecast of river flows, routing the flow and river confluences.
- CO2:** To understand river confluences and its balance, reservoir routing and aggregation of water users.
- CO3:** Be familiar with management of different irrigation structures, water conservation and concerned technological innovations.
- CO4:** Have thorough understanding of judicious water allocation for various purposes and reservoir operation.
- CO5:** Gain knowledge about soil erosion and sedimentation, control measures and catchment treatment.

PROGRAMME ELECTIVE –II/ 1WETPE02

**AIR POLLUTION AND CONTROL TECHNOLOGIES**

**OBJECTIVES:**

**COURSE OUTCOMES**

The student is expected to

- CO1:** The student is expected to understand the effects of air pollutants, the metrological aspects, plume behavior and atmospheric dispersion equation.
- CO2:** Acquire knowledge on sampling techniques and analyze air quality.
- CO3:** Understand and analyze the basic mechanisms involved, working principle and design aspects of various air pollution controlling equipments.
- CO4:** Identify the methods to control sulphurdioxide and nitrogen oxide emissions.
- CO5:** Gain knowledge on vehicular emissions and auto mobiles pollution control at sources along with legal measures.

1A01

**RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS**

**COURSE OUTCOMES:**

Students will be able to

- CO1:** Understand research problem formulation.
- CO2:** Analyze research related information
- CO3:** Follow research ethics
- CO4:** Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- CO5:** Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasize the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- CO6:** Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

1WET03

**HYDROLOGY LABORATORY**

## **COURSE OUTCOMES**

Students are expected to

- CO1: Explore the groundwater using electrical resistivity and seismic methods.
- CO2: Identify civil utility using Ground Penetrating Radar.
- CO3: Determine of aquifer characters using pumping tests and well logging techniques.
- CO4: Study the characteristics curves and specific energy curves.
- CO5: Determine the frictional losses, coefficient of discharge and surface profiles coordinates.

1WET04

## **ENVIRONMENTAL LABORATORY**

### **COURSE OUTCOMES**

Students will be able to

- CO1: Perform common environmental experiments relating to water and wastewater quality, and know which tests are appropriate for given environmental problems.
- CO2: Statistically analyze and interpret laboratorial results.
- CO3: Understand and use the water and wastewater sampling procedures and sample preservations.
- CO4: Demonstrate the ability to write clear technical laboratorial reports.
- CO5: Understand the impact of biological parameters on wastewater.

PROGRAMME CORE-III/ 2WET05

## **GEOSPATIAL APPLICATIONS IN WATER RESOURCES**

### **COURSE OUTCOMES**

The Student is expected to

- CO1: Develop the knowledge on basic concepts of remote sensing, elements involved in remote sensing, its energy sources and interaction with earth's surface features and foundations of remote sensing.
- CO2: Comprehend the concepts of Geographical Information System (GIS), components of GIS, types and data structures.
- CO3: Understand how the data sets are acquired and developed, and can carry out the preprocessing of data inputs.
- CO4: Improve the learning on global positioning system (GPS), factors influencing GPS, GPS signal characteristics, mathematical model and GPS applications.
- CO5: Identify the importance of Remote sensing and GIS in various applications like water resources, drought assessment, flood plain zoning etc.

PROGRAMME CORE-IV/2WET06

## **WATER AND WASTEWATER TREATMENT TECHNOLOGIES**

### **COURSE OUTCOMES:**

The student is expected to

- CO1: Learn about water transmission pipe networks, non-revenue water and wastewater treatment as a part of water conservation.
- CO2: Understand different water wastewater treatment units and its stages and design of water treatment plant.
- CO3: Know about sewerage systems, design and appurtenances.
- CO4: Gain knowledge about secondary or biological treatment of waste water sludge treatment and disposal, low cost waste treatment systems like oxidation pond and oxidation ditch.
- CO5: Know about ecological sanitation and wetlands and its role in the treatment of wastewater, constructed wetlands, recycle and reuse of treated wastewater.

**FLUVIAL HYDRAULICS**

**COURSE OUTCOMES**

The student is expected to

- CO1: To learn about types of flows and flow profiles, varied flow analysis and computation.
- CO2: Understand dam break analysis, formation of jump on sloping channels, surges and its types.
- CO3: Know about different methods of dimensional analysis and its applications.
- CO4: Gain knowledge about different dimensionless members and their model laws and flow fields in which they are applicable, kinds of similarity and types of models and scale effect.
- CO5: Be thorough with design of alluvial channels, different theories and their relative merits and demerits.

**URBAN HYDROLOGY**

**COURSE OUTCOMES**

The student is expected to

- CO1: To know about impact of urbanization on urban runoff urban water sub systems, urban hydrologic cycle.
- CO2: Learn modeling of storm water, probabilistic and statistical approaches of analysis of storm water data.
- CO3: Understand urban drainage systems, sewers, components, design considerations, infiltration and exfiltration in sewers, field investigations and control measures.
- CO4: Be well acquainted with storm water management, monitoring run off, quantity and quality, measures to mitigate damaging effects of urban storm runoff.
- CO5: Be familiar with maintenance of urban drainage systems, pump stations, illicit connections, limitations and regulations.

**SUSTAINABLE WATER RESOURCES DEVELOPMENT**

**COURSE OUTCOMES**

The student is expected to

- CO1: To know about frame work for sustainable development of water Resources keeping global water crises in view.
- CO2: To learn virtual water, national water policy, national water mission along with the challenges in the development of sustainable development of water resources.
- CO3: To be thorough sustainable water resources management in local, regional and global perspective including the challenges to achieve sustainable water use and management.
- CO4: To gain knowledge regarding water economics, options for water conservation and private sector involvement in water resources management.
- CO5: To be well versed with water act, government policies on water conservation and the measures for sustainable water resources.

**ENVIRONMENTAL IMPACT ASSESSMENT**

**COURSE OUTCOMES**

groundwater resources and assess the impact significance on landfills and human habitation.

- CO4: Identify and interpret the projects which create impacts on surface water environment, surface water quality, Impact significance on water resources project.
- CO5: Understand the concept of environment audit, its objective, different types of audit and experience on site activities and gain technical knowledge during the field visit to industries.

**CLIMATE CHANGE ADAPTATION AND MITIGATION**

### **COURSE OUTCOMES**

The Student is expected to

- CO1: Understand the basic concept of climate change and its impacts on earth and India.
- CO2: Evaluate the climate risk for different sectors.
- CO3: Develop an adaptation plan for various sectors and prioritize the measures based on impact and cost-benefit analysis.
- CO4: Propose mitigation measures, carry out carbon emission reduction and cost benefit analysis.
- CO5: Understand the international and national policies on climate change along with sources of finance for implementing CCA and CCM measures.

### **AUDIT COURSE -II/2A03** **ENGLISH FOR RESEARCH PAPER WRITING**

#### **COURSE OUTCOMES:**

Students will be able to:

- CO1: Understand that how to improve your writing skills and level of readability
- CO2: Learn about what to write in each section
- CO3: Understand the skills needed when writing a Title
- CO4: Ensure the good quality of paper at very first-time submission

### **AUDIT COURSE -II/2A03** **DISASTER MANAGEMENT**

#### **COURSE OUTCOMES:**

Students will be able to:

- CO1: Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- CO2: Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- CO3: Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- CO4: Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

### **AUDIT COURSE-II/2A03 SANSKRIT FOR TECHNICAL KNOWLEDGE**

#### **COURSE OUTCOMES:**

Students will be able to

- CO1: Understand basic Sanskrit language.
- CO2: Understand Ancient Sanskrit literature about science & technology.
- CO3: Develop logic in students being a logical language.

### **AUDIT COURSE- II/2A03** **VALUE EDUCATION**

#### **COURSE OUTCOMES:**

Students will be able to

- CO1: Gain knowledge of self-development
- CO2: Learn the importance of Human values
- CO3: Develop the overall personality

### **AUDIT COURSE-II/2A03** **CONSTITUTION OF INDIA**

#### **COURSE OUTCOMES:**



Students will be able to:

- CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- CO3: Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- CO4: Discuss the passage of the Hindu Code Bill of 1956.

#### AUDIT COURSE-II/2A03

#### **PEDAGOGY STUDIES**

##### **COURSE OUTCOMES:**

Students will be able to understand:

- CO1: What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- CO2: What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- CO3: How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

##### **COURSE OUTCOMES:**

Students will be able to:

- CO1: Develop healthy mind in a healthy body thus improving social health also
- CO2: Improve efficiency

#### AUDIT COURSE-II/2A03

#### **PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**

##### **COURSE OUTCOMES:**

Students will be able to

- CO1: Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- CO2: The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- CO3: Study of Neetishatakam will help in developing versatile personality of students.

##### **COURSE OUTCOMES**

The Student is expected to

- CO1: Identify and generate different types of maps using GIS software.
- CO2: Prepare the maps for the delineated catchment area using GIS.
- CO3: Carry out geometric correction of satellite data using ground control points (GCPs), and preparing mosaics of satellite images.
- CO4: Generate Digital Elevation Models (DEM) and NDVI from satellite image of AOI.
- CO5: Prepare Land use/land cover maps using unsupervised and supervised classification algorithms.



**COURSE OUTCOMES:**

- The Student is expected to
- CO1: Apply the concept of geomatics for watershed analysis and rainfall-runoff modelling using SWAT.
  - CO2: Execute evapotranspiration modeling using CROPWAT.
  - CO3: Identify harvesting structures in given area.
  - CO4: Priority watershed maps, flood maps including inundated areas, Surface water body maps, drought maps and their analysis.
  - CO5: Design the pipe distribution network and model the groundwater resources.

**2A04****MINI PROJECT WITH SEMINAR****COURSE OUTCOMES:**

- CO1: Students will get an opportunity to work in actual industrial environment if they opt for internship.
- CO2: In case of mini project, they will solve a live problem using software/analytical/computational tools.
- CO3: Study different techniques used to analyze complex systems
- CO4: Students will learn to write technical reports.
- CO5: Students will develop skills to present and defend their work in front of technically qualified audience.

## PROGRAMME ELECTIVE –V/3WETPE05

**SOLID AND HAZARDOUS WASTE MANAGEMENT****COURSE OUTCOMES**

- The student is expected to
- CO1: To know about solid and hazardous waste transportation, environmental laws and analysis of hazardous waste.
  - CO2: Learn waste recovery processes, cradle to grave concept of handling hazardous waste.
  - CO3: Understand disposal of hazardous waste both on surface and underground and waste minimization and hazardous waste remediation technologies.
  - CO4: Be familiar with collection transportation treatment and safe disposal of both biological and electronic waste and be conversant with reuse and recycling of wastes, recovery of by products and energy audit.
  - CO5: Gain knowledge about waste land characteristics and its remediation, different kinds of pollution of soils, remediation methods.

## PROGRAMME ELECTIVE –V/3WETPE05

**HYDRO POWER DEVELOPMENT****COURSE OUTCOMES**

- The student is expected to
- CO1: To know about hydropower systems, types, different load studies, pondage and storage.
  - CO2: Understand different intake structures, layout of a hydropower plant, penstock, design and anchorages.
  - CO3: Learn about water hammer, analysis, solution of linearized equations.
  - CO4: Be familiar with surge tanks, types, working, computations and stability analysis.
  - CO5: Be well acquainted with power houses, arrangement, selection of type, criteria for fixing dimensions, layout of underground power houses, stability and merits.

PROGRAMME ELECTIVE –V3WETPE05  
**MICRO IRRIGATION TECHNOLOGIES**

**COURSE OUTCOMES:**

The student is expected to

CO1: The design of an irrigation system.

CO2: Know about design of drip and sprinkler irrigation systems.

CO3: Understand the concepts of land scaping.

CO4: Gain knowledge on automation and fertigation.

CO5: Familiarize with operation and maintenance of irrigation systems.

OPEN ELECTIVE/3WETOE

**BUSINESS ANALYTICS**

**COURSE OUTCOMES:**

Students will be able to

CO1: Demonstrate knowledge of data analytics.

CO2: Think critically in making decisions based on data and deep analytics.

CO3: Use technical skills in predicative and prescriptive modeling to support business decision-making.

CO4: Translate data into clear, actionable insights.

OPEN ELECTIVE/3WETOE

**INDUSTRIAL SAFETY**

OPEN ELECTIVE/3WETOE

**OPERATIONS RESEARCH**

**COURSE OUTCOMES:**

The student should be able to

CO1: Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.

CO2: Students should able to apply the concept of non-linear programming

CO3: Students should able to carry out sensitivity analysis

CO4: Student should able to model the real world problem and simulate it.

OPEN ELECTIVE/3WETOE

**ENVIRONMENTAL STATISTICS**

**COURSE OUTCOMES**

The Student is expected to

- CO1: Understand the data, sampling procedures, descriptive and inferential statistics in environmental data
- CO2: Use R and MS Excel for basic statistical analysis for environmental data
- CO3: differentiate discrete and continuous probabilities and its application in environmental science, carry out various test and hypothesis
- CO4: use correlation, regression and analysis of various in R and Excel for interpreting environmental data and use it for decision making
- CO5: Understand the concept of spatial statistics and use it for environmental data for decision making

**DISSERTATION PHASE-1**

**COURSE OUTCOMES:**

- CO1: Students will be exposed to self-learning various topics.
- CO2: Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
- CO3: Students will learn to write technical reports.
- CO4: Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.

**DISSERTATION PHASE- II**

**COURSE OUTCOMES:**

- CO1: Students will be able to use different experimental techniques.
- CO2: Students will be able to use different software/ computational/analytical tools.
- CO3: Students will be able to design and develop an experimental set up/ equipment/test rig.
- CO4: Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
- CO5: Students will be able to either work in a research environment or in an industrial environment.
- CO6: Students will be conversant with technical report writing.
- CO7: Students will be able to present and convince their topic of study to the engineering community.

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