Syllabus of Water Management for UG programmes
Major/Minor Course
(Semester 1st)

Course objective and outcome: The objective of this course is to impart the knowledge of hydrology that deals with the occurrence, distribution, movement and properties of water on the earth.

Paper Title: Introduction to water **(4+2 credits)**

Paper code: WMG122M

Paper outcome: This paper is to offer a better insights on basics of water ranging from importance, characteristics distribution and consumption patterns.

Unit I: Properties of water **(Credits-4)**

Origin of water on earth, Unique properties of water (Polarity, Cohesion, Density, Surface Tension, Viscosity, Heat capacity, Boiling and freezing points, Temperature, Taste, Odour, Colour), Importance of water.

Unit II: Water resources distribution

Water as a resource, Concept of valuing water, Types of water resources, Inland water distribution and importance, Ground water distribution and importance, Cryosphere: Distribution and importance, Marine waters: Distribution and importance, Water resources of J&K (River systems and glaciers).

Unit III: Water and human civilization

Importance of water in human civilization (Mesopotamian and Indus), Water catastrophes: Historical perspective and consequences, Water infrastructure and tools (Ancient, Medieval and modern).

Unit IV: Water use and availability

Distribution of water, Availability and consumption patterns in domestic, industrial, and agricultural sectors, Concept of water stress and scarcity, Water footprint, Domestic water demand and consumption in urban and rural India, Sustainable Development Goal 6 (SDG)

Laboratory course **(Credits-2)**

1. Evaluation of per capita domestic water consumption pattern
2. Calculation of personal water footprint
3. Visit to any archeological/relevant site for demonstration of water infrastructure
4. Determination of water quality on basis of odor and color
5. Perception of stakeholders regarding drinking water quality available in the institution/College
6. Estimation of water temperature of different ecosystems
7. Questionnaire survey on water demands by various sectors (Domestic, Agriculture, Industry)
8. Visit to a any nearby drinking water supply scheme/source

Suggested readings:

Bansil, P.C. 2004. *Water Management in India*. Concept Publishing Company, India.

Brebbia, C.A. 2013. *Water Resources Management VII*. WIT Press.

CEA. 2011. *Water Resources and Power Maps of India*. Central Board of Irrigation & Power.

Grumbine, R.E. and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science* 339: 36-37.

Loucks, D.P., Stedinger, J.R. & Haith, D. A. 1981. *Water Resource Systems Planning and Analysis*. Englewood Cliffs, NJ, Prentice Hall.

Mays, L.W. 2006. *Water Resources Sustainability*. The McGraw-Hill Publications.

Schward and Zhang, 2003. *Fundamentals of Groundwater*. John Willey and Sons.

Souvorov, A.V. 1999. *Marine Ecologonomics: The Ecology and Economics of Marine Natural Resource Management*. Elsevier Publications.

Vickers, A. 2001. *Handbook of Water Use and Conservation*. Water Plow Press.

Syllabus of Water Management for UG programmes
Major/Minor Course
(Semester 2nd)

Paper Title: Hydrology and Water Quality **(4+2 credits)**

Paper code: WMG222M

Paper outcome: The paper introduces students to the concept of Physicochemical and biological quality of water. The students will also be aware of different water quality standards for application of water in different sectors.

Unit I: Hydrology and hydrological cycle **(Credits-4)**

Concept and scope of hydrology, Hydrological cycle: Evaporation: Process, Factors effecting evaporation, Measurement of evaporation, Transpiration: process, Factors affecting transpiration, Condensation: Process and measurement, Precipitation: Process, Types and forms, Measurement and distribution.

Unit II: Runoff and ground water

Runoff cycle and its components, Factors effecting runoff, Measurement of Runoff, Stream, gauging, Stream hydrology, Hydrograph concept and its applications, Ground water movement (Darcy's Law), Permeability and hydraulic conductivity, Aquifers: Types and geology.

Unit II1: Physical water quality parameters

Temperature, Colour, Taste, Odour Turbidity: Total Solids (TS), Total dissolved Solids (TDS), Total Suspended Solids (TSS), Volatile suspended solids (VSS), Volatile Dissolved Solids (VDS), Total Volatile Solids (TVS), pH, Conductivity, Concept of water quality index.

Unit IV: Chemical and biological water quality parameters

Major cations (Ca, Mg, Na, K), Major Anions (bicarbonates, sulphates, chlorides), Dissolved Gases in water (DO, CO_2), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), Microbial water quality-coliform bacteria, Indicator organisms.

Laboratory course **(Credits-2)**

1. Sampling methods (Grab and Composite) for physicochemical analysis of water (lake, river, groundwater, spring)
2. Measurement of precipitation and evaporation
3. Measurement of flow and discharge of stream/spring
4. Determine pH and alkalinity of water sample
5. Determine conductivity of different water samples
6. Determination of TSS and TDS of different water samples
7. Determination of hardness in different water samples
8. Determination of Chloride in water sample

Suggested readings:

Bansil, P.C. 2004. *Water Management in India*. Concept Publishing Company, India.

Brebbia, C.A. 2013. *Water Resources Management VII*. WIT Press.

CEA. 2011. *Water Resources and Power Maps of India*. Central Board of Irrigation & Power.

Grumbine, R.E. and Pandit, M.K. 2013. Threats from India's Himalaya dams. *Science* 339: 36-37.

Loucks, D.P., Stedinger, J.R. & Haith, D. A. 1981. *Water Resource Systems Planning and Analysis*. Englewood Cliffs, NJ, Prentice Hall.

Mays, L.W. 2006. *Water Resources Sustainability*. The McGraw-Hill Publications.

Schward and Zhang, 2003. *Fundamentals of Groundwater*. John Willey and Sons.

Souvorov, A.V. 1999. *Marine Ecologonomics: The Ecology and Economics of Marine Natural Resource Management*. Elsevier Publications.

Vickers, A. 2001. *Handbook of Water Use and Conservation*. Water Plow Press.

Gleick, P. H. 1993. *Water in Crisis*. Pacific Institute for Studies in Dev., Environment &Security. Stockholm Env. Institute, Oxford Univ. Press.

Syllabus of Water Management for UG programme
Multidisciplinary Course

WMG022I: Water Resource: Economics, Governance and Policy (CREDITS - 03)

Paper outcome: It is expected to give an exposure to students of social and natural sciences and humanities for better understanding of water resources, water economics, water governance and policy.

Unit I: Water resources and sustainable development

Water as a resource, Dublin-Rio Principles on Water and Sustainable Development, Brief account of concept of water stress, scarcity, water footprint and virtual water trade, Right to Water (SDG-6); Entitlements and criteria, Concept and overview of Water, Sanitation and Hygiene (WASH), Swach Bharat Mission and National Water Mission

Unit II: Water economics

Valuing of water: The use and non-use values of water, Introduction to water valuation methods: Non-revenue waters (NRW) and unaccounted for water (UFW); Metering water uses; Water management through economic instruments. Water Pricing - Approach and Models: Significance of water pricing Water pricing models - flat rate and uniform rate, Brief account of water pricing practices in India and abroad.

Unit III: Water governance, conflicts and policy

Water Governance: Elements and dimensions of water governance; Effective water governance schemes; Indicators of good governance. Water Governance in India: Salient features of National water policy 2012 and Jammu and Kashmir Water Resource (Regulation and Management) act 2010, Conflicts in Water Pricing: Conflicts on subsidy verses sustainability, overview of global water conflicts and interstate water conflicts in India.

Suggested readings:

1. Handbook of Water Economics: Principles and Practice (2003) by Colin H. Green; Publisher - Willy
2. Handbook of Water Economics (2015)by Ariel Dinar and Kurt Schwabe (editors); Publisher - Edward Elgar
3. Water and the Laws in India (2009) by Ramaswamy R. Iyer; Publisher - SAGE Publications
4. Water Law Poverty and Development, Water Sector Reforms in India by Philippe Cullet; Publisher - Oxford (2009)
5. Water Resource Economics: Towards a Sustainable Use of Water for Irrigation in India (2015) by M.G. Chandrakanth; Publisher - Springer
6. Water Governance: An Evaluation of Alternative Architectures (2013), by A. Gunawansa and L. Bhullar (editors) Publisher - Edward Elgar (2013)

NEP 2020 FYUG PROGRAMME WITH WATER MANAGMENT AS MAJOR/MINOR

III SEMESTER

COURSE CODE:WMG322J COURSE TYPE: CT-1 (MAJOR)
COURSE TITLE:Water Chemistry CREDITS: (Theory-4, Practical -2)
Maximum Marks: 100 Minimum Marks: 36

Courselearning outcome: Water chemistry is an introductory course that explores the chemical properties, composition, and behaviour of water. The aim of the course is to develop a comprehensive understanding of the fundamental concepts and principles of water chemistry. The course is designed to develop critical thinking and problem-solving skills in the context of water chemistry. The student will be able to interpret and communicate results related to water quality.

THEORY (4 credits: 60 hours)

Unit I: Stoichiometry **(15 hours)**

1.1.Concept: Mole, molarity, normality, molality
1.2.Chemical equilibrium
1.3.Acid-base reactions
1.4.Titrimetry
1.5.Gravimetry

Unit IIReactions in Water **(15 hours)**

2.1.Composition of natural waters
2.2.Redox reactions in water
2.3.Movement of light in water
2.4.Movement of heat in water
2.5.Photosynthesis in water

Unit III: Analytical Chemistry **(15 hours)**

3.1.Potentiometry
3.2.Conductiometryand Turbidometry
3.3.Spectrophotometry: UV-Visible
3.4.Flame photometry
3.5.Chromatography: principle and applications

Unit IV: Chemistry of water **(15 hours)**

4.1.Solubility of gases in water
4.2.Biochemical oxygen demand
4.3.Chemical oxygen demand
4.4.Carbonate-bicarbonate system
4.5.Nutrients in water (N and P)

PRACTICALS: (2 credits) **(30 hours)**

1. Standardization of reagents – titrants (acids, bases)
2. Measurement of suspended solids in different water samples
3. Determine of transparency in a lake ecosystem
4. Estimation of salinity in water samples
5. Experimental verification of Beer-Lambert's law
6. Determination of turbidity of water samples
7. Determination of dissolved oxygen content in water samples
8. Determination of CO_2 in water samples

HEAD