

Government Degree College, Baramulla

Major/Minor Course

Semester 2nd

Water Management for UG programmes (Batch, 2022)

Hydrology and Water Quality

Code: BWM22C201

Credits (Theory 4: Practical 2)

Course objective: The paper introduces to the concept of hydrology, physicochemical and biological quality of water.

Paper outcome: The students will learn about importance of cycling of water between different spheres and water quality standards for application of water in different sectors.

Theory:4 credits

Unit I: Hydrology and hydrological cycle(16 hrs)

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

Unit II: Runoff and ground water (16 hrs)

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

Unit III: Physical water quality parameters (16 hrs)

Temperature, Colour, Taste, and 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.

Unit IV: Chemical and biological water quality parameters (16 hrs)

Major cations (Ca, Mg, Na, K), Major Anions (bicarbonates, sulphates, chlorides), Dissolved Gases in water (DO, CO₂), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), Microbial water quality-coliform bacteria, Indicator organisms.

Laboratory course: 02 credits

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

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4. Determine pH and alkalinity of water sample
5. Determine conductivity, TSS and TDS of different water samples
6. Determination of hardness in different water samples
7. Determination of Chloride in water sample
8. Identification of indicator organisms.

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 Wiley and Sons.
- Souvorov, A.V. 1999. Marine Ecogonomics: 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., Env & Security. Stockholm Env. Institute, Oxford Univ. Press.

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SKILL ENHANCEMENT COURSE

Semester 2nd

Water Management for UG programmes (Batch, 2022)

Water Conservation

Code: BWM22S202

Credits (Theory 2: Practical 2)

Objectives/Expected Learning Outcomes: The course will help students to have skill in water resource management, application of different measures for water conservations and most importantly how to use water wisely at different sectors. The course will be valuable for environmentalists, horticulturists, farmers, plumbers, irrigation and industry staff etc.

Theory: 02 credits

UNIT-I: Introduction to water conservation

16 hours

- 1.1. The water cycle: evaporation, precipitation, infiltration, runoff 2.1 Water saving measures and strategies
- 1.2. Water storage and quality
- 1.3. Water use pattern
- 1.4. Water footprint concept
- 1.5. Significance of water conservation at regional and global level

UNIT-II: Water conservation strategies and techniques

16 hours

- 2.1 Water saving measures and strategies
- 2.2 Water conservation at home
- 2.3 Water conservation in agriculture
- 2.4 Water conservation in industries
- 2.5 Water conservation and health

Practical: 02 credits

1. Assessment of percentage of households with access to sanitation facility
2. Case studies on techniques of rainwater harvesting
3. Estimation of runoff from a given area
4. Evaluation of per capita domestic water consumption pattern
5. Calculation of personal water footprint
6. Visit to a check dam/pond and report preparation

Recommended Books:

1. *Fundamentals of Water and Wastewater* by Gopal, Krishna. (2004). New Delhi: APH Publishing corporation.
2. Mays, L.W. 2006. *Water Resources Sustainability*. The McGraw-Hill Publications.
3. Vickers, A. 2001. *Handbook of Water Use and Conservation*. Water Plow Press.
4. *Waste water management* by Gomes, K. (2009). Delhi: Oxford Book Company.
5. *Water Harvesting Treatment and Technology* by Swaroop, U. (2013). Delhi: Signature books international.
6. *Water Management: A futuristic approach* by Wheatly, K. (2015). New York: Castilo reference.
7. *Water Resources Management In India: Problems and prospects* by Rasure, K. A. (2013). Delhi: Manglam publications.

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SEMESTER 1st

Multidisciplinary Course

Subject: Water Management

Title: Water Resource: Economics, Governance and Policy Code: BWM22M103

Credit: (3) Theory: 03

Contact Hours: 48 (T)

***Course Objective:** The objective of this paper is to give exposure to the students of social science, natural sciences and humanities for better understanding of water resources, water economics, water governance and policy.*

***Learning outcome:** It is expected that the students will understand and apply the policies, strategies developed for the sustainable practices of water conservation, management of water resources and importance of health and hygiene.*

Theory: 03 Credits

Unit I: Water resources and sustainable development

(16 hrs)

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

Unit II: Water economics

(16 hrs)

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), 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

(16 hrs)

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, National water conflicts.

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)