Government Degree College, Baramulla

(3rd SEMESTER) **Major/Minor**

Subject: Water Management

Course Title: Water Chemistry Course code: BWM22C301

Credit: (4+2) Theory: 04; Practical: 02 Contact Hours: 64 (T) + 64 L)

Course objective:

- 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.

Course Outcome:

- The student will be able to interpret and communicate results related to water quality.
- Students will gain a comprehensive understanding of water chemistry and its relevance in various environmental, ecological and health context.

Unit I: Stoichiometry **16 hrs**

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

Unit II Reactions in Water **16 hrs**

2.1. Composition of natural waters
2.2. Redox reactions in water
2.3. Motion of Light in water
2.4. Movement of Heat in water
2.5. Photosynthesis in water

Unit III: Analytical Chemistry **16 hrs**

3.1. Potentiometry
3.2. Conductometry
3.3. Spectrophotometry: UV and Visible
3.4. Flame photometry
3.5. Chromatography: Principle and applications

Unit IV: Chemistry of water **16 hrs**

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: **32 hrs**

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 different water samples
5. Experimental verification of Beer-Lambert's law
6. Determination of turbidity of different water samples
7. Determination of dissolved oxygen content in different water samples
8. Determination of CO_2 in different water samples

Suggested Readings:

1. "Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters" by Werner Stumm and James J. Morgan.
2. "Environmental Chemistry of Lakes and Reservoirs" by Eugene A. Silow.
3. "Standard Methods for the Examination of Water and Wastewater" by American Public Health Association (APHA).
4. "Water Chemistry" by Mark M. Benjamin.
5. "Environmental Chemistry" by Colin Baird and Michael Cann.
6. "Environmental Chemistry" by Stanley E. Manahan.
7. "Introduction to Environmental Chemistry" by Manahan, Stanley E.
8. "Water Chemistry: An Introduction to the Chemistry of Natural and Engineered Aquatic Systems" by Patrick Brezonik and William Arnold.
9. Principles of Water Chemistry" by George P. Sims and John J. Rusten.
10. "Principles of Aquatic Chemistry" by François M. M. Morel and Janet G. Hering, Published by Wiley-Blackwell.
11. "Water Chemistry: An Introduction to the Chemistry of Natural and Engineered Aquatic Systems" by Patrick Brezonik and William Arnold,Published by Oxford University Press.
12. "Environmental Chemistry of Lakes and Reservoirs" by Eugene A. Silow, Published by American Chemical Society.
13. "Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters" by Werner Stumm and James J. Morgan, Published by John Wiley & Sons.
14. "Introduction to Environmental Chemistry" by Manahan, Stanley E, published by CRC Press.
15. "Water Quality and Treatment: A Handbook on Drinking Water" by American Water Works Association (AWWA) Published by McGraw-Hill Education.

Government Degree College, Baramulla

(3rd SEMESTER) **Skill Enhancement Course**

Subject: Water Management

Course Title: Water and Waste Water Management Course code: BWM22S302

Credit: (2+2) Theory: 02; Practical: 02 Contact Hours: 32 (T) + 64 L)

Course Objective:

- The students are expected to have a better comprehension and understanding of the processes and techniques of water treatment through field visits and laboratory experiments.
- Students will get an exposure to act as operators for running various water treatment plants.

Course outcome:

- Students will have a comprehensive understanding of water resources, water treatment technologies and waste water management practices.
- They will be equipped to address water quality issues, contribute to sustainable water management, and ensure the availability of safe and clean water for communities and the environment.

Unit I: Drinking water treatment 16 hrs

1.1. Drinking water characteristics and standards

1.2. Methods of water purification: Coagulation, flocculation and sedimentation

1.3. Filtration process and types of filters: sand filters, pressure filters, horizontal filters

1.4. Chemical treatment: adsorption, gas stripping, ion exchange

1.5. Disinfection and desalination of water

Unit II: Sewage treatment 16 hrs

2.1. Waste water characteristics and constituents

2.2. Wastewater treatment plants: design and working

a. Primary

b. Secondary

c. Tertiary

2.3. Principle and design: Trickling filter, activated sludge Process and Rotating biological contractor

2.4. Sludge and its disposal techniques

2.5. Reclamation and reuse of industrial and domestic wastewater

Laboratory course: 32 hrs

1. A visit to drinking water / sewage treatment facility and report preparation.
2. Working and design of Sewage Treatment Plants.
3. Presentation based on case studies of waste water management.
4. Study of different solid waste disposal techniques.

Suggested Readings:

1. Peavy, H.S., Rowe and Tchobonoglous, G., (1985), "Environmental Engineering", McGraw Hill
2. Raju, B.S.N., (1995), "Water Supply and Wastewater Engineering", Tata McGraw Hill Pvt. Co. Ltd., New Delhi.
3. Metcalf and Eddy, "Wastewater Engineering", 4th ed., McGraw Hill Higher Edu,2002.
4. W. Wesley Eckenfelder, Jr., "Industrial Water Pollution Control", 2nd Edn.,McGraw Hill Inc., 1989.
5. S. P. Mahajan, "Pollution control in process industries", 27th Ed. Tata McGraw Hill Publishing Company Ltd., 2012.
6. Benefield R.D., and Randal C.W., (1980), "Biological Process Design for Wastewater Treatment", Prentice Hall, Englewood Chiffs, New Jersey.
7. Karia G.L., and Christian R.A., (2001), "Wastewater Treatment Concepts and Design Approach", Prentice Hall of India Pvt. Ltd., New Delhi.
8. Fair, G. M., J. C. Geyer, and D. A. Okun. 1971. Elements of water supply and wastewater disposal, 2d ed. John Wiley & Sons, New York.

Government Degree College, Baramulla

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)