Course: Water Quality Monitoring & Testing

Programme Learning Outcomes (PLOs)

PLO1: To develop strong technical proficiency in water quality assessment and sampling methods
PLO2: To develop strong analytical skill and technical competence and capacity building in water quality analysis, instrumentation, handling and operation
PLO3: To acquire and build practical knowledge and skill of operation and monitoring of water treatment plants

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Semester-I

Course Title: Fundamentals of Water Quality Assessment **Course Type: Skill**

Course Code: FWQ126 **Credits: 04:(Theory: 02; Practical: 02)**

Max. Marks: 100 (Theory:50; Practical:50)

Course Learning Outcomes (CLOs):

CLO1: *To have a comprehensive understanding of water quality assessment, sampling methods, and QA/QC procedures*

CLO2: *Able to understand & perform water quality monitoring in light of indicators and standards*

CLO3: *Able to measure, report and interpret water quality data through physicochemical and biological parameters*

Unit I: Water quality sampling

Water quality assessment: Objectives & importance; Sampling methods and collection of water, sampling: spot, grab and composite sampling; Handling and preservation of water samples; Real-time water quality monitoring; Quality Assurance (QA) and Quality Control (QC) concept

Unit II: Water quality monitoring

Physical parameters of water: temperature, turbidity, total dissolved solids and transparency; Chemical parameters of water: pH, conductivity, alkalinity, hardness, dissolved oxygen; Biological aspects of water: Total & faecal coliform; Biomonitoring for water quality assessment; Drinking water standards: BIS and WHO guidelines; CPCB classification

Unit III & IV (Practicals: 02 Credits)

1. Measurement of pH, temperature, turbidity, and total dissolved solids (TDS) in water samples
2. Determination of alkalinity in water samples
3. Determination of total hardness and Dissolved Oxygen of water samples
4. Detection of coliform in water samples
5. Biomonitoring field index assessment of a local water body

Suggested Readings:

1. Lillie, R. A., Szczytko, S. W., & Miller, M. A. (2003). *Macroinvertebrate data interpretation guidance manual*. Wisconsin Department of Natural Resources.
2. Nathanson, J. A. (2007). *Basic environmental technology: Water supply, waste management, and pollution control* (5th ed.). Pearson Prentice Hall.
3. Li, Y., & Migliaccio, K. (Eds.). (2010). *Water quality concepts, sampling, and analyses* (1st ed.). CRC Press.
4. Bureau of Indian Standards. (2012). *Indian standard drinking water—Specification* (2nd rev.). BIS.
5. American Public Health Association. (2017). *Standard methods for the examination of water and wastewater* (23rd ed.). APHA Press.
6. World Health Organization. (2017). *Guidelines for drinking-water quality* (4th ed., incorporating the 1st addendum). WHO.

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Semester-II

Course Title: Water Quality Analysis & Instrumentation **Course Type: Skill**

Course Code: WQA226 **Credits: 04:(Theory: 02; Practical: 02)**

Max. Marks: 100 (Theory:50; Practical:50)

Course Learning Outcomes (CLOs):

CLO1: *To have a comprehensive understanding of water quality parameters in light of organic and inorganic pollutants*

CLO2: *Able to operate water quality instruments*

CLO3: *Able to perform and determine water quality data through organic and inorganic constituents*

Unit I: Water Quality Parameters

BOD and COD; Nutrient dynamics: nitrogen (ammonia, nitrate) and phosphorus; Chlorophyll; Types of organic matter (CPOM, DOM, FDOM); An overview of heavy metals and pesticides

Unit II: Water Quality Analysis and Instrumentation

Principle, working and applications of spectrophotometer, Flame photometer, DO meter, pH meter, Conductivity meter, Water quality indexing: WQI concept and importance

Unit III & IV (Practicals: 02 Credits)

1. Determination of BOD of water samples
2. Determination of COD of water samples
3. Determination of nitrate-nitrogen in water samples
4. Determination of phosphorus in water samples
5. Determination of chlorophyll concentration in water samples

Suggested Readings:

1. Wetzel, R. G. (2001). Limnology: Lake and river ecosystems (3rd ed.). Academic Press.
2. Sawyer, C. N., McCarty, P. L., & Parkin, G. F. (2002). Chemistry for environmental engineering and science (5th ed.). McGraw-Hill.
3. Schwarzenbach, R. P., Gschwend, P. M., & Imboden, D. M. (2005). Environmental organic chemistry (2nd ed.). John Wiley & Sons.
4. Abbasi, T., & Abbasi, S. A. (2012). Water quality indices. Elsevier.
5. Water Environment Federation. (2013). Water quality instrumentation: Principles and practice. Water Environment Federation.
6. Mitra, S., & Kebbekus, B. B. (2018). Environmental chemical analysis. CRC Press.

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Semester III

Course Title: Water and Wastewater Treatment Processes **Course Type: Skill**

Course Code: WWT326 **Credits: 04:(Theory: 02; Practical: 02)**

Max. Marks: 100 (Theory:50; Practical:50)

Course Learning Outcomes (CLOs):

CLO1: *To have a comprehensive understanding of drinking water treatment processes and methods*

CLO2: *To gain comprehensive knowledge about treatment methods and technologies*

CLO3: *To acquire practical knowledge of operating and maintaining water treatment plants*

Unit I: Drinking Water Treatment Processes

Screening, Coarse solids reduction: comminutors, macerators and grinders; Sedimentation; Filtration: types of filters; Adsorption and types of adsorbents; Chemical methods: Coagulation and flocculation; Disinfection: characteristics, methods, and mechanism; Disinfectants: chlorine, UV and ozone; Safety rules and record-keeping

Unit II: Wastewater Characteristics and Treatment Processes

Waste water types & characteristics; Waste water treatment: preliminary, primary, secondary and tertiary/advanced treatment; Treatment technology: FAB, SQR, SBR, & MBR; Concept of key Operational Parameters: flow rate, organic load, MLSS, MLVSS, F/M ratio, SRT, HRT, sludge volume index; Sludge characteristics and management

Unit III & IV (Practicals: 02 Credits)

1. Visit to any STP and water treatment (filtration) plant
2. Determination/estimation of MLSS, F/M ratio
3. Determination of optimum alum dose
4. Determination of chlorine dose
5. Sludge Volume Index (SVI) Determination

Suggested readings:

1. Central Pollution Control Board. (2011). *Water and wastewater analysis: A guide manual*. Ministry of Environment and Forests. https://indiawaterportal.org/sites/default/files/iwp2/Water_and_wastewater_analysis_Guide_manual_Central_Pollution_Control_Board_2011.pdf
2. Spellman, F. R. (2009). *Handbook of water and wastewater treatment plant operations* (2nd ed.). CRC Press.
3. Benjamin, M. M., & Lawler, D. F. (2013). *Water quality engineering: Physical/chemical treatment processes*. Wiley.
4. Metcalf & Eddy, Inc., Tchobanoglous, G., Burton, F. L., & Stensel, H. D. (2013). *Wastewater engineering: Treatment and resource recovery* (5th ed.). McGraw-Hill Education.
5. Ahuja, S. (Ed.). (2018). *Advances in water purification techniques: Meeting the needs of developed and developing countries*. Elsevier.
6. Riffat, R., & Husnain, T. (2022). *Fundamentals of wastewater treatment and engineering*. CRC Press.

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