



Course Number: CE559

Course Title: Biological Wastewater Treatment

Credits: 3-0-0-3

Prerequisites: None

Intended for: UG/M.Tech./MS/PhD

Distribution: Elective

1. Preamble:

Domestic as well as industrial wastewaters, when discharged into environment without prior treatment, pose major threat to surface water quality as well as to flora and fauna. As a result, these wastewaters need to be treated prior to their discharge into environment. The main objective of this course is to provide theoretical knowledge and practical application of various biological processes employed in wastewater treatment and how to design and operate these treatment processes. The course also familiarizes the students with the operation and maintenance methods as well as the troubleshooting techniques employed in various wastewater treatment processes.

2. Course Modules:

Module 1: Introduction (2 hours)

Need for wastewater treatment, Need for sludge treatment, Benefits of biological wastewater treatment, Overview of wastewater treatment processes

Module 2: Water and wastewater quality parameter (6 hours)

pH and DO, Solids: total, dissolved, volatile and fixed solids, Organic carbon: BOD, COD and TOC, Nitrogen: Total Kjeldahl Nitrogen (TKN), Ammonia-nitrogen (NH_3N), Nitrite-nitrogen (NO_2N) and Nitrate-nitrogen (NO_3N), Phosphorous, Microbial analysis: Most probable number (MPN)

Module 3: Process Analysis (6 hours)

Rate of reaction, Order of reaction, Effect of temperature on reaction rate, Enzyme Reaction and kinetics, Types of reactors: CSTR and plug flow reactor, Reactor analysis, Residence time

Module 4: Biological Systems (6 hours)

Overview and application in wastewater treatment, Biological growth and kinetics, Half-life and doubling time, Yield and decay, Monod's kinetics, Estimation of kinetic parameters

Module 5: Aerobic Process (10 hours)

Suspended growth processes: Ponds and lagoons, Activated sludge process: Process description and its modifications, Substrate utilization and biomass growth, Process design, Hydraulic and Solids residence time, Activated sludge process with and without biomass recirculation, Efficiency and loading criteria, Effect of temperature on process performance, Trouble shooting, Attached growth processes: Rotating biological contactor (RBC), Trickling filter

Module 6: Anaerobic Processes (6 hours)

Process description, Process design, Startup and operation, High-rate anaerobic processes, Biofilm and biofloc processes, Loading criteria and biogas generation rate, Biogas yield and composition, Biogas cleanup and use, Trouble shooting and maintenance, Sludge digestion

Module 7: Downstream Treatment

(6 hours)

Need for nutrient removal, Nitrogen removal processes, Biological nitrification and denitrification, Phosphorus removal, Disinfection

3. Textbooks:

- i) Metcalf & Eddy. Inc. George Tchobanoglous, Franklin Burton, H. David Stensel (2003). Wastewater Engineering: Treatment and Reuse. (4th Edition), McGraw-Hill International Edition, New York
- ii) Henze, M., Mark C. M. Van Loosdrecht, George A. Ekema, Damir Brdjanovic (1997). Biological Wastewater Treatment: Principles, Modelling and Design, IWA Publishing, London

4. Reference Books:

- i) Sawyer, C. N., Parkin, G. F. and McCarty, P. L. (2008). Chemistry for Environmental Engineering. New York: McGraw-Hill.
- ii) Bailey, J. E. and Ollis, D. F. (1987). Biochemical Engineering Fundamentals. (2nd Edition). New York: McGraw-Hill International

