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|  | **National Institute of Technology Meghalaya**An Institute of National Importance | **CURRICULUM** |
| Programme | **Master of Technology**  | Year of Regulation |  **2018-19** |
| Department | **Civil Engineering** | Semester | **I**  |
| Course Code | Course Name | Pre-requisite | Credit Structure | Marks Distribution |
| L | T | P | C | INT | MID | END | Total |
| **CE 581** | **Biological Process for Wastewater Treatment** | **NIL** | **3** | **0** | **0** | **3** | **50** | **50** | **100** | **200** |
| Course Objectives | 1. To learn the fundamentals of process kinetics and bioreactors
2. To study about various biological treatment processes and its operations for the wastewater treatment
3. To study about various biological treatment processes and its operations for the wastewater treatment.
4. To explain the design principles and operational problems involved in various biological treatment processes
5. To Design and assess the operation of a biofilm system for wastewater treatment
 | Course Outcomes | CO1 | Able to describe the range of conventional and advanced biological treatment processes for the treatment of bulk organics, nutrients and micro pollutants |
| CO2 | Able to design the biological reactors based on biokinetics |
| CO3 | Able to select appropriate processes for specific applications, and have some knowledge of practical design considerations |
| CO4 | Able to execute and asses the performance of bioreactors in laboratory scale |
| CO5 | Able to design and optimise biological wastewater treatment processes. |
| SYLLABUS |
| No. | Content | Hours | COs |
| I | **Introduction:**Need for wastewater treatment, Need for sludge treatment, Benefits of biological wastewater treatment, Overview of wastewater treatment processes | **2** | CO1, CO 2 |
| II | **Water and wastewater quality parameter:**DO and pH, Solids: total, dissolved, volatile and fixed solids, Organic carbon: BOD, COD and TOC, Nitrogen: Total Kjeldahl Nitrogen (TKN), Ammonia-nitrogen (NH3N), Nitrite-nitrogen (NO2N) and Nitrate-nitrogen (NO3N), Phosphorous, Microbial analysis: Most probable number (MPN) | **5** | CO2, CO3, CO4 |
| III | **Process Analysis:**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 | **6** | CO2, CO3, CO4 |
| IV | **Biological Systems:** 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. | **6** | CO4, CO5, |
| V | **Aerobic Process:**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 | **6** | CO4, CO5 |
| VI | **Anaerobic Processes:**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, UASB, SBR etc, | **6** | CO4, CO5 |
| VII | **Downstream Treatment:**Need for nutrient removal, Nitrogen removal processes, Biological nitrification and denitrification, Phosphorus removal, Disinfection | **5** | CO4, CO5 |
| Total Hours | **36** |  |
| **Essential Readings** |
| 1. Metcalf & Eddy. Inc. George Tchobanoglous, Franklin Burton, H. David Stensel (2003). Wastewater Engineering: Treatment and Reuse. (4th Edition), McGraw-Hill International Edition, New York
 |
| 1. Henze, M., Mark C. M. Van Loosdrecht, George A. Ekema, Damir Brdjanovic (1997). Biological Wastewater Treatment: Principles, Modelling and Design, IWA Publishing, London
 |
| 1. Sawyer, C. N., Parkin, G. F. and McCarty, P. L. (2008). Chemistry for Environmental Engineering. New York: McGraw-Hill
 |
| **Supplementary Readings** |
| 1. Bailey, J. E. and Ollis, D. F. (1987). Biochemical Engineering Fundamentals. (2nd Edition). New York: McGraw-Hill International
 |
| 1. John Meurig Thomas, W. John Thomas; Principles and Practice of Heterogeneous Catalysis (PPHC), 2nd Edition, ISBN: 978-3-527-31458-4,
 |
| 1. Arceivala, S. J. and Asolekar, S. R., Wastewater Treatment for Pollution Control, 3rd Edition, McGraw-Hill Education (India) Pvt. Ltd., New Delhi, 2006.
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