Course Code	Course Name	L-T-P	Credits	Year of Introduction
BT461	Design of Biological Wastewater Treatment Systems	3-0-0	3	2016

Prerequisite : Nil

Course Objectives

- To provide the necessary theoretical background for the design of most common biological waste treatment systems.

Syllabus

Characteristics and *impacts of wastewater on* the environment, basic design considerations, types of biological treatment processes and reactors, aerobic suspended growth systems, anaerobic digesters, design consideration for upflow anaerobic sludge blanket reactors, biogas production.

Expected outcome

A student who successfully completes this course will be able to

i. Explain the characteristics of wastewater.
ii. Identify different types of reactors for wastewater treatment.
iii. Design a completely mixed activated sludge system.
iv. Explain the design features of an upflow anaerobic sludge blanket reactor.
v. Explain the factors affecting biogas production.

Reference Books

1. G Karia, R A Christian, *Wastewater Treatment: Concepts and Design Approach*, 2/e, PHI Learning Pvt., Ltd., 2013.
2. P Venugopala Rao, *Textbook of Environmental Engineering*, Prentice-Hall of India Pvt. Ltd., 2002.
3. Metcalf & Eddy, *Wastewater Engineering: Treatment and Reuse*, 4/e, Tata McGraw-Hill Education, 2003.
4. M Narayana Rao, Amal K Datta, *Waste Water Treatment: Rational Methods of Design and Industrial Practices*, 3/e, Oxford & IBH Publishing Company Pvt. Ltd., New Delhi,
5. R S Khoiyangbam, Navindu Gupta, Sushil Kumar, *Biogas Technology: Towards Sustainable Development*, The Energy and Resources Institute (TERI), 2011.

Course Plan

Module	Contents	Hours	Sem. Exam Marks
I	Wastewater-origin, characteristics, *impacts of wastewater on* the environment, basic design considerations-estimation of wastewater quantities, variation in wastewater flow rates-average daily flow, maximum daily flow, peak hourly flow, minimum daily flow, minimum hourly flow, process flow sheet, reactor considerations.	5	15%
II	Objectives and fundamentals of biological treatment, types of biological treatment processes, types of reactors used for wastewater treatment process, kinetics of biological treatment systems-batch and continuous systems, biological nitrogen removal, biological phosphorous removal.	5	15%
FIRST INTERNAL EXAM			

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III	Aerobic suspended growth systems-Conventional activated sludge processes and its modifications-theoretical principles, design of completely mixed activated sludge system, F/M ratio, hydraulic loading, MLSS, MLVSS, sludge age, sludge return, calculation of the reactor volume, production and removal of excess sludge, sludge volume index, Solids Retention Time (SRT) or Mean Cell Residence Time, oxygen requirements.	8	15%
IV	Aerobic attached growth system-Trickling filters-theoretical principles, classification, design principles, process design considerations, Oxidation ponds-construction and design considerations, aerobic sludge digestion, waste stabilization ponds, oxidation ditches-theory and design, factors affecting the design, theory and design of rotating biological contactors	8	15%
SECOND INTERNAL EXAM			
V	Fundamentals of anaerobic treatment, types of anaerobic digesters-conventional systems, high-rate systems and combined treatment systems, design of upflow anaerobic sludge blanket reactors, anaerobic sequencing batch reactor, anaerobic filters-upflow and downflow anaerobic filters, sludge treatment and disposal, sludge digestion, sludge drying, sludge conditioning, sludge drying characteristics.	8	20%
VI	Biogas technology-microbiology of biogas production, process parameters for a biogas plant, biogas yield from different substrates, methods to enhance biogas production-effect of heating, insulation and stirring on gas production, basic components of a biogas plant, biogas plant designs-continuous type plants, semi-continuous plants, fixed dome type, floating gasholder digester (KVIC),kinetic models for predicting biogas production, design equations of biogas plants.	8	20%
END SEMESTER EXAMINATION			

QUESTION PAPER PATTERN:

Maximum Marks: 100 Exam Duration: 3 hours

The question paper consists of Part A, Part B and Part C.

Part A consists of three questions of 15 marks each uniformly covering Modules I and II. The student has to answer two questions (15×2=30 marks).

Part B consists of three questions of 15 marks each uniformly covering Modules III and IV. The student has to answer two questions (15×2=30 marks).

Part C consists of three questions of 20 marks each uniformly covering Modules V and VI. The student has to answer two questions (20×2=40 marks).

For each question there can be a maximum of 4 subparts.

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