Birla Institute of Technology & Science, Pilani
Hyderabad Campus

SECOND SEMESTER 2022-2023

Course Handout Part II

Date: 16-01-2023

In addition to Part-I (General Handout for all courses appended to the timetable), this portion gives further specific details regarding the course.

Course No. : **CE F342**
Course Title : **Water and Wastewater Treatment**
Instructor-in-Charge : Murari R R Varma

Laboratory Instructors :Rishith Vogeti
N Satish
Deepjyothi Deb

Scope and Objective of the Course:

The course is designed to give a preliminary understanding of concepts and basics of the water supply and wastewater systems design for a given town/city/locality. The unit operations and processes required in treating water, depending on the sources of the raw water, are given more emphasis than the distribution network. Similarly, the sewage collection from municipal households and processes involved in treating the sewage before it can be let out into surface water bodies are discussed. A brief introduction to advances in treatment technologies is included in the relevant sections.

Course outcomes:

At the end of the course, the student will be able to.

1. Identify and measure major pollutants and corresponding parameters in the water source.
2. Establish treatment operations to remove specific pollutants depending on the surface or groundwater source.
3. Evaluate the extent and kind of treatment required for municipal wastewater depending on its characteristics and where it will be discharged.
4. Applying the concepts to design simple water and wastewater treatment operations.

Textbooks:

1. Garg, S. K. (2020). *Environmental Engineering - (Vol. I)*: *Water Supply Engineering* (34th ed., Vol. 1) Khanna
2. Garg, K. S. (2021). *Environmental Engineering (Vol. II) Sewage Waste Disposal and Air Pollution Engineering* (39th ed., Vol. 2). Khanna.

Reference books

1. Davis, M. L., 2013. *Water and Wastewater Engineering - Design Principles and Practice.* 1st ed. New Delhi: Tata McGraw-Hill Education.

2. Metcalf & Eddy, Inc., George Tchobanoglous, H. Stensel, Ryujiro Tsuchihashi, Franklin Burton, 2014. Wastewater Engineering: Treatment and Resource Recovery, Fifth. Ed.
3. Online articles and other publications

Course Plan:

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Text Book	SLOs
1-3	Classify different sources of water and their stressors.	Sources of water, wastewater	CH-3(T1) CH-1(T2)	a, c, f
4-6	Determine the minimum and desirable amounts of water required for different uses like domestic, public, industrial, institutional, etc. Predict the population of a given community for the design period using an appropriate/justifiable method	Population forecasting methods, factors affecting the rate of demand	CH-2(T1)	a, c
7-8	Identify pollutants present in water and the levels to which they need to be removed	Common impurities in water, physical and chemical analysis, Standards of purified water	CH-8(T1)	a, b
9-10	Define and describe different methods for estimating oxygen demand in wastewater, their importance and applications: ThOD, COD and BOD	Wastewater - Physical, chemical and biological characteristics, BOD, COD	CH-7(T2)	a, b, c, e
11-20	Analyze water quality and determine treatment needs using appropriate standards. Explain the different types of settling that are encountered in water and wastewater treatment. Explain the mechanisms and importance of coagulation and flocculation in water and wastewater treatment plants Design appropriate treatment processes to achieve treatment objectives	Important Unit Operations in Water Treatment: Screening, aeration, Sedimentation tanks. Coagulation and flocculation, Design of sedimentation tanks, Filtration: Filtration hydraulics, porous media filters, Softening	CH9(T1), CH-9 (T2), R1	a, c, e
21-22	Describe the need for disinfection in water or wastewater treatment. Evaluate the merits and demerits of different types of disinfectants.	Various approaches for disinfection	CH-9(T1)	a, b

	Define terms such as chlorine demand, breakpoint chlorination, and chlorine residuals.			
23-24	Describe types of sewerage systems and components of sewerage system Differentiate sewage and septage	Separate and combined Sewerage systems. Characteristics of Faecal sludge and septage. Estimation of design sewer discharge.	CH-2,5 (T2), R3	a, c
25-34	Differentiate unit processes and unit operations Estimate the quantity and quality of wastewater generated in a community	Unit operations and chemical processes in wastewater treatment: Screening procedures, Grit Chamber	CH-9(T2)	a, c
35-38	Describe the differences between suspended and attached growth processes. Explain aerobic, anoxic and anaerobic treatments. Select an appropriate biological process for water or wastewater treatment. Design a complete suspended/attached growth process for wastewater treatment.	Unit processes: Biological treatment-Trickling Filters, Recirculation, Aeration tanks, Activated sludge systems, various design procedures; miscellaneous processes: Oxidation ditches and ponds, Aerobic and anaerobic ponds, Sludge Treatment, Thickening	CH-9(T2), R2	a, c, e
39-41	Explain the various aspects of faecal sludge and septage management	Collection and disposal of excreta in unsewered urban and rural areas, Septic tanks, Faecal sludge and septage management	CH-12,13 (T2), R3	a, c
42	Describe the different methods for analyzing flows or head losses in distribution networks. Make use of criteria like self-cleansing and maximum velocity to design sewers	Various approaches to the design of water distribution systems, Design of Sewers	CH-6(T1), CH-4(T2)	a, c

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Mid Semester Test	90 minutes	25	13/03 4.00 - 5.30PM	OB
Quiz / Tutorial Assignments	During lecture/ tutorial	10	Will be announced during the tutorial/ or the day before in case of a quiz	OB

Project (Group projects)	Two Evaluations (Mid and Final)	10	TBA	OB
Laboratory (Lab work/ Viva/ Quiz)	TBA	20	TBA	OB
Comprehensive exam	180 minutes	35	09/05 AN	OB

List of Experiments:

1	Determination of Calcium/ Magnesium in water	1 Turn
2	Determination of Alkalinity of water	1 Turn
3	Determination of Dissolved Oxygen (DO) in water	1 Turn
4	Determination of Iron content in water	1 Turn
5	Determination of Chloride content in water	1 Turn
6	Determination of Sulphate content in water	
7	Determination of Residual Chlorine	1 Turn
8	Determination of Nitrate / Phosphate content in wastewater	1 Turn
9	Determination of COD content in wastewater	1 Turn
10	Determination Solids in Wastewater (TDS, TSS, SVI)	1 Turn
11	Determination of the Optimum dose of a coagulant	1 Turn
12	Microbiological examination (Coliform test)	1 Turn
13	Determination of Fluoride content in water	1 Turn
14	Determination of BOD content in wastewater	1 Turn

*** Student Learning Outcomes (SLOs):**

SLOs are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

(a) an ability to apply knowledge of mathematics, science and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Chamber/Online Consultation Hour: Tuesday 5-6 PM.

Notices: Notices concerning the course will be displayed on **CANVAS** (All students are requested to get accounts in *Canvas for students*).

Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester, and any academic dishonesty is unacceptable.

Make-up Policy:

- Please avoid frivolous make-ups. Make-ups are strongly discouraged.
- In case of unavoidable reasons, requests for the **make-up of lab sessions** have to be made before the lab date (which makeup is requested) in the provided format **to the lab instructor with a copy to IC**. In medical emergencies, the requests must be communicated within two days. In case of medical emergencies, requests must be supported by valid certificates.
- Make-up will not be provided in the case of *tutorial evaluation/quiz.* The best n evaluation out of a minimum n+2 (usually 12) will be considered. Students are requested to make an effort to attend the maximum no of *assessments* to avoid the need for makeup.

INSTRUCTOR-IN-CHARGE

CE F342