



SECOND SEMESTER 2021-2022

Course Handout Part II

Date: 15-01-2022

In addition to Part-I (General Handout for all courses appended to the time table) 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 : Jittin Varghese
Sandra Maria Cherian
N Satish

Scope and Objective of the Course:

The course is designed to give a preliminary understanding of concepts and basics of design of water supply and wastewater systems for a given town/city/locality. The unit operations and processes required in treating water depending on sources of the raw water are given more emphasis than the distribution network. Similarly, the collection of sewage from municipal households and processes involved in treating the sewage before they can be let out into surface water bodies are discussed. Brief introduction advances in treatment technologies are 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 that will be required for removing 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 depending on where it is to 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 population of a given community for the design period using an appropriate/justifiable method	Population forecasting methods, factors affecting 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. Define terms such as chlorine demand, breakpoint chlorination, and chlorine residuals.	Various approaches for disinfection	CH-9(T1)	a, b
23-24	Describe types of sewerage system 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 differences between suspended, attached growth processes. Explain aerobic, anoxic and anaerobic treatments.	Unit processes: Biological treatment-Trickling Filters,	CH-9(T2), R2	a, c, e

	Select an appropriate biological process for water or wastewater treatment. Design a complete suspended/attached growth process for wastewater treatment.	Recirculation, Aeration tanks, Activated sludge systems, various design procedures, Miscellaneous processes: Oxidation ditches and ponds, Aerobic and anaerobic ponds, Sludge Treatment, Thickening		
39-40	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
41-42	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 of design of water distribution system, 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 min	25	12/03 3.30pm to 5.00pm	OB
Surprise/ Online Pop Quiz	TBA	10	To be announced in class.	OB
Project (Group projects)	-	10	Continuous	OB
Laboratory Quiz and Viva	-	15	TBA	OB
Comprehensive	2 hours	40	12/05 AN	OB / CB

List of Experiments:

1	Determination of Calcium/ Magnesium of water	1 Turn
2	Determination of Alkalinity of water	1 Turn
3	Determination of Dissolved Oxygen (DO) of 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 Optimum dose of a coagulant and Determination of Turbidity	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: With prior appointment on through **email only**. Kindly do not message for appointments through social media. If required to discuss live, it could be done through *Google meet* with prior appointment. Students are advised to initiate meetings on *Google meet* after appointment through *Google Calendar*.

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 type of academic dishonesty is not acceptable.

Make-up Policy: Please avoid frivolous make-ups. Prior and genuine make-up requests shall be accommodated on a case-to-case basis.

In the case of *pop quiz/quiz*, the best 10 quizzes out of minimum n+1 (usually 11) will be considered. Students are requested to make an effort to attend maximum no of quizzes to avoid the need for makeup. Only in case of persistent internet connectivity issues, they may be considered to be evaluated as a special case. Such cases are to be informed to the instructor at the earliest.

In case of issues of medical emergencies, requests have to be supported by valid certificates.

INSTRUCTOR-IN-CHARGE

CE F342

