IV Semester

PUBLIC HEALTH ENGINEERING			
Course Code	**21CV43**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2+2+2+0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

1.Analyze the variation of water demand and to estimate water requirement for a community.

2. Study drinking water quality standards and to illustrate qualitative analysis of water.

3. Analysis of physical and chemical characteristics of water and wastewater.

4.Understand and design of different unit operations and unit process involved in water and wastewater treatment process

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Apart from conventional lecture methods various types of innovative teaching techniques through videos, animation films may be adopted so that the delivered lesson can progress the students in theoretical, applied and practical skills.
2. Arrange field visits to give brief information about the water and wastewater treatment plant.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking and enhance the knowledge of treatment processes.
5. Adopt Problem Based Learning (PBL), which fosters students, Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Seminars, surprise tests and Quizzes may be arranged for students in respective subjects to develop skills.

Module-1

Introduction: Water: Need for protected water supply, Demand of Water: Types of water demands - domestic demand, industrial, institutional and commercial demand, public use and fire demand estimation, factors affecting per capita demand, Variations in demand of water, Peak factor.

Design period and factors governing design period. Methods of population forecasting and numerical problems. Physico chemical characteristics of water(Analysis to be conducted in laboratory session). Sampling.

8hours

Teaching-Learning Process	Chalk and talk, powerpoint presentation, demonstration and analysis in laboratory

Module-2	
Water Treatment: Objectives, Unit flow diagrams – significance of each unit, Aeration process- Limitations and types, **Sedimentation -** Theory, settling tanks, types and design with numericals, Coagulation and flocculation, types of coagulants,(Optimisation of coagulant to be carried out in the laboratory),**Filtration:** mechanism, theory of filtration, types offilters: slow sand, rapid sand and pressure filters. Operation and cleaning. Design of slow and rapid sand filter without under drainage system (numericals) **8hours**	
Teaching-Learning Process	Chalk and talk, videos, PowerPoint Presentation,anim.ations and visit to in around water treatment plant
Module-3	
Disinfection: Methods of disinfection with merits and demerits. Breakpoint of chlorination (Analysis to be conducted in laboratory session) Softening: Lime soda and Zeolite process. **Wastewater**: **Introduction:** Need for sanitation, methods of sewage disposal, types of sewerage systems, **Treatment of municipal waste water:** Waste water characteristics(Analysis to be conducted in laboratory session): sampling, significance and techniques, physical, chemical and biological characteristics,Numericals on BOD, **8hours**	
Teaching-Learning Process	Chalk and talk, videos, PowerPoint Presentation, animations
Module-4	
Treatment Process: flow diagram for municipal waste water Treatment unit operations and process,Screens: types, disposal. Grit chamber, oil and grease removal. primary and secondary settling tanks (no numericals), Suspended growth system - conventional activated sludge process and its modifications. **8hours**	
Teaching-Learning Process	Chalk and talk, videos, PowerPoint Presentation,, animations, and visit to in around waste water treatment plant
Module-5	
Attached growth system – trickling filter, numericals on Trickling filters, bio-towers and rotating biological contactors. Principle of stabilization ponds, oxidation ditch, Sludge digesters(aerobic and anaerobic), Equalization., thickeners and drying beds. 10hours	
Teaching-Learning Process	Chalk and talk, videos, PowerPoint Presentation, animations

EXPERIMENTS

Experiments to be carried out are:

1. Determination of pH, Conductivity, TDS and Turbidity.
2. Determination of Acidity and Alkalinity
3. Determination of Calcium, Magnesium and Total Hardness.
4. Determination of Dissolved Oxygen
5. Determination of BOD.
6. Determination of Chlorides
7. Determination of percentage of % of available chlorine in bleaching powder sample, Determination of Residual Chlorine and chlorine demand.
8. Determination of Solids in Sewage: (i) Total Solids, (ii) Suspended Solids, (iii) Dissolved Solids, (iv)Volatile Solids, Fixed Solids (v) Settleable Solids.
9. Determination of optimum coagulant dosage using Jar test apparatus.
10. Determination Nitrates and Iron by spectrophotometer
11. Determination of COD(Demonstration)
12. 13. Air Quality Monitoring (Demonstration)

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- Estimate average and peak water demand for a community.
- Evaluate water quality and environmental significance of various parameters and plan suitable treatment system.
- Design the different units of water treatment plant
- Understand and design the various units of wastewater treatment plant
- Acquire capability to conduct experiments and estimate the concentration of different parameters and compare the obtained results with the concerned guidelines and regulations..

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC

Two Tests each of **20 Marks (duration 01 hour**)

- First test after covering 40-45 % of the syllabus
- Second test after covering 85-95% of the syllabus

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of the 9th week of the semester

Scaled-down marks of the average of two tests and other assessment methods will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The 15 **marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks** shall be for the test conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to **05 marks.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally scaled down to 50 Marks.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

- The minimum marks to be secured in CIE to appear for SEE shall be 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions is to be set from the practical component of IPCC, the total marks of all questions should not be more than 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify for the SEE. Marks secured will be scaled down to 50.
- The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

- Howard S. Peavy, Donald R. Rowe, George T, “Environmental Engineering” - Tata McGraw Hill, New York, Indian Edition, 2013
- S. K. Garg, Environmental Engineering vol-I, Water supply Engineering – M/s Khanna Publishers, New Delhi2010
- B.C. Punmia and Ashok Jain, Environmental Engineering I-Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi2010.
- B C Punmia, “Environmental Engineering vol-II”, Laxmi Publications 2nd, 2016
- Karia G.L., and Christian R.A, “Wastewater Treatment Concepts and Design Approach”, Prentice Hall of India Pvt. Ltd., New Delhi. 3rd, Edition, 2017
- S.K.Garg, “Environmental Engineering vol-II, Water supply Engineering”, Khanna Publishers, – New Delhi, 28th edition and 2017
- CPHEEO Manual on water supply and treatment engineering, Ministry of Urban Development, Government of India, New Delhi.
- Mark.J Hammer, Water & Waste Water Technology, John Wiley & Sons Inc., New York,2008.

Web links and Video Lectures (e-Resources):

Lecture 01: Background and Course Introduction
https://youtu.be/yDnrv-oGSBc
Lecture 02: Water Sources and Availability
https://youtu.be/K4Vty0cmybI
Lecture 03: Water Uses
https://youtu.be/9H7dPkWOsjA
Lecture 04: Water Supply Key Issues and Concerns
https://youtu.be/JueYGPbsflw
Lecture 05: Urban water services and water supply systems
https://youtu.be/bCKm9KkcQtw
Lecture 06: Urban water services and water supply systems
https://youtu.be/s0hy0ZlM1bA
Lecture 07: Components of Water Demand
https://youtu.be/mVmErXpIp64
Lecture 08: Fluctuations in Water Demand
https://youtu.be/qXUwy5OnX9Q
Lecture 09: "Concept of Design Period and Design Population Need to Forecast Population Population Forecasting Methods
https://youtu.be/QyLdA_qhUog
Lecture 10: Demand Forecasting and Design Capacities
https://youtu.be/rKTwjvx7E8A
Lecture 11: Water Sources and Collection of Water
https://youtu.be/TvEGgZw1El4
Lecture 12: Surface Water Intakes
https://youtu.be/GcQOyAdG5OM
Lecture 13: Surface Water Intakes Systems
https://youtu.be/r1oJtm_SXz4
Lecture 14: Groundwater Intake
https://youtu.be/Zo1p7uRDEmM
Lecture 15: Well Interferences,Well losses and Efficiency
https://youtu.be/dRU5M_WICU0
Lecture 16: Raw water Conveyance and Pumping
https://youtu.be/iQwEoEhujTc
Lecture 17: Practice Problems
https://youtu.be/e5bduQiz5NY
Lecture 18 : Raw Water Storage
https://youtu.be/WZlI7kWoUjE
Lecture 19 : Treated Water Storage
https://youtu.be/BuZ48afjd04
Lecture 20 : Placement, Design and Construction of Storage Reservoirs
https://youtu.be/nQCZbXaBb1o
Lecture 21 : Practice Problems on Reservoir Capacity Estimation
https://youtu.be/yuPLzQvmU-c
Lecture 22 : Water Quality and Water Pollutants
https://youtu.be/fZPry6BENPI
Lecture 23 : Water Quality Parameters
https://youtu.be/6VuHxD3t9kw
Lecture 24 : Philosophy of Water Treatment
https://youtu.be/6I-eBqE7Hew
Lecture 25 : Water Treatment Units Screening and Aeration

Lecture 26 : Water Treatment Units Sedimentation
https://youtu.be/T1M4Ecjwq7Q
Lecture 27 : Practice Problems On Sedimentation
https://youtu.be/Zlh2mpOjIMU
Lecture 28: Coagulation and Flocculation: Theory
https://youtu.be/aAo2bBaF0yU
Lecture 29: Coagulation and Flocculation: Selection and Application
https://youtu.be/44p0lN31ogo
Lecture 30: Coagulation and Flocculation: Design Operation and Process Control
https://youtu.be/v0TDfCz_jLU
Lecture 31: Filtration Theory and Slow Sand Filters
https://youtu.be/nuJQe9F_2zI
Lecture 32: Rapid Sand Filter: Filter Media and Components
https://youtu.be/3qw3sKcuQlY

Lecture 33: Rapid Sand Filters and Pressure Filters
https://youtu.be/PEX_0DebrSQ
Lecture 34: Practice Problems Coagulation Flocculation and Filtration
https://youtu.be/73jxsBCDuq4
Lecture 35: Disinfection Basic
https://youtu.be/d4UG9Xivuik
Lecture 36: Chlorination
https://youtu.be/L3eSkeOU3jY

- Activity Based Learning (Suggested Activities in Class)/ Practical Based learning http://nptel.ac.in
- https://swayam.gov.in
- https://www.vlab.co.in/participating-institute-amrita-vishwa-vidyapeetham