## Department of Civil Engineering

## Details of Lesson Plan

| S.No. | Particulars | Details |
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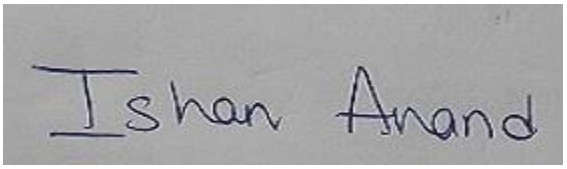
| 1. | Course Name | Environment Engineering |
| 2. | Course Code | CE-403 |
| 3. | Academic Year | 2024-25 |
| 4. | Semester | 4th SEMESTER |
| 5. | Number of Lesson plans | 40 |
| 6. | Faculty Assigned | Mr. Ishan Anand |




Faculty Signature

| Lesson Plan No. 1 | Course Name: Environment Engineering<br>Topic: Scope of Environmental Engineering | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>a. Articulate the concept of sources of water.<br>b. Learnt about the important hydrological concepts.<br>c. Illustrate the study of surface and sub surface sources of water.<br>d. Learn about rain gauges and its types. |
| **Teaching Aids (if any)** | a. Pen and white board.<br>b. Quizzes. |
| **Teaching Development** | 1. **Introduction** (5 minutes)<br>- Introduce the students about the concept of sources of water, its hydrological concept.<br>- Introduce them about study of surface and sub surface sources of water.<br>- Highlight the importance of aquifers, aquitard, aquiclude, aquifuge.<br>2. **Development** (30 minutes)<br>a) Discussed about general introduction about various sources of water that are into two categories:<br>1) Surface sources- Ponds, lakes, rivers, oceans, storage reservoirs.<br>2) Subsurface sources- Springs, infiltration galleries, infiltration wells, wells and tube wells.<br>b) Importance of hydrological cycle in ground water recharge.<br>c) Importance of precipitation and its different types.<br>d) Rainfall and its distribution like ground rainfall, infiltrations, and depression storages.<br>e) Types of rain gauges used in India.<br>f) Discussed about aquifers – confined and unconfined aquifers.<br>g) Ground water resources, layers of saturation zones, Them's equation for confined aquifers and unconfined aquifers.<br>3. **Exercise** (5 minutes) –<br>Derive the relations for dupit equation for unconfined aquifers. |
| **Closure** | 1. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br>2. Suggested Reading<br>- Video links<br>https://www.youtube.com/watch?v=LiL0_sfdhQ0&t=1208s<br>-<br>3. Homework<br>- Read about the surface and subsurface ground water sources of water make a list and submit on Google classroom. |

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| | Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 1. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 2 | Course Name: Environment Engineering<br>Topic: Surface and ground water sources | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>e. Articulate the concept of sources of water.<br>f. Learnt about the important hydrological concepts.<br>g. Illustrate the study of surface and sub surface sources of water.<br>h. Learn about rain gauges and its types. |
| **Teaching Aids (if any)** | c. Pen and white board.<br>d. Quizzes. |
| **Teaching Development** | 4. **Introduction** (5 minutes)<br>- Introduce the students about the concept of sources of water, its hydrological concept.<br>- Introduce them about study of surface and sub surface sources of water.<br>- Highlight the importance of aquifers, aquitard, aquiclude, aquifuge.<br>5. **Development** (30 minutes)<br>h) Discussed about general introduction about various sources of water that are into two categories:<br>3) Surface sources- Ponds, lakes, rivers, oceans, storage reservoirs.<br>4) Subsurface sources- Springs, infiltration galleries, infiltration wells, wells and tube wells.<br>i) Importance of hydrological cycle in ground water recharge.<br>j) Importance of precipitation and its different types.<br>k) Rainfall and its distribution like ground rainfall, infiltrations, and depression storages.<br>l) Types of rain gauges used in India.<br>m) Discussed about aquifers – confined and unconfined aquifers.<br>n) Ground water resources, layers of saturation zones, Them's equation for confined aquifers and unconfined aquifers.<br>6. **Exercise** (5 minutes) –<br>Derive the relations for dupit equation for unconfined aquifers. |
| **Closure** | 4. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br>5. Suggested Reading<br>- Video links<br>https://www.youtube.com/watch?v=LiL0_sfdhQ0&t=1208s<br>-<br>6. Homework<br>- Read about the surface and subsurface ground water sources of water make a list and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |

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| **Evaluation** | 2. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 3 | Course Name: Environment Engineering<br>Topic: Selection and development of sources | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>i. Articulate the concept of sources of water.<br>j. Learnt about the important hydrological concepts.<br>k. Illustrate the study of surface and sub surface sources of water.<br>l. Learn about rain gauges and its types. |
| **Teaching Aids (if any)** | e. Pen and white board.<br>f. Quizzes. |
| **Teaching Development** | 7. **Introduction** (5 minutes)<br>- Introduce the students about the concept of sources of water, its hydrological concept.<br>- Introduce them about study of surface and sub surface sources of water.<br>- Highlight the importance of aquifers, aquitard, aquiclude, aquifuge.<br>8. **Development** (30 minutes)<br>o) Discussed about general introduction about various sources of water that are into two categories:<br>5) Surface sources- Ponds, lakes, rivers, oceans, storage reservoirs.<br>6) Subsurface sources- Springs, infiltration galleries, infiltration wells, wells and tube wells.<br>p) Importance of hydrological cycle in ground water recharge.<br>q) Importance of precipitation and its different types.<br>r) Rainfall and its distribution like ground rainfall, infiltrations, and depression storages.<br>s) Types of rain gauges used in India.<br>t) Discussed about aquifers – confined and unconfined aquifers.<br>u) Ground water resources, layers of saturation zones, Them's equation for confined aquifers and unconfined aquifers.<br>9. **Exercise** (5 minutes) –<br>Derive the relations for dupit equation for unconfined aquifers. |
| **Closure** | 7. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br>8. Suggested Reading<br>- Video links<br>https://www.youtube.com/watch?v=LiL0_sfdhQ0&t=1208s<br>-<br>9. Homework<br>- Read about the surface and subsurface ground water sources of water make a list and submit on Google classroom. |

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| | Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 3. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 4 | Course Name: Environment Engineering<br>Topic: Water supply systems/demands | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>m. Articulate the concept of water supply systems.<br>n. Learnt about various types of water demands.<br>o. Illustrate the amount of water available for public.<br>p. Fire demands, Average daily demand, maximum daily demand, and maximum hourly demand. |
| **Teaching Aids (if any)** | g. Pen and white board.<br>h. Quizzes.<br>i. IS:1172-1993 |
| **Teaching Development** | 10. **Introduction** (5 minutes)<br>- Introduce the students about the concept of water supply systems.<br>- Introduce them various types of water demands.<br>- Highlight them about various empirical approaches to calculate fire demand.<br>11. **Development** (30 minutes)<br>v) Discussed about various types of water demands:<br>7) Domestic water demand.<br>8) Industrial water demand.<br>9) Institutional water demand or commercial.<br>10) Demand for public uses.<br>11) Fire demands.<br>w) Average requirements or water demands for low income group and high income group.<br>x) Calculation of per capita demand or LPCD.<br>y) Fire demands and its calculation using empirical approaches like:<br>1) Kuchling's formula.<br>2) Buston's formula.<br>3) Freeman's formula.<br>4) National board of fire formula.<br>z) Learnt about average daily demand.<br>aa) Discussed about maximum daily demand and graphically studying the trend analysis of maximum hourly demand.<br>12. **Exercise** (5 minutes) –<br>Solve a numerical on designing a distribution system on basis of daily demands of water. |
| **Closure** | 10. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br>11. Suggested Reading<br>- Video links<br>- https://www.youtube.com/watch?v=nluTKmE4lGs |

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| | 12. Homework<br>- Read about various types of water demands make a list and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 4. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 5 | Course Name: Environment Engineering<br>Topic: Municipal water demand variations. | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>q. Articulate the concept of municipal water demands.<br>r. Learnt about various types of water demands.<br>s. Illustrate the amount of water available for public.<br>t. Fire demands, Average daily demand, maximum daily demand, and maximum hourly demand. |
| **Teaching Aids (if any)** | j. Pen and white board.<br>k. Quizzes.<br>l. IS:1172-1993 |
| **Teaching Development** | 13. **Introduction** (5 minutes)<br>- Introduce the students about the concept of water supply systems.<br>- Introduce them various types of water demands.<br>- Highlight them about various empirical approaches to calculate fire demand.<br>14. **Development** (30 minutes)<br>bb) Discussed about various types of water demands:<br>12) Domestic water demand- its consumption.<br>13) Industrial water demand- its consumption.<br>14) Institutional water demand or commercial.<br>15) Demand for public uses.<br>16) Fire demands calculation.<br>cc) Water required compensating losses in thefts and wastes.<br>dd) Calculation of total requirement of water for a town or a city.<br>ee) Discussed about calculating the future growth of population by various methods by population forecasting.<br>ff) Factors affecting per capita demand.<br>gg) Policy of metering and method of charging in municipal areas.<br>hh) Studying population growth trends.<br>15. **Exercise** (5 minutes) –<br>Analyze simple graphical method of population forecasting. |
| **Closure** | 13. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br>14. Suggested Reading<br>- Video links<br>- https://www.youtube.com/watch?v=nluTKmE4lGs<br><br>15. Homework<br>- Solve the numerical in the text book mentioned in class, make a note and submit on Google classroom. |

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| | Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 5. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 6 | Course Name: Environment Engineering<br>Topic: Population forecasting and water demand estimations. | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>u. Articulate the concepts of population forecasting.<br>v. Knowledge about various methods of population forecasting.<br>w. Able to study the population data and population growth of a city and design the distribution for that population.<br>x. Ideal population growth curve. |
| **Teaching Aids (if any)** | m. Pen and white board.<br>n. Quizzes. |
| **Teaching Development** | 16. **Introduction** (5 minutes)<br>- Introduce the students about the concept of Population forecasting.<br>- Introduce them various methods of calculation of population of an area.<br>- Highlight them about logistic curve of population calculation.<br>17. **Development** (30 minutes)<br>ii) Discussed about forecasting of population and types:<br>17) Arithmetic increase method.<br>18) Geometric increase method.<br>19) Incremental increase method.<br>20) Decreasing rate of growth method.<br>21) Simple graphical method.<br>22) The logistic curve method.<br>jj) Method that is used to calculate the population of already developed city.<br>kk) Method that is used to calculate the population of rapidly growing city.<br>ll) Method that is used to calculate the population of city where rate of growth is not constant.<br>mm) Concept of saturation population, population at any time‘t’.<br>18. **Exercise** (5 minutes) –<br>Solving different numerical on different methods. |
| **Closure** | 16. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br>17. Suggested Reading<br>- Video links<br>- https://www.youtube.com/watch?v=5EVvM-TL1WU<br>18. Homework |

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| | - Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 6. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 7 | Course Name: Environment Engineering<br>Topic: Intakes and Transmission systems | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>y. Articulate the definitions and general introduction of intake conduits.<br>z. Knowledge about factors governing the location of intakes.<br>aa. Able to know about different types of intake structures.<br>bb. Information about various types of conduits in transmission systems. |
| **Teaching Aids (if any)** | o. Pen and white board.<br>p. Quizzes.<br>q. Power point presentations. |
| **Teaching Development** | 19. **Introduction** (5 minutes)<br>- Introduce the students about simple submerged intakes.<br>- Introduce them about medium sized river intake structure and uses of that structure over canal intakes.<br>- Highlight them about conduits for transporting water in distribution system.<br>20. **Development** (30 minutes)<br>nn) Discussed about types of intake structures:<br>23) Simple submerged intakes.<br>24) Intake towers.<br>25) Medium sized river intake structures.<br>26) Typical twin well type of river intake structures.<br>27) Single well type of river intake structure<br>28) Design of inlet well.<br>oo) Factors governing the location of an intake.<br>pp) Design of coarse screen, design of intake conduit, intakes of sluiceway of dams.<br>qq) Requirements of good distribution systems.<br>rr) Layout of distribution networks<br>1) Dead end system.<br>2) Grid iron system.<br>3) Ring system.<br>4) Radial system.<br>21. **Exercise** (5 minutes) –<br>Solving different numerical on canal intakes designing coarse screens and intake conduits. |
| **Closure** | 19. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br>20. Suggested Reading<br>- Video links<br>- https://www.youtube.com/watch?v=rKMFga1C-Pk |

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| | 21. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 7. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 8 | Course Name: Environment Engineering<br>Topic: Pipes for transporting water and their designs. | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>cc. Articulate the designs of different pipes used in transporting of water.<br>dd. Knowledge about flumes, aquiducts, canals, pressure conduits.<br>ee. Able to know about gravity conduits and pressure conduits.<br>ff. Information about hydraulic flow and designing of pressure pipes as gravity mains |
| **Teaching Aids (if any)** | r. Pen and white board.<br>s. Quizzes. |
| **Teaching Development** | 22. **Introduction** (5 minutes)<br>- Introduce the students about gravity conduits like flumes, aquiducts, canals, pressure conduits.<br>- Introduce them about hydraulic flow and design of pipes.<br>- Highlight them about conduits for transporting water in distribution system.<br>23. **Development** (30 minutes)<br>ss) Discussed about various types of conduits:<br>29) Gravity conduits- canals, flumes, aqueducts.<br>30) Pressure conduits<br>tt) Designs of pipes by Darcy-Weisbach formula, manning's formula, hazen-william's formula, modifier H-W formula.<br>uu) Study of flow in pipe systems.<br>vv) Requirements of water hammer pressures.<br>ww) Laying of water supply pipes.<br>xx) Gate valves, air valves, pressure relief valves, reflux valves, manholes.<br>yy) Testing of pipelines.<br>zz) Various types of pressure pipes:<br>1) Cast iron pipes.<br>2) Galvanised steel pipes and its corrosion control.<br>3) RCC pipes.<br>4) Asbestos pipes<br>5) Vitrified clay pipes<br>6) Hume steel pipes.<br>7) Gates and valves in pipe lines.<br>8)<br>**Exercise** (5 minutes) –<br>Solving different numerical on designing the piping system in transmission of water. |
| **Closure** | 22. Summarize the Lesson Learning Outcomes and get affirmation from students on these. |

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| | 23. Suggested Reading<br>- Video links<br>https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>24. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 8. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 9 | Course Name: Environment Engineering<br>Topic: Physical chemical and biological water quality parameters. | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>gg. Identify and explain the key **physical**, **chemical and biological** parameters used to assess water quality.<br>hh. Understand the significance of these parameters in maintaining water safety and environmental health.<br>ii. Differentiate between different water quality parameters and their methods of measurement. |
| **Teaching Aids (if any)** | t. Pen and white board.<br>u. Quizzes.<br>v. Presentation slides. |
| **Teaching Development** | 24. Introduction (5 minutes)<br>- Introduce the concept of water quality and why it is crucial for public health, ecosystems, and water treatment processes.<br>- Briefly outline the three categories of water quality parameters: physical, chemical, and biological.<br>25. Development (30 minutes)<br>aaa) Define physical parameters and explain their role in assessing water's physical state<br>Temperature: Influences chemical reactions, biological processes, and aquatic life.<br>Turbidity: Measures the clarity of water, which affects light penetration and photosynthesis.<br>Color and Odor: Important for aesthetic qualities and user acceptability.<br>Solids (Total Suspended Solids - TSS, Total Dissolved Solids - TDS): Affect the taste and clarity of water.<br>bbb) Discuss chemical contaminants and their effect on water quality.<br>pH: A measure of how acidic or basic water is. Critical for the solubility of nutrients and metals.<br>Dissolved Oxygen (DO): Essential for aquatic organisms. A low DO level indicates poor water quality.<br><br>Highlight the role of biological parameters in detecting contamination from organic sources.<br>Coliform Bacteria (e.g., E. coli): Indicates the presence of pathogens and possible fecal contamination. |

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| | Exercise (5 minutes) –<br>Provide an activity for students to interpret sample water quality data. |
| **Closure** | 25. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br>26. Suggested Reading<br>- Video links<br>https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>27. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 9. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 10 | Course Name: Environment Engineering<br>Topic: Water Quality index, water quality standards. | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>jj. Understand the concept of the Water Quality Index (WQI) and its importance in simplifying water quality data.<br>kk. Explain the process of calculating WQI using various parameters.<br>ll. Learn about national and international Water Quality Standards (e.g., WHO, EPA, BIS).<br>mm. Assess water quality based on WQI and standards, and interpret its significance for public health and environmental sustainability |
| **Teaching Aids (if any)** | w. Pen and white board.<br>x. Quizzes.<br>y. Presentation slides. |
| **Teaching Development** | 26. Introduction (5 minutes)<br>- Introduce the importance of water quality in ensuring public health and environmental safety.<br>- Briefly explain Water Quality Standards, which provide acceptable limits for water quality parameters set by regulatory bodies.<br>27. Development (30 minutes)<br>ccc) Define WQI as it provides an overall assessment of water quality by aggregating various water quality parameters into a single value. This helps simplify complex water quality data for decision-makers and the public.<br>ddd) Select important parameters (e.g., pH, DO, BOD, TSS, etc.).<br>eee) Assign weights to parameters based on their importance for water quality (e.g., DO has a higher weight than TDS).<br>fff) Use WQI to compare water quality in different regions, track changes over time, or assess the impact of pollution control measures.<br>ggg) Explain how water quality standards vary depending on the region, usage (drinking, recreational), and purpose (industrial, agricultural).<br>hhh) Discuss the consequences of water quality not meeting these standards (e.g., health risks, environmental degradation).<br><br>Exercise (5 minutes) –<br>Compare the calculated WQI to acceptable water quality standards and assess whether the water is suitable for drinking or other uses. |
| **Closure** | 28. Summarize the Lesson Learning Outcomes and get affirmation from students on these. |

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| | 29. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>30. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 10. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 11 | Course Name: Environment Engineering<br>Topic: Classification of Water bodies | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>nn. Understand the various types of water bodies and their characteristics.<br>oo. Classify water bodies based on different factors such as size, flow, and salinity.<br>pp. Recognize the ecological and environmental significance of each type of water body.<br>qq. Assess the importance of maintaining the quality and sustainability of these water bodies. |
| **Teaching Aids (if any)** | z. Pen and white board.<br>aa. Quizzes.<br>bb. Presentation slides. |
| **Teaching Development** | 28. Introduction (5 minutes)<br>- Introduce the concept of water bodies as natural or artificial features that collect and store water.<br>- Explain why the classification of water bodies is important for ecological conservation, water resource management, and environmental planning.<br>29. Development (30 minutes)<br>iii) Streams: Small water bodies flowing over land, often feeding into rivers.<br>jjj) Brooks & Creeks: Smaller, faster-moving streams or rivulets, generally part of a larger river system.<br>kkk) Lakes: Large, stagnant bodies of water surrounded by land, with minimal flow. Explain how lakes can be natural or artificial (reservoirs).<br>lll) The largest and deepest water bodies, covering more than 70% of Earth's surface. Explain how oceans influence climate, support marine ecosystems, and are major sources of water in the hydrological cycle.<br>mmm) Reservoirs: Large man-made lakes created by damming rivers, used for water supply, irrigation, and hydroelectric power.<br>nnn) Discuss the consequences of water quality not meeting these standards (e.g., health risks, environmental degradation).<br><br>Exercise (5 minutes) –<br>Assign students to classify a list of water bodies based on their characteristics (size, flow, salinity). |
| **Closure** | 31. Summarize the Lesson Learning Outcomes and get affirmation from students on these. |

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| | 32. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>33. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 11. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 12 | Course Name: Environment Engineering<br>Topic: Water treatment schemes | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>rr. Understand the key principles of water treatment.<br>ss. Learn about different water treatment schemes and their components.<br>tt. Identify the steps involved in water treatment processes such as coagulation, sedimentation, filtration, and disinfection.<br>uu. Recognize the importance of water treatment in ensuring safe and potable water for communities. |
| **Teaching Aids (if any)** | cc. Pen and white board.<br>dd. Quizzes.<br>ee. Presentation slides. |
| **Teaching Development** | 30. Introduction (5 minutes)<br>- Introduce the concept of water treatment and why it is essential for providing clean, safe drinking water.<br>- Explain that the treatment process involves various stages designed to remove physical, chemical, and biological contaminants from raw water.<br>31. Development (30 minutes)<br>ooo) Briefly mention the importance of water treatment in preventing waterborne diseases and maintaining public health.<br>ppp) Discussed about coagulation that it is process of adding chemicals (e.g., alum, ferric chloride) to water to form tiny, sticky particles called flocs.<br>qqq) After coagulation, water is allowed to sit in a sedimentation tank where the heavier floc particles settle at the bottom.<br>rrr) Discuss the role of clarifiers in removing suspended solids from the water.<br>sss) Water passes through filters (sand, gravel, and activated carbon) to remove smaller particles and pathogen.<br>The final step in water treatment where disinfectants (e.g., chlorine, ozone, UV light) are added to kill remaining microorganisms.<br><br>Exercise (5 minutes) –<br>Ask students to sketch a basic flow diagram of a water treatment plant based on the steps discussed. |
| **Closure** | 34. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>35. Suggested Reading<br>- Video links |

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| | https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>36. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 12. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 13 | Course Name: Environment Engineering<br>Topic: Design of plain sedimentation | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>vv. Understand the principles behind plain sedimentation and its role in water treatment.<br>ww. Learn how to design a sedimentation tank based on key parameters such as detention time, surface loading rate, and settling velocity.<br>xx. Analyze the factors that influence the effectiveness of sedimentation in removing suspended solids.<br>yy. Apply basic design principles to solve problems related to the design of sedimentation tanks. |
| **Teaching Aids (if any)** | ff. Pen and white board.<br>gg. Quizzes.<br>hh. Presentation slides. |
| **Teaching Development** | 32. Introduction (5 minutes)<br>- Define plain sedimentation as the process of removing suspended solids from water by allowing them to settle naturally under the influence of gravity.<br>- Briefly mention the types of sedimentation tanks**:** rectangular, circular**,** and hopper-bottomed tanks.<br>33. Development (30 minutes)<br>ttt) Brief to remove particles from water based on their size, shape, and density, using gravity to settle them at the bottom of the tank.<br>uuu) Surface Loading Rate (also called overflow rate): The flow rate per unit area of the tank's surface. This rate controls how fast water moves through the tank and influences particle settling.<br>vvv) Settling Velocity: The speed at which particles settle out of the water column. This depends on particle size, density, and water viscosity.<br>www) Discrete Particles: Settle individually without interacting with other particles<br>xxx) Discussed about different types of sedimentation tanks and its design in detail.<br>Zone Settling: Occurs when large concentrations of particles settle<br><br>Exercise (5 minutes) –<br>Design a sedimentation tank for a flow rate of 1000 $m^3$/day with a surface loading rate of 25 $m^3/day/m^2$ and a detention time of 3 hours. |
| **Closure** | 37. Summarize the Lesson Learning Outcomes and get affirmation from students on these. |

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| | 38. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>39. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 13. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 14 | Course Name: Environment Engineering<br>Topic: Coagulation and flocculation | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>zz. Understand the principles of coagulation and flocculation in water treatment.<br>aaa. Explain the role of coagulants and flocculants in removing suspended solids and turbidity from water.<br>bbb. Identify the chemical reactions and mechanisms involved in the coagulation and flocculation processes.<br>ccc. Learn the factors that influence the efficiency of these processes and their application in water treatment design. |
| **Teaching Aids (if any)** | ii. Pen and white board.<br>jj. Example problems for calculations.<br>kk. Presentation slides. |
| **Teaching Development** | 34. Introduction (5 minutes)<br>- Define coagulation and flocculation as key processes in water treatment for removing suspended particles and colloids.<br>- Explain that coagulation involves the destabilization of particles, while flocculation refers to the aggregation of these particles into larger, settleable flocs.<br>- Highlight the importance of these processes for reducing turbidity and contaminant load before sedimentation and filtration stages.<br>35. Development (30 minutes)<br>yyy) Brief to this coagulation process where small, suspended particles are neutralized using chemicals called coagulants causing the particles to aggregate into larger masses.<br>zzz) These particles are often too small to settle or be filtered directly, hence the need for coagulation.<br>aaaa) Aluminum Sulfate (Alum): The most common coagulant used in water treatment. When added to water, it forms aluminum hydroxide, which neutralizes the charges on suspended particles.<br>bbbb) Charge Neutralization: Suspended particles in water are usually negatively charged. Coagulants neutralize these charges, allowing the particles to stick together. Discussed about different types of sedimentation tanks and its design in detail.<br>cccc) Once coagulation has taken place and particles have been destabilized, flocculation occurs. This is a gentle mixing process that encourages particles to form larger clusters (flocs).<br><br>Exercise (5 minutes) –<br>Reinforce the importance of these processes in water treatment, particularly for reducing turbidity and improving the efficiency of |

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| | downstream filtration and disinfection. |
| **Closure** | 40. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>41. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>42. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 14. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 15 | Course Name: Environment Engineering<br>Topic: Filtration- Slow and Rapid sand filters | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>ddd. Compare and contrast slow sand filters, rapid sand filters, and pressure filters.<br>eee. Discuss the advantages and limitations of each filtration method.<br>fff. Understand the importance of disinfection in water treatment and describe different disinfection units (chlorination, UV, ozone, etc.).<br>ggg. Apply these concepts in designing an effective water treatment system. |
| **Teaching Aids (if any)** | ll. Pen and white board.<br>mm. Example problems for calculations.<br>nn. Presentation slides. |
| **Teaching Development** | 36. Introduction (5 minutes)<br>- Briefly introduce the role of filtration and disinfection in the overall water treatment process.<br>- Highlight the need for disinfection after filtration to ensure water safety.<br>- Define each filtration type: slow, rapid, and pressure filtration.<br>37. Development (30 minutes)<br>dddd) Explain that slow sand filters rely on biological processes in a fine sand bed for filtration.<br>eeee) Advantages: Low-cost, low-maintenance, effective at removing pathogens.<br>ffff) Principle: Water is forced through a sand filter under pressure, typically enclosed in tanks.<br>gggg) Principle: Uses mechanical processes with a coarser sand bed and higher filtration rate.<br>hhhh) Advantages: High filtration speed, suitable for large-scale water treatment plants.<br><br>Exercise (5 minutes) –<br>Present a real-world case study of a water treatment plant and ask students to identify where each filtration and disinfection method is used. |
| **Closure** | 43. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>44. Suggested Reading<br>- Video links<br>https://www.youtube.com/watch?v=-l7- |

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| | 2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>45. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 15. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 16 | Course Name: Environment Engineering<br>Topic: Design of water supply system | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>hhh. Identify the essential data required for designing a water supply system.<br>iii. Understand the significance of demographic, topographic, and hydrological data in the design process.<br>jjj. Analyze the relationship between water demand and system design parameters.<br>kkk. Interpret water quality standards and how they influence design decisions. |
| **Teaching Aids (if any)** | oo. Pen and white board.<br>pp. Example problems for calculations.<br>qq. Presentation slides. |
| **Teaching Development** | 38. Introduction (5 minutes)<br>- Define what a water supply system is and its purpose in urban and rural contexts.<br>- Explain why accurate data collection is critical in the design of a water supply system.<br>- Briefly introduce the different types of data needed (demographic, topographic, hydrological, etc.).<br>39. Development (30 minutes)<br>iiii)Daily and peak water consumption: Discuss per capita water use and its variations based on residential, commercial, and industrial needs.<br>jjjj)Role of elevation and terrain: Highlight how topography impacts the design of pipelines, reservoirs, and pump stations.<br>kkkk) Water sources: Explain the importance of determining the available quantity and quality of surface and groundwater sources.<br>llll)Discuss common water quality parameters (pH, turbidity, microbial content, chemical contaminants) and how these affect treatment requirements and design.<br>mmmm) Impact of future growth and seasonal variations on system design.<br><br>Exercise (5 minutes) –<br>Provide students with a case study of a small town or rural area and ask them to identify the necessary data for designing a water supply system. |
| **Closure** | 46. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>47. Suggested Reading<br>- Video links |

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| | https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>48. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 16. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 17 | Course Name: Environment Engineering<br>Topic: Generation and estimation of community sewage. | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>lll. Understand the sources and factors influencing the generation of community sewage.<br>mmm. Learn methods for estimating sewage generation from residential, commercial, and industrial areas.<br>nnn. Apply standard formulas and guidelines for calculating sewage generation.<br>ooo. Use this knowledge for preliminary design considerations of sewage systems. |
| **Teaching Aids (if any)** | rr. Pen and white board.<br>ss. Example problems for calculations.<br>tt. Presentation slides. |
| **Teaching Development** | 40. Introduction (5 minutes)<br>- Define sewage and its sources: domestic, industrial, commercial, and storm water.<br>- Explain why it is important to estimate sewage generation for designing sewer systems.<br>- Highlight the role of population, water usage, and types of areas (residential, industrial) in determining sewage volume.<br>41. Development (30 minutes)<br>nnnn) Explain how water consumption directly correlates to sewage generation.<br>oooo) Industrial sewage: Wastewater from factories and industries, which may require pre treatment before entering community sewers.<br>pppp) Commercial sewage: Sewage from businesses, offices, and institutions.<br>qqqq) Highlight the importance of factoring in future growth in sewage system design.<br>rrrr) Introduce the concept of per capita sewage generation, typically assumed as 75-80% of per capita water consumption.<br><br>Exercise (5 minutes) –<br>Students should calculate average sewage generation as well as peak flow using peaking factors. |
| **Closure** | 49. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>50. Suggested Reading |

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| | - Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>51. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 17. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 18 | Course Name: Environment Engineering<br>Topic: Alternative Systems for sewage collection and conveyance. | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>ppp. Understand the limitations of conventional sewage systems and the need for alternative systems.<br>qqq. Identify and describe different types of alternate sewage collection and conveyance systems.<br>rrr. Apply this knowledge to select the most suitable sewage collection system based on the specific requirements of a region or community.<br>sss.Understand the environmental, economic, and operational benefits of using alternative sewage systems. |
| **Teaching Aids (if any)** | uu. Pen and white board.<br>vv. Example problems for calculations.<br>ww. Presentation slides. |
| **Teaching Development** | 42. Introduction (5 minutes)<br>- Define conventional sewage systems (gravity sewers) and briefly explain their limitations, including high costs, dependence on topography, and potential environmental impacts.<br>- Explain the increasing importance of exploring alternative sewage systems, especially in rural areas or regions with difficult terrain or water scarcity.<br>43. Development (30 minutes)<br>ssss) Explain the basic operation of a septic tank system, where sewage is collected, settled, and partially treated before discharging into a leach field.<br>tttt)Suitable for low-density rural areas with sufficient land space for infiltration.<br>uuuu) Discuss DEWATS as small-scale systems that treat sewage locally using natural processes (e.g., anaerobic digestion, constructed wetlands).<br>vvvv) Explain how pressurized systems use pumps to convey sewage through small-diameter pipes.<br>wwww) Explain the use of dry composting toilets (Ecosan) that separate and treat human waste on-site, converting it into useful products like compost.<br><br>Exercise (5 minutes) –<br>Have students compare vacuum, pressurized, and decentralized systems based on cost, maintenance, and environmental factors. |
| **Closure** | 52. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>53. Suggested Reading |

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| | - Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>54. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 18. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 19 | Course Name: Environment Engineering<br>Topic: Design of sewers | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>ttt. Understand the key factors influencing sewer design, such as population, wastewater flow, and rainfall.<br>uuu. Learn the different types of sewer systems and their applications.<br>vvv. Apply standard formulas and guidelines for calculating sewage generation.<br>www. Use this knowledge for preliminary design considerations of sewage systems. |
| **Teaching Aids (if any)** | xx. Pen and white board.<br>yy. Example problems for calculations.<br>zz. Presentation slides. |
| **Teaching Development** | 44. Introduction (5 minutes)<br>- Define sewage and its sources: domestic, industrial, commercial, and storm water.<br>- Explain why it is important to estimate sewage generation for designing sewer systems.<br>- Highlight the role of population, water usage, and types of areas (residential, industrial) in determining sewage volume.<br>45. Development (30 minutes)<br>xxxx) Explain how water consumption directly correlates to sewage generation.<br>yyyy) Industrial sewage: Wastewater from factories and industries, which may require pre treatment before entering community sewers.<br>zzzz) Commercial sewage: Sewage from businesses, offices, and institutions.<br>aaaaa) Highlight the importance of factoring in future growth in sewage system design.<br>bbbbb) Introduce the concept of per capita sewage generation, typically assumed as 75-80% of per capita water consumption.<br><br>Exercise (5 minutes) –<br>Students should calculate average sewage generation as well as peak flow using peaking factors. |
| **Closure** | 55. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>56. Suggested Reading<br>- Video links<br>https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&inde |

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| | x=2<br>57. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 19. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 20 | Course Name: Environment Engineering<br>Topic: Characterization of sewage | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>xxx. Understand the sources and factors influencing the generation of community sewage.<br>yyy. Learn methods for estimating sewage generation from residential, commercial, and industrial areas.<br>zzz. Apply standard formulas and guidelines for calculating sewage generation.<br>aaaa. Use this knowledge for preliminary design considerations of sewage systems. |
| **Teaching Aids (if any)** | aaa. Pen and white board.<br>bbb. Example problems for calculations.<br>ccc. Presentation slides. |
| **Teaching Development** | 46. Introduction (5 minutes)<br>- Define sewage and its sources: domestic, industrial, commercial, and storm water.<br>- Explain why it is important to estimate sewage generation for designing sewer systems.<br>- Highlight the role of population, water usage, and types of areas (residential, industrial) in determining sewage volume.<br>47. Development (30 minutes)<br>ccccc) Explain how water consumption directly correlates to sewage generation.<br>ddddd) Industrial sewage: Wastewater from factories and industries, which may require pre treatment before entering community sewers.<br>eeeee) Commercial sewage: Sewage from businesses, offices, and institutions.<br>fffff) Highlight the importance of factoring in future growth in sewage system design.<br>ggggg) Introduce the concept of per capita sewage generation, typically assumed as 75-80% of per capita water consumption.<br><br>Exercise (5 minutes) –<br>Students should calculate average sewage generation as well as peak flow using peaking factors. |
| **Closure** | 58. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>59. Suggested Reading<br>- Video links<br>https://www.youtube.com/watch?v=-l7- |

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| | 2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>60. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 20. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 21 | Course Name: Environment Engineering<br>Topic: Parameters for characterization of sewage. | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>bbbb. Understand the sources and factors influencing the generation of community sewage.<br>cccc. Learn methods for estimating sewage generation from residential, commercial, and industrial areas.<br>dddd. Apply standard formulas and guidelines for calculating sewage generation.<br>eeee. Use this knowledge for preliminary design considerations of sewage systems. |
| **Teaching Aids (if any)** | ddd. Pen and white board.<br>eee. Example problems for calculations.<br>fff. Presentation slides. |
| **Teaching Development** | 48. Introduction (5 minutes)<br>- Define sewage and its sources: domestic, industrial, commercial, and storm water.<br>- Explain why it is important to estimate sewage generation for designing sewer systems.<br>- Highlight the role of population, water usage, and types of areas (residential, industrial) in determining sewage volume.<br>49. Development (30 minutes)<br>hhhhh) Explain how water consumption directly correlates to sewage generation.<br>iiiii) Industrial sewage: Wastewater from factories and industries, which may require pre treatment before entering community sewers.<br>jjjjj) Commercial sewage: Sewage from businesses, offices, and institutions.<br>kkkkk) Highlight the importance of factoring in future growth in sewage system design.<br>lllll) Introduce the concept of per capita sewage generation, typically assumed as 75-80% of per capita water consumption.<br><br>Exercise (5 minutes) –<br>Students should calculate average sewage generation as well as peak flow using peaking factors. |
| **Closure** | 61. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>62. Suggested Reading |

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| | - Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>63. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 21. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 22 | Course Name: Environment Engineering<br>Topic: Sampling, testing of Sewage | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>ffff. Understand the importance and methods of sewage sampling for testing.<br>gggg. Learn the procedures for collecting representative sewage samples.<br>hhhh. Apply laboratory techniques to analyze sewage for parameters such as BOD, COD, pH, solids, and pathogens.<br>iiii. Interpret test results to assess sewage quality and treatment effectiveness. |
| **Teaching Aids (if any)** | ggg. Pen and white board.<br>hhh. Example problems for calculations.<br>iii. Presentation slides. |
| **Teaching Development** | 50. Introduction (5 minutes)<br>- Define sewage sampling and its purpose in assessing the quality of wastewater.<br>- Highlight the importance of accurate sampling in evaluating the performance of wastewater treatment plants and ensuring regulatory compliance.<br>- Explain the need for testing physical, chemical, and biological parameters to understand the composition of sewage.<br>51. Development (30 minutes)<br>mmmmm) Explain how a single sample collected at a specific time and location, representing the sewage characteristics at that moment.<br>nnnnn) Discuss when each type of sampling is appropriate (e.g., grab samples for immediate analysis, composite samples for long-term trends).<br>ooooo) Explain the need for using preservatives (e.g., ice for temperature-sensitive parameters) to maintain sample integrity until testing.<br>ppppp) Highlight preservation techniques for specific tests (e.g., acidic preservation for COD, refrigeration for biological tests).<br>qqqqq) Introduce the concept of per capita sewage generation, typically assumed as 75-80% of per capita water consumption.<br><br>Exercise (5 minutes) –<br>Demonstrate a hands-on sewage sampling exercise in the laboratory or through a video demonstration.<br>Guide students through calculations and interpretation of test results to assess sewage quality. |
| **Closure** | 64. Summarize the Lesson Learning Outcomes and get affirmation from students on these. |

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| | 65. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>66. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 22. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 23 | Course Name: Environment Engineering<br>Topic: BOD Kinetics | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>jjjj. Understand the importance and methods of sewage sampling for testing.<br>kkkk. Learn the procedures for collecting representative sewage samples.<br>llll. Apply laboratory techniques to analyze sewage for parameters such as BOD, COD, pH, solids, and pathogens.<br>mmmm. Interpret test results to assess sewage quality and treatment effectiveness. |
| **Teaching Aids (if any)** | jjj. Pen and white board.<br>kkk. Example problems for calculations.<br>lll. Presentation slides. |
| **Teaching Development** | 52. Introduction (5 minutes)<br>- Define sewage sampling and its purpose in assessing the quality of wastewater.<br>- Highlight the importance of accurate sampling in evaluating the performance of wastewater treatment plants and ensuring regulatory compliance.<br>- Explain the need for testing physical, chemical, and biological parameters to understand the composition of sewage.<br>53. Development (30 minutes)<br>rrrrr) Explain how a single sample collected at a specific time and location, representing the sewage characteristics at that moment.<br>sssss) Discuss when each type of sampling is appropriate (e.g., grab samples for immediate analysis, composite samples for long-term trends).<br>ttttt) Explain the need for using preservatives (e.g., ice for temperature-sensitive parameters) to maintain sample integrity until testing.<br>uuuuu) Highlight preservation techniques for specific tests (e.g., acidic preservation for COD, refrigeration for biological tests).<br>vvvvv) Introduce the concept of per capita sewage generation, typically assumed as 75-80% of per capita water consumption.<br><br>Exercise (5 minutes) –<br>Demonstrate a hands-on sewage sampling exercise in the laboratory or through a video demonstration.<br>Guide students through calculations and interpretation of test results to assess sewage quality. |
| **Closure** | 67. Summarize the Lesson Learning Outcomes and get affirmation from students on these. |

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| | 68. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>69. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 23. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 24 | Course Name: Environment Engineering<br>Topic: Analysis of Sewage | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>nnnn. Understand the importance and methods of sewage sampling for testing.<br>oooo. Learn the procedures for collecting representative sewage samples.<br>pppp. Apply laboratory techniques to analyze sewage for parameters such as BOD, COD, pH, solids, and pathogens.<br>qqqq. Interpret test results to assess sewage quality and treatment effectiveness. |
| **Teaching Aids (if any)** | mmm. Pen and white board.<br>nnn. Example problems for calculations.<br>ooo. Presentation slides. |
| **Teaching Development** | 54. Introduction (5 minutes)<br>- Define sewage sampling and its purpose in assessing the quality of wastewater.<br>- Highlight the importance of accurate sampling in evaluating the performance of wastewater treatment plants and ensuring regulatory compliance.<br>- Explain the need for testing physical, chemical, and biological parameters to understand the composition of sewage.<br>55. Development (30 minutes)<br>wwwww) Explain how a single sample collected at a specific time and location, representing the sewage characteristics at that moment.<br>xxxxx) Discuss when each type of sampling is appropriate (e.g., grab samples for immediate analysis, composite samples for long-term trends).<br>yyyyy) Explain the need for using preservatives (e.g., ice for temperature-sensitive parameters) to maintain sample integrity until testing.<br>zzzzz) Highlight preservation techniques for specific tests (e.g., acidic preservation for COD, refrigeration for biological tests).<br>aaaaaa)Introduce the concept of per capita sewage generation, typically assumed as 75-80% of per capita water consumption.<br><br>Exercise (5 minutes) –<br>Demonstrate a hands-on sewage sampling exercise in the laboratory or through a video demonstration.<br>Guide students through calculations and interpretation of test results to assess sewage quality. |
| **Closure** | 70. Summarize the Lesson Learning Outcomes and get affirmation from students on these. |

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| | 71. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>72. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 24. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 25 | Course Name: Environment Engineering<br>Topic: Storm water flow characteristics | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>rrrr. Understand the factors that influence storm water flow and runoff generation.<br>ssss. Learn the procedures for collecting representative sewage samples.<br>tttt. Highlight the importance of managing storm water to prevent flooding, erosion, and water pollution.<br>uuuu. Discuss why storm water flow characteristics differ from sewage flow due to variability in rainfall patterns, surface characteristics, and drainage systems. |
| **Teaching Aids (if any)** | ppp. Pen and white board.<br>qqq. Example problems for calculations.<br>rrr. Presentation slides. |
| **Teaching Development** | 56. Introduction (5 minutes)<br>- Define sewage sampling and its purpose in assessing the quality of wastewater.<br>- Highlight the importance of accurate sampling in evaluating the performance of wastewater treatment plants and ensuring regulatory compliance.<br>- Explain the need for testing physical, chemical, and biological parameters to understand the composition of sewage.<br>57. Development (30 minutes)<br>bbbbbb) Explain how a single sample collected at a specific time and location, representing the sewage characteristics at that moment.<br>cccccc)Discuss when each type of sampling is appropriate (e.g., grab samples for immediate analysis, composite samples for long-term trends).<br>dddddd) Explain the need for using preservatives (e.g., ice for temperature-sensitive parameters) to maintain sample integrity until testing.<br>eeeeee)Highlight preservation techniques for specific tests (e.g., acidic preservation for COD, refrigeration for biological tests).<br>ffffff) Introduce the concept of per capita sewage generation, typically assumed as 75-80% of per capita water consumption.<br><br>Exercise (5 minutes) –<br>Demonstrate a hands-on sewage sampling exercise in the laboratory or through a video demonstration.<br>Guide students through calculations and interpretation of test results to |

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| | assess sewage quality. |
| **Closure** | 73. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>74. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>75. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 25. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 26 | Course Name: Environment Engineering<br>Topic: Basic principles of sewage management | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>vvvv. Understand the factors that influence storm water flow and runoff generation.<br>wwww. Learn the procedures for collecting representative sewage samples.<br>xxxx. Highlight the importance of managing storm water to prevent flooding, erosion, and water pollution.<br>yyyy. Discuss why storm water flow characteristics differ from sewage flow due to variability in rainfall patterns, surface characteristics, and drainage systems. |
| **Teaching Aids (if any)** | sss.Pen and white board.<br>ttt. Example problems for calculations.<br>uuu. Presentation slides. |
| **Teaching Development** | 58. Introduction (5 minutes)<br>- Define sewage sampling and its purpose in assessing the quality of wastewater.<br>- Highlight the importance of accurate sampling in evaluating the performance of wastewater treatment plants and ensuring regulatory compliance.<br>- Explain the need for testing physical, chemical, and biological parameters to understand the composition of sewage.<br>59. Development (30 minutes)<br>gggggg) Explain how a single sample collected at a specific time and location, representing the sewage characteristics at that moment.<br>hhhhhh) Discuss when each type of sampling is appropriate (e.g., grab samples for immediate analysis, composite samples for long-term trends).<br>iiiiii) Explain the need for using preservatives (e.g., ice for temperature-sensitive parameters) to maintain sample integrity until testing.<br>jjjjjj) Highlight preservation techniques for specific tests (e.g., acidic preservation for COD, refrigeration for biological tests).<br>kkkkkk) Introduce the concept of per capita sewage generation, typically assumed as 75-80% of per capita water consumption.<br><br>Exercise (5 minutes) –<br>Demonstrate a hands-on sewage sampling exercise in the laboratory or through a video demonstration.<br>Guide students through calculations and interpretation of test results to assess sewage quality. |

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| **Closure** | 76. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>77. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>78. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 26. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 27 | Course Name: Environment Engineering<br>Topic: Primary treatment unit of sewage | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>zzzz. Understand the basic concept of unit operations and processes in wastewater treatment.<br>aaaaa. Learn the role of primary treatment units in the removal of large suspended solids from wastewater<br>bbbbb. Describe the types of screening processes used in wastewater treatment plants.<br>ccccc. Understand the design principles of screening units and their application in treatment processes. |
| **Teaching Aids (if any)** | vvv. Pen and white board.<br>www. Example problems for calculations.<br>xxx. Presentation slides. |
| **Teaching Development** | 60. Introduction (5 minutes)<br>- Define unit operations (physical processes) and unit processes (chemical and biological processes) in wastewater treatment.<br>- Highlight the importance of primary treatment as the first major step in removing large, floating, or suspended debris from raw wastewater.<br>- Explain the need for testing physical, chemical, and biological parameters to understand the composition of sewage.<br>61. Development (30 minutes)<br>llllll) Explain that screening is used to protect downstream equipment (e.g., pumps and pipes) by removing large solid debris from raw sewage.<br>mmmmmm) Discuss how it improves overall plant operation and reduces maintenance needs.<br>nnnnnn) Highlight that screening also helps prevent clogging and damage to treatment units such as sedimentation tanks and biological treatment processes.<br>oooooo) Explain that coarse screens remove large debris (such as bottles, cans, and large objects) with openings ranging from 25 to 75 mm.<br>pppppp) Explain that fine screens remove smaller debris (such as small plastics, fine materials) with openings as small as 1.5 to 6 mm.<br><br>Exercise (5 minutes) –<br>Solve numerical problems on calculating screen dimensions and head loss for a given flow rate and screen type. |
| **Closure** | 79. Summarize the Lesson Learning Outcomes and get affirmation from students on these. |

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| | 80. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>81. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 27. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 28 | Course Name: Environment Engineering<br>Topic: Secondary treatment unit of sewage | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>ddddd. Understand the purpose and importance of secondary treatment in sewage treatment processes.<br>eeeee. Understand the role of microorganisms in treating organic matter in sewage.<br>fffff. Analyze the advantages, limitations, and applications of secondary treatment methods.<br>ggggg. Identify different types of biological processes used in secondary treatment units (e.g., activated sludge process, trickling filters). |
| **Teaching Aids (if any)** | yyy. Pen and white board.<br>zzz. Example problems for calculations.<br>aaaa. Presentation slides. |
| **Teaching Development** | 62. Introduction (5 minutes)<br>- Define secondary treatment as a biological process aimed at removing dissolved and suspended organic matter from sewage.<br>- Explain the role of microorganisms in breaking down organic pollutants (mainly BOD) to reduce the pollution load before discharge or further treatment.<br>- Highlight the necessity of secondary treatment following primary treatment, as it targets organic matter that primary treatment cannot remove effectively.<br>63. Development (30 minutes)<br>qqqqqq) Explain that the activated sludge process is a suspended growth system where sewage is aerated to stimulate the growth of aerobic bacteria that consume organic pollutants.<br>rrrrrr) Discuss the Design Considerations in brief mention key design parameters such as hydraulic retention time (HRT), sludge age, and food-to-microorganism (F/M) ratio.<br>ssssss) High removal efficiency for BOD and organic matter but requires careful operation and maintenance, energy for aeration, and skilled operators.<br>ttttt) Explain that coarse screens remove large debris (such as bottles, cans, and large objects) with openings ranging from 25 to 75 mm.<br>uuuuuu) Explain that fine screens remove smaller debris (such as small plastics, fine materials) with openings as small as 1.5 to 6 mm.<br><br>Exercise (5 minutes) – |

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| | Solve numerical problems on calculating screen dimensions and head loss for a given flow rate and screen type. |
| **Closure** | 82. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>83. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>84. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 28. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 29 | Course Name: Environment Engineering<br>Topic: Tertiary treatment unit of sewage sludge handling | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>hhhhh. Understand the role and importance of tertiary treatment in wastewater management.<br>iiiii. Learn about common tertiary treatment methods (e.g., filtration, disinfection, nutrient removal).<br>jjjjj. Identify different methods of sludge handling, treatment, and disposal (e.g., thickening, digestion, dewatering, drying).<br>kkkkk. Evaluate the environmental impact and sustainability of tertiary treatment and sludge handling processes. |
| **Teaching Aids (if any)** | bbbb. Pen and white board.<br>cccc. Example problems for calculations.<br>dddd. Presentation slides. |
| **Teaching Development** | 64. Introduction (5 minutes)<br>- Define secondary treatment as a biological process aimed at removing dissolved and suspended organic matter from sewage.<br>- Explain the role of microorganisms in breaking down organic pollutants (mainly BOD) to reduce the pollution load before discharge or further treatment.<br>- Highlight the necessity of secondary treatment following primary treatment, as it targets organic matter that primary treatment cannot remove effectively.<br>65. Development (30 minutes)<br>vvvvvv) Explain that the activated sludge process is a suspended growth system where sewage is aerated to stimulate the growth of aerobic bacteria that consume organic pollutants.<br>wwwwww) Discuss the Design Considerations in brief mention key design parameters such as hydraulic retention time (HRT), sludge age, and food-to-microorganism (F/M) ratio.<br>xxxxxx) High removal efficiency for BOD and organic matter but requires careful operation and maintenance, energy for aeration, and skilled operators.<br>yyyyyy) Explain that coarse screens remove large debris (such as bottles, cans, and large objects) with openings ranging from 25 to 75 mm.<br>zzzzzz)Explain that fine screens remove smaller debris (such as small plastics, fine materials) with openings as small as 1.5 to 6 mm.<br><br>Exercise (5 minutes) –<br>Solve numerical problems on calculating screen dimensions and head loss for a given flow rate and screen type. |
| **Closure** | 85. Summarize the Lesson Learning Outcomes and get affirmation from students on these. |

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| | 86. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>87. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 29. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 30 | Course Name: Environment Engineering<br>Topic: Location-thickening, stabilization, dewatering, drying and disposal. | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>lllll. Understand the purpose and importance of secondary treatment in sewage treatment processes.<br>mmmmm. Understand the role of microorganisms in treating organic matter in sewage.<br>nnnnn. Analyze the advantages, limitations, and applications of secondary treatment methods.<br>ooooo. Identify different types of biological processes used in secondary treatment units (e.g., activated sludge process, trickling filters). |
| **Teaching Aids (if any)** | eeee. Pen and white board.<br>ffff. Example problems for calculations.<br>gggg. Presentation slides. |
| **Teaching Development** | 66. Introduction (5 minutes)<br>- Define secondary treatment as a biological process aimed at removing dissolved and suspended organic matter from sewage.<br>- Explain the role of microorganisms in breaking down organic pollutants (mainly BOD) to reduce the pollution load before discharge or further treatment.<br>- Highlight the necessity of secondary treatment following primary treatment, as it targets organic matter that primary treatment cannot remove effectively.<br>67. Development (30 minutes)<br>aaaaaaa) Explain that the activated sludge process is a suspended growth system where sewage is aerated to stimulate the growth of aerobic bacteria that consume organic pollutants.<br>bbbbbbb) Discuss the Design Considerations in brief mention key design parameters such as hydraulic retention time (HRT), sludge age, and food-to-microorganism (F/M) ratio.<br>ccccccc) High removal efficiency for BOD and organic matter but requires careful operation and maintenance, energy for aeration, and skilled operators.<br>ddddddd) Explain that coarse screens remove large debris (such as bottles, cans, and large objects) with openings ranging from 25 to 75 mm.<br>eeeeeee) Explain that fine screens remove smaller debris (such as small plastics, fine materials) with openings as small as 1.5 to 6 mm.<br><br>Exercise (5 minutes) –<br>Solve numerical problems on calculating screen dimensions and head |

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| | loss for a given flow rate and screen type. |
| **Closure** | 88. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>89. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>90. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 30. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 31 | Course Name: Environment Engineering<br>Topic: Sludge Disposal requirement | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>ppppp. Understand the characteristics of sludge that influence disposal options.<br>qqqqq. Learn about the regulatory and environmental requirements for safe sludge disposal.<br>rrrrr. Identify various sludge disposal methods (e.g., land application, incineration, and land filling).<br>sssss. Evaluate the advantages, limitations, and guidelines of each sludge disposal method. |
| **Teaching Aids (if any)** | hhhh. Pen and white board.<br>iiii. Example problems for calculations.<br>jjjj. Presentation slides. |
| **Teaching Development** | 68. Introduction (5 minutes)<br>- Define sludge as the semi-solid material remaining after the treatment of wastewater.<br>- Highlight that sludge contains organic matter, nutrients, pathogens, and heavy metals, which can be hazardous if not handled properly.<br>- Explain that proper sludge disposal is critical to prevent environmental pollution, health risks, and resource wastage.<br>69. Development (30 minutes)<br>fffffff) Discuss the key characteristics of sludge that affect disposal options like moisture content, organic content, Nutrient content<br>ggggggg) Discuss the Design Considerations in brief mention key design parameters such as hydraulic retention time (HRT), sludge age, and food-to-microorganism (F/M) ratio.<br>hhhhhhh) High removal efficiency for BOD and organic matter but requires careful operation and maintenance, energy for aeration, and skilled operators.<br>iiiiiii) Explain that coarse screens remove large debris (such as bottles, cans, and large objects) with openings ranging from 25 to 75 mm.<br>jjjjjjj) Explain that fine screens remove smaller debris (such as small plastics, fine materials) with openings as small as 1.5 to 6 mm.<br><br>Exercise (5 minutes) –<br>Solve numerical problems on calculating screen dimensions and head loss for a given flow rate and screen type. |
| **Closure** | 91. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>92. Suggested Reading<br>- Video links<br>https://www.youtube.com/watch?v=-l7- |

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| | 2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>93. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 31. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 32 | Course Name: Environment Engineering<br>Topic: Types of Treatment of sewage | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>ttttt. Understand the various types of sewage treatment processes (preliminary, primary, secondary, tertiary).<br>uuuuu. Identify key unit operations and processes within each type of treatment.<br>vvvvv. Apply knowledge of these processes to select appropriate treatments for different wastewater characteristics.<br>wwwww. Evaluate the environmental and operational factors influencing the selection of treatment processes. |
| **Teaching Aids (if any)** | kkkk. Pen and white board.<br>llll. Example problems for calculations.<br>mmmm. Presentation slides. |
| **Teaching Development** | 70. Introduction (5 minutes)<br>- Define sewage treatment as the process of removing contaminants from wastewater to produce treated effluent that can be safely discharged or reused.<br>- Explain the growing importance of sewage treatment in protecting public health, preventing environmental pollution, and promoting water reuse.<br>- Explain that proper sludge disposal is critical to prevent environmental pollution, health risks, and resource wastage.<br>71. Development (30 minutes)<br>kkkkkkk) Explain that preliminary treatment is designed to remove large objects (e.g., sticks, rags, plastics) and coarse solids that could damage equipment or clog pipes.<br>lllllll) Define primary treatment as the physical removal of settle able solids and organic material.<br>mmmmmmm) Define secondary treatment as a biological process that degrades dissolved and suspended organic matter using microorganisms.<br>nnnnnnn) Describe trickling filters as a system where wastewater flows over a bed of media covered with a bio film that breaks down organic material.<br>ooooooo) Discuss factors like aeration, sludge recirculation, and retention time that influence the efficiency of secondary treatment processes.<br><br>Exercise (5 minutes) –<br>Encourage students to consider factors like water quality standards, budget, and environmental impact. |
| **Closure** | 94. Summarize the Lesson Learning Outcomes and get affirmation from students on these. |

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| | 95. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>96. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 32. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 33 | Course Name: Environment Engineering<br>Topic: Aerobic and Anaerobic treatment of sewage. | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>xxxxx. Evaluate the environmental and operational factors that influence the efficiency of both treatments.<br>yyyyy. Understand the fundamental differences between aerobic and anaerobic treatment processes.<br>zzzzz. Identify the advantages, limitations, and applications of aerobic and anaerobic treatment in sewage management.<br>aaaaaa. Evaluate the advantages, limitations, and guidelines of each sludge disposal method. |
| **Teaching Aids (if any)** | nnnn. Pen and white board.<br>oooo. Example problems for calculations.<br>pppp. Presentation slides. |
| **Teaching Development** | 72. Introduction (5 minutes)<br>- Explain the two main types of biological treatment aerobic (in the presence of oxygen) and anaerobic in the absence of oxygen).<br>- Highlight the importance of biological treatment in reducing the organic load (measured as BOD/COD) and producing cleaner effluent.<br>- Explain that proper sludge disposal is critical to prevent environmental pollution, health risks, and resource wastage.<br>73. Development (30 minutes)<br>ppppppp) Explain that aerobic treatment relies on aerobic microorganisms that degrade organic matter in the presence of oxygen.<br>qqqqqqq) Discuss how microorganisms use oxygen to break down organic matter into simpler compounds (carbon dioxide and water).<br>rrrrrrr) Describe the activated sludge process as a suspended growth system where sewage is aerated to support bacterial growth.<br>sssssss) Discuss the importance of sludge recycling to maintain microbial populations.<br>ttttttt) Describe trickling filters as an attached growth system where wastewater is distributed over media covered with bio-film.<br><br>Exercise (5 minutes) –<br>Encourage students to recommend modifications to the plant's design to optimize the chosen treatment method. |
| **Closure** | 97. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>98. Suggested Reading<br>- Video links |

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| | https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>99. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 33. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 34 | Course Name: Environment Engineering<br>Topic: Quality and characteristics of sewage | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>bbbbbb. Understand the physical, chemical, and biological characteristics of sewage.<br>cccccc. Identify key parameters used to assess sewage quality, such as BOD, COD, pH, solids, and nutrients.<br>dddddd. Apply the knowledge of sewage characteristics to evaluate treatment process requirements.<br>eeeeee. Interpret sewage analysis results and assess their implications for treatment plant design and operation. |
| **Teaching Aids (if any)** | qqqq. Pen and white board.<br>rrrr. Case studies showing the impact of sewage characteristics on treatment plant design<br>ssss. Presentation slides. |
| **Teaching Development** | 74. Introduction (5 minutes)<br>- Define sewage as a mixture of wastewater from domestic, industrial, and storm water sources.<br>- Explain the importance of understanding sewage characteristics for designing effective treatment processes.<br>- Highlight how sewage quality impacts environmental pollution, public health, and regulatory compliance.<br>75. Development (30 minutes)<br>uuuuuuu) Explain its significance as a key indicator of organic pollution and wastewater strength.<br>vvvvvvv) Discuss the importance of COD testing in assessing the overall organic load of wastewater, including industrial pollutants.<br>wwwwwww) Define COD as the amount of oxygen required to chemically oxidize both organic and inorganic compounds in sewage.<br>xxxxxxx) Define pathogens as disease-causing microorganisms (e.g., bacteria, viruses, parasites) that may be present in sewage.<br>yyyyyyy) Discuss the importance of disinfection (e.g., chlorination, UV treatment) in removing pathogens from treated wastewater.<br><br>Exercise (5 minutes) –<br>Provide students with a sewage quality report that includes parameters such as BOD, COD, pH, and nutrients. Ask them to evaluate the treatment needs of the wastewater and propose appropriate primary, secondary, and tertiary treatment methods. |
| **Closure** | 100. Summarize the Lesson Learning Outcomes and get affirmation from students on these. |

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| | 101. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>102. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 34. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 35 | Course Name: Environment Engineering<br>Topic: Sewage Treatment units | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>ffffff. Understand the physical, chemical, and biological characteristics of sewage.<br>gggggg. Identify key parameters used to assess sewage quality, such as BOD, COD, pH, solids, and nutrients.<br>hhhhhh. Apply the knowledge of sewage characteristics to evaluate treatment process requirements.<br>iiiiii. Interpret sewage analysis results and assess their implications for treatment plant design and operation. |
| **Teaching Aids (if any)** | tttt. Pen and white board.<br>uuuu. Case studies showing the impact of sewage characteristics on treatment plant design<br>vvvv. Presentation slides. |
| **Teaching Development** | 76. Introduction (5 minutes)<br>- Define sewage as a mixture of wastewater from domestic, industrial, and storm water sources.<br>- Explain the importance of understanding sewage characteristics for designing effective treatment processes.<br>- Highlight how sewage quality impacts environmental pollution, public health, and regulatory compliance.<br>77. Development (30 minutes)<br>zzzzzzz) Explain its significance as a key indicator of organic pollution and wastewater strength.<br>aaaaaaa) Discuss the importance of COD testing in assessing the overall organic load of wastewater, including industrial pollutants.<br>bbbbbbbb) Define COD as the amount of oxygen required to chemically oxidize both organic and inorganic compounds in sewage.<br>cccccccc) Define pathogens as disease-causing microorganisms (e.g., bacteria, viruses, parasites) that may be present in sewage.<br>ddddddd) Discuss the importance of disinfection (e.g., chlorination, UV treatment) in removing pathogens from treated wastewater.<br><br>Exercise (5 minutes) –<br>Provide students with a sewage quality report that includes parameters such as BOD, COD, pH, and nutrients. Ask them to evaluate the treatment needs of the wastewater and propose appropriate primary, secondary, and tertiary treatment methods. |
| **Closure** | 103. Summarize the Lesson Learning Outcomes and get affirmation from students on these. |

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| | 104. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>105. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 35. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 36 | Course Name: Environment Engineering<br>Topic: ASP, Trickling Filters, Stabilization Ponds | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>jjjjjj. Understand the principles, mechanisms, and operational characteristics of the Activated Sludge Process (ASP), trickling filters, and stabilization ponds.<br>kkkkkk. Identify the advantages and limitations of each treatment method.<br>llllll. Evaluate the suitability of each treatment type based on wastewater characteristics and treatment goals.<br>mmmmmm. Learn the design parameters and operational considerations for these treatment methods. |
| **Teaching Aids (if any)** | wwww. Pen and white board.<br>xxxx. Presentation slides. |
| **Teaching Development** | 78. Introduction (5 minutes)<br>- Explain biological treatment as a crucial step in sewage treatment, utilizing microorganisms to degrade organic matter.<br>- Explain the importance of understanding sewage characteristics for designing effective treatment processes.<br>- Introduce the three primary biological treatment methods covered in this lesson: Activated Sludge Process (ASP), trickling filters, and stabilization ponds.<br>79. Development (30 minutes)<br>eeeeeeee) Discuss the mechanism for distributing wastewater evenly over the media (e.g., rotating arms, perforated pipes).<br>ffffffff)Discuss the role of aeration in providing oxygen for microbial metabolism and mixing sewage with microorganisms.<br>gggggggg) Describe the process of settling where activated sludge is separated from treated effluent.<br>hhhhhhhh) Describe the types of media used (e.g., stones, plastic) and their role in providing surface area for biofilm growth.<br>iiiiiiii) Discuss the importance of maintaining optimal flow rates, media characteristics, and oxygen availability for effective treatment.<br><br>Exercise (5 minutes) –<br>Encourage students to consider factors like treatment efficiency, land availability, and operational costs. |
| **Closure** | 106. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>107. Suggested Reading<br>- Video links |

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| | https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>108. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 36. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 37 | Course Name: Environment Engineering<br>Topic: Reuse for irrigation and aqua culture. | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>nnnnnn. Understand the benefits and necessity of reusing treated wastewater in agriculture and aquaculture.<br>oooooo. Learn the different treatment processes required to make wastewater suitable for reuse.<br>pppppp. Identify health and environmental considerations associated with the reuse of treated wastewater.<br>qqqqqq. Discuss regulatory frameworks governing the reuse of treated wastewater. |
| **Teaching Aids (if any)** | yyyy. Pen and white board.<br>zzzz. Presentation slides. |
| **Teaching Development** | 80. Introduction (5 minutes)<br>- Define treated wastewater reuse and its relevance in sustainable water management.<br>- Explain the increasing demand for water in agriculture and aquaculture due to population growth and climate change.<br>- Highlight the potential economic and environmental benefits of these applications.<br>81. Development (30 minutes)<br>jjjjjjjj) Explain its significance as a key indicator of organic pollution and wastewater strength.<br>kkkkkkkk) Discuss the importance of maintaining water quality parameters such as dissolved oxygen, pH, and temperature.<br>llllllll) Potential bioaccumulation of harmful substances in fish.<br>mmmmmmmm) Regulatory compliance regarding effluent quality and safety standards for fish consumption.<br>nnnnnnnn) Discuss guidelines from organizations like the World Health Organization (WHO) and the U.S. Environmental Protection Agency (EPA).<br><br>Exercise (5 minutes) –<br>Answer any remaining questions and ensure students understand the importance of integrating reclaimed water into agricultural and aquaculture systems. |
| **Closure** | 109. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>110. Suggested Reading<br>- Video links<br>https://www.youtube.com/watch?v=-l7- |

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| | 2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>111. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 37. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 38 | Course Name: Environment Engineering<br>Topic: Indian Standards for disposal of effluents | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>rrrrrr. Understand the regulatory framework governing effluent disposal in India.<br>ssssss. Learn about the key standards and guidelines for effluent quality established by Indian authorities.<br>ttttt. Analyze the implications of these standards for wastewater treatment and environmental protection.<br>uuuuuu. Evaluate the effectiveness of the standards in addressing pollution and promoting sustainable practices. |
| **Teaching Aids (if any)** | aaaaa. Pen and white board.<br>bbbbb. Case studies showing the impact of sewage characteristics on treatment plant design<br>ccccc. Presentation slides. |
| **Teaching Development** | 82. Introduction (5 minutes)<br>- Explain the importance of establishing standards for effluent disposal to protect public health, aquatic ecosystems, and the environment.<br>- Highlight the role of regulatory frameworks in ensuring compliance and sustainable practices.<br>- Discuss the significance of the Water (Prevention and Control of Pollution) Act, 1974, in establishing legal frameworks for effluent management.<br>83. Development (30 minutes)<br>oooooooo) Explain its significance as a key indicator of organic pollution and wastewater strength.<br>pppppppp) Explain the limits for these parameters and the rationale behind them to protect water quality.<br>qqqqqqqq) Discuss any recent amendments or changes to effluent standards by the CPCB or state authorities.<br>rrrrrrrr)Highlight the importance of adapting standards to new scientific knowledge, technological advancements, and environmental conditions.<br>ssssssss) Present case studies of industries that have successfully implemented effluent treatment systems to meet CPCB standards.<br><br>Exercise (5 minutes) –<br>Encourage students to consider factors such as wastewater characteristics, available treatment technologies, and regulatory requirements. |
| **Closure** | 112. Summarize the Lesson Learning Outcomes and get affirmation from students on these. |

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| | 113. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>114. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 38. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 39 | Course Name: Environment Engineering<br>Topic: Imhofff tanks, septic tanks | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>vvvvvv. Understand the design, function, and operational characteristics of Imhoff tanks and septic tanks.<br>wwwwww. Learn the advantages and limitations of each type of tank in sewage treatment.<br>xxxxxx. Identify the appropriate applications for Imhoff tanks and septic tanks based on wastewater characteristics.<br>yyyyyy. Analyze case studies demonstrating the effectiveness of these systems in different settings. |
| **Teaching Aids (if any)** | ddddd. Pen and white board.<br>eeeee. Case studies showing the impact of sewage characteristics on treatment plant design<br>fffff. Presentation slides. |
| **Teaching Development** | 84. Introduction (5 minutes)<br>- Define Imhoff tanks and septic tanks as types of wastewater treatment systems used for preliminary treatment of sewage.<br>- Highlight the role of regulatory frameworks in ensuring compliance and sustainable practices.<br>- Explain the importance of these systems in reducing organic matter and solids before further treatment or disposal.<br>85. Development (30 minutes)<br>ttttttt) Explain how sewage enters the upper chamber, where solids settle to the bottom and form sludge, while the supernatant flows to the outlet.<br>uuuuuuuu) Discuss how the sludge is an aerobically digested in the lower chamber, producing biogas and reducing the volume of sludge.<br>vvvvvvvv) Explain the operational parameters of Imhoff tanks, including hydraulic retention time (HRT), sludge loading rates, and typical flow rates.<br>wwwwwwww) Discuss the importance of proper maintenance to prevent odor issues and ensure effective treatment.<br>xxxxxxxx) Define septic tanks as underground, watertight containers designed to treat domestic wastewater through settling and anaerobic digestion.<br><br>Exercise (5 minutes) –<br>Encourage students to consider the environmental impact and compliance with local regulations in their evaluation. |
| **Closure** | 115. Summarize the Lesson Learning Outcomes and get affirmation from students on these. |

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| | 116. Suggested Reading<br>- Video links https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>117. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 39. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |

| Lesson Plan No. 40 | Course Name: Environment Engineering<br>Topic: Stabilization Ponds, oxidation ponds | Course No.: CE-403 |
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| **Objectives** | At the end of the lesson the student shall be able to:<br>zzzzzz. Identify the advantages and limitations of these treatment systems in sewage management.<br>aaaaaaa. Learn the key parameters affecting the performance of stabilization and oxidation ponds.<br>bbbbbbb. Analyze case studies demonstrating the effectiveness of these systems in various applications.<br>ccccccc. Evaluate the environmental considerations and regulatory requirements for using stabilization and oxidation ponds. |
| **Teaching Aids (if any)** | ggggg. Pen and white board.<br>hhhhh. Presentation slides. |
| **Teaching Development** | 86. Introduction (5 minutes)<br>- Describe stabilization ponds as shallow, open bodies of water designed for treating wastewater through natural processes.<br>- Explain how stabilization ponds utilize sunlight for photosynthesis by algae, which produces oxygen for aerobic bacteria to break down organic matter.<br>- Discuss the role of sedimentation in removing suspended solids and how nutrient uptake by algae contributes to overall treatment efficiency.<br>87. Development (30 minutes)<br>yyyyyyyy) Discuss the mechanism for distributing wastewater evenly over the media (e.g., rotating arms, perforated pipes).<br>zzzzzzzz) Discuss the role of aeration in providing oxygen for microbial metabolism and mixing sewage with microorganisms.<br>aaaaaaaaa) Describe the process of settling where activated sludge is separated from treated effluent.<br>bbbbbbbbb) Describe the types of media used (e.g., stones, plastic) and their role in providing surface area for biofilm growth.<br>ccccccccc) Discuss the importance of maintaining optimal flow rates, media characteristics, and oxygen availability for effective treatment.<br><br>Exercise (5 minutes) –<br>Encourage students to consider factors like treatment efficiency, land availability, and operational costs. |
| **Closure** | 118. Summarize the Lesson Learning Outcomes and get affirmation from students on these.<br><br>119. Suggested Reading<br>- Video links |

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| | https://www.youtube.com/watch?v=-l7-2KkIRKc&list=PLtqsV4c_a47qPBlLMurACw40fn2djXDFZ&index=2<br>120. Homework<br>- Solve the numerical in the text book mentioned in class for respective chapter, make a note and submit on Google classroom.<br><br>Spend 5 minutes to wrap up and consolidate the learning. |
| **Evaluation** | 40. Reflective Questions (What, Why, Who?). Allow students to answer and discuss.<br><br>Spend 5 minutes to evaluate student assimilation of the lesson contents |