# ENVIRONMENTAL ENGINEERING

Subject code: **CE602PC**

Regulations: R16-JNTUH

Class: III Year B. Tech CE II Sem

DEPARTMENT OF CIVIL ENGINEERING

BHARAT INSTITUTE OF ENGINEERING AND TECHNOLOGY

Ibrahimpatnam - 501 510, Hyderabad

# ENVIRONMENTAL ENGINEERING (CE602PC)
# COURSE PLANNER

## I. COURSE OVERVIEW:

The aim of this course is to introduce basic principles of environmental engineering and it is further extended to cover the application of environmental engineering by the inclusion of water and waste water treatment. This subject provides the knowledge of water resources, water treatment, design of distribution system waste water treatment, and safedisposal methods. The topic of characteristics of water, waste water and sludge digestion are also included.

## II. PREREQUISITE(S):

| Level | Credits | Periods | Prerequisite |
|---|---|---|---|
| UG | 4 | 4 | Engineering chemistry, Mathematics |

## III. COURSE OBJECTIVES:

**The objectives of the course are to enable the student;**

This subject provides the knowledge of water sources treatment, design of distribution system waste water treatment, and safe disposal methods. The topics of characteristics of waste water, sludge digestion are also included.

## IV. COURSE OUTCOMES:

**At the end of this course, a student will be able to:**

| S.No | Course Outcomes | Blooms Taxonomy Level |
|---|---|---|
| **1** | Analyze characteristics of water and wastewater. | **L2: Understanding** |
| **2** | Estimate the quantity of drinking water and wastewater generated | **L2: Understanding** |
| **3** | Design components of water supply systems. Design sewerage system. | **L3: Apply** |

## V. HOW PROGRAM OUTCOMES ARE ASSESSED:

| Program outcomes | | Level | Proficiency assessed by |
|---|---|---|---|
| PO1 | **Engineering knowledge**: To Apply the knowledge of mathematics, science, engineering fundamentals/principals, and civil engineering to the solution of complex engineering problems encountered in modern engineering practice. | - | Assignments |
| PO2 | **Problem analysis**: Ability to Identify, formulate, review research literature, and analyze complex engineering problems related to Civil Engineering and reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. | 1 | Exercise, Exams |
| PO3 | **Design/development of solutions**: Design solutions for complex | - | Exercise |

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| | engineering problems related to Civil Engineering and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. | | |
| PO4 | **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. | - | Discussion, Seminars |
| PO5 | **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. | 3 | Discussion, Seminars |
| PO6 | **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the Civil Engineering professional engineering practice. | - | Discussions |
| PO7 | **Environment and sustainability**: Understand the impact of the Civil Engineering professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. | - | ------ |
| PO8 | **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. | - | ------ |
| PO9 | **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. | - | ------ |
| PO10 | **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. | - | ------ |
| PO11 | **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. | 0.67 | ----- |
| PO12 | **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. | - | Prototype, Discussions |

## VI. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

| Program outcomes | | Level | Proficiency assessed by |
|---|---|---|---|
| PSO 1 | **ENGINEERING KNOWLEDGE:** Graduates will be able to apply technical knowledge in drawing, analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good basics in mathematics, basic sciences and technical communication. | - | Lectures and Assignments |

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| PSO 2 | **BROADNESS AND DIVERSITY:** Graduates will be able to summarize and can demonstrate about societal, economical, environmental, health and safety factors involved in infrastructural development, and shall work within multidisciplinary teams with competence in modern tool usage. | - | Tutorials |
| PSO 3 | **SELF-LEARNING AND SERVICE:** Graduates will be able to pursue lifelong learning and professional development to face the challenging and emerging needs of our society, ethically and responsibly. | 1 | Seminars and Projects |

**N - None** **S - Supportive** **H – Highly Related**

**VII. SYLLABUS:**

**JNTUH SYLLABUS**

**UNIT – I**

Introduction: Waterborne diseases – protected water supply – Population forecasts, design period – types of water demand – factors affecting – fluctuations – fire demand – water quality and testing – drinking water standards: sources of water - Comparison from quality and quantity and other considerations – intakes – infiltration galleries.

**UNIT – II**

Layout and general outline of water treatment units – sedimentation – principles – design factors – coagulation-flocculation clarifier design – coagulants - feeding arrangements. Filtration – theory – working of slow and rapid gravity filters – multimedia filters – design of filters – troubles in operation - comparison of filters – disinfection – theory of chlorination, chlorine demand - other disinfection practices- Miscellaneous treatment methods.

**UNIT – III**

Distribution systems requirement –method and layouts -Design procedures- Hardy Cross and equivalent pipe methods pipe – joints, valves such as sluice valves, air valves, scour valves and check valves water meters – laying and testing of pipe lines – pump house – Conservancy and water carriage systems – sewage and storm water estimation – time of concentration – storm water overflows combined flow

**UNIT – IV**

Characteristics of sewage – cycles of decay – decomposition of sewage, examination ofsewage – B.O.D. Equation – C.O.D. Design of sewers – shapes and materials – sewer

appurtenances manholes – inverted siphon – catch basins – flushing tanks – ejectors, pump and pump houses – house drainage – components requirements – sanitary fittings-traps – onepipe and two pipe systems of plumbing – ultimate disposal of sewage – sewage farming –dilution.

**UNIT – V**

Waste water treatment plant – Flow diagram - primary treatment Design of screens – grit chambers – skimming tanks – sedimentation tanks – principles of design – Biological treatment – trickling filters – standard and high rate – Construction and design of oxidation ponds. Sludge digestion – factors effecting – design of Digestion tank – Sludge disposal by drying – septic tanks working principles and design – soak pits.

**SUGGESTED BOOKS:**

**TEXT BOOKS:**

1. Environmental Engineering by H.S Peavy, D. R. Rowe, G. Tchobanog lous, McGraw

Hill Education (India) Pvt Ltd, 2014

2. Environmental Engineering by D. P. Sincero and G.A Sincero, Pearson 2015.

3. Water Supply & Environmental Engineering by A.K. Chatterjee.

4. Water Supply and sanitary Engineering by G.S. Bindi, Dhanpat Rai & Sons Publishers.

**REFERENCE BOOKS:**

1. Water and Waste Water Technology by Steel, Wiley

2. Waste water engineering by Metcalf and Eddy, McGraw Hill, 2015.

3. Water and Waste Water Engineering by Fair Geyer and Okun, Wiley, 2011

4. Water and Waste Water Technology by Mark J Hammar and Mark J. Hammar

Jr.Wiley, 2007.

**MOOC'S- SWAYAM/ NPTEL:**

http://nptel.ac.in/courses/112104118/
http://nptel.ac.in/courses/112104118/#

**GATE SYLLABUS:**

**Water requirements:** Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, sludge disposal, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment Unit operations and unit processes of domestic wastewater, sludge disposal.

**Air Pollution:** Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

**Municipal Solid Wastes:** Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal).

**Noise Pollution:** Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

**IES SYLLABUS:**

**A. Water Supply Engineering**

Sources of supply, yields, design of intakes and conductors; Estimation of demand; Water quality standards; Control of Water-borne diseases; Primary and secondary treatment, detailing and maintenance of treatment units; Conveyance and distribution systems of treated water, leakages and control; Rural water supply; Institutional and industrial water supply.

**B. Waste Water Engineering**

Urban rain water disposal; Systems of sewage collection and disposal; Design of sewers and sewerage systems; pumping; Characteristics of sewage and its treatment, Disposal of products of sewage treatment, stream flow rejuvenation Institutional and industrial sewage management, Plumbing Systems, Rural and semi-urban sanitation.

**C. Solid Waste Management**

Sources, classification, collection and disposal; Design and Management of landfills.

**D. Air And Noise Pollution And Ecology**

Sources and effects of air pollution, monitoring of air pollution; Noise pollution and standards; Ecological chain and balance, Environmental assessment.

**VIII. COURSE PLAN:**

| Lecture No. | Week | Unit | Topics to be covered | Learning Objective | Teaching Methodology | References |
|---|---|---|---|---|---|---|
| 1. | 1 | 1 | **UNIT-I** introduction, water borne diseases | **To understand:** Outline of various units | Chalk and Talk | T1 |
| 2. | 1 | 1 | water supply schemes - protected water supply | **To learn:** explain distribution of water supply | Chalk and Talk | T1 |
| 3. | 1 | 1 | population forecasts | **To understand:** explain growth of population in future | Chalk and Talk | |

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| 4. | 1 | 1 | design period, water demand- types of demand | **To understand:** explain types of demand | Chalk and Talk | |
| 5. | 2 | 1 | factors affecting fluctuations - fire demand | **To understand:** explain types of demand | Chalk and Talk | T1 |
| 6. | 2 | 1 | water quality parameters and testing | **To learn:** classify water parameters | Chalk and Talk | |
| 7. | 2 | 1 | drinking water standards | **To learn:** classify and standardize water parameters | Chalk and Talk | |
| 8. | 2 | 1 | sources of water | **To understand:** classify sources of water | Chalk and Talk | T1 |
| 9. | 3 | 1 | comparison from quality and quantity and other considerations | **To understand:** classify water parameters | Chalk and Talk | |
| 10. | 3 | 1 | intakes - infiltration galleries | **To understand:** classify sources of water | Chalk and Talk | |
| 11. | 3 | 2 | **Unit-II**: layout and general outline of water treatment units | **To understand:** outline of treatment units | Chalk and Talk | T1 |
| 12. | 3 | 2 | sedimentation, principles | **To understand:** sedimentation design | Chalk and Talk | |
| 13. | 4 | 2 | design factors of sedimentation | **To understand:** sedimentation design | Chalk and Talk | |
| 14. | 4 | 2 | coagulation, flocculation, clarifier design | **To understand:** coagulation, flocculation design | Chalk and Talk | T1 |

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| 15. | 4 | 2 | coagulants - feeding arangements, filtration-theory | **To understand:** coagulation, flocculation design | Chalk and Talk | |
| 16. | 4 | 2 | working of slow and rapid gravity filters | **To learn:** filtration design | Chalk and Talk | |
| 17. | 5 | 2 | multimedia filters - design of filters | **To learn:** filtration design | Chalk and Talk | |
| 18. | 5 | 2 | troubles in operations, comparison of filters | **To learn:** filtration design | Chalk and Talk | T1 |
| 19. | 5 | 2 | disinfection, types and methods of disinfection | **To understand:** disinfection methods | Chalk and Talk | |
| 20. | 5 | 2 | theory of chlorination & chlorine demand | **To understand:** disinfection methods | Chalk and Talk | |
| 21. | 6 | 2 | other disinfection methods, miscellaneous treatment methods | **To understand:** disinfection methods | Chalk and Talk | T1 |
| 22. | 6 | 3 | **UNIT -III** distribution system requirements | **To understand:** distribution systems | Chalk and Talk | |
| 23. | 6 | 3 | design of distribution systems | **To understand:** distribution systems | Chalk and Talk | |
| 24. | 6 | 3 | hardy cross method | **To learn:** flow in pipe network | Chalk and Talk | T1 |
| 25. | 7 | 3 | equivalent pipes method | **To learn:** flow in pipe network | Chalk and Talk | |
| 26. | 7 | 3 | pipe joints and valves such as sluice valves air valves scour valves and check valves, water meters | **To understand:** flow apputenances | Chalk and Talk | T1 |

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| 27. | 7 | 3 | laying and testing of pipes | **To understand:** flow apputenances | Chalk and Talk | |
| 28. | 7 | 3 | conservancy and water carriage systems | conservation of water | Chalk and Talk | |
| 29. | 8 | 3 | sewage and storm water estimation, time of concentration | **To understand:** storm and sewage water estimation | Chalk and Talk | |
| 30. | 8 | 3 | storm water overflows, combined overflows | **To understand:** storm and sewage water estimation | Chalk and Talk | T1 |
| 31. | 8 | 4 | **UNIT4** sewage characteristics | **To understand:** sewage characteristics | Chalk and Talk | |
| 32. | 8 | 4 | cycles of decay, | **To understand:** sewage characteristics | Chalk and Talk | |
| 33. | 9 | 4 | decomposition and examination of sewage | **To understand:** sewage examination | Chalk and Talk | T1 |
| 34. | 9 | 4 | B.O.D. C.O.D . equations | **To understand:** calculation of decay | Chalk and Talk | |
| 35. | 9 | 4 | design of sewers - shapes and materials | **To learn:** sewer design | Chalk and Talk | |
| 36. | 9 | 4 | design of sewers - shapes and materials | **To learn:** sewer design | Chalk and Talk | T1 |
| 37. | 10 | 4 | sewer appurtenances, manholes, inverted siphon, catch basins | **To learn:** sewer appurtenances | Chalk and Talk | |
| 38. | 10 | 4 | flushing tanks | **To understand:** sewer appurtenances | Chalk and Talk | T1 |

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| 39. | 10 | 4 | ejectors, pumps and pump houses | **To understand:** sewer appurtenances | Chalk and Talk | |
| 40. | 10 | 4 | house drainage | **To understand:** sewer appurtenances | Chalk and Talk | |
| 41. | 11 | 4 | components requirements, sanitary fittings, traps | **To understand:** sewer appurtenances | Chalk and Talk | |
| 42. | 11 | 4 | one pipe and two pipe systems of plumbing | **To understand:** sewer appurtenances | Chalk and Talk | T1 |
| 43. | 11 | 4 | ultimate disposal of sewage , sewage farming, dilution | **To understand:** sewage disposal | Chalk and Talk | |
| 44. | 11 | 4 | sewage farming | **To understand:** sewage disposal | Chalk and Talk | |
| 45. | 12 | 4 | dilution | **To understand:** sewage usage | Chalk and Talk | T1 |
| 46. | 12 | 5 | **Unit -5** Layout and general outline of various units in a waste water treatment plant-flow diagram | **To understand:** waste water treatment | Chalk and Talk | |
| 47. | 12 | 5 | grit chamber | **To learn:** waste water treatment | Chalk and Talk | |
| 48. | 12 | 5 | skimming tank | **To learn:** waste water treatment | Chalk and Talk | T1 |
| 49. | 13 | 5 | sedimentation tank | **To learn:** waste water treatment | Chalk and Talk | |
| 50. | 13 | 5 | | | | |
| 51. | 13 | 5 | principles and design of biological treatment | **To learn:** biological treatment | Chalk and Talk | T1 |
| 52. | 13 | 5 | principles and design of biological treatment | **To learn:** biological treatment | Chalk and Talk | |
| 53. | 14 | 5 | trickling filters | **To learn:** biological | Chalk and | T1 |

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|---|---|---|---|---|---|---|
| | | | | treatment | Talk | |
| 54. | 14 | 5 | standard and high rate filters | **To understand:** filtration treatment | Chalk and Talk | |
| 55. | 14 | 5 | standard and high rate filters | **To understand:** filtration treatment | Chalk and Talk | |
| 56. | 14 | 5 | construction and design of oxidation ponds | **To understand:** teritary treatment | Chalk and Talk | T1 |
| 57. | 15 | 5 | construction and design of oxidation ponds | **To understand:** teritary treatment | | |
| 58. | 15 | 5 | oxidation ditches- sludge treatment | **To understand:** teritary treatment | Chalk and Talk | |
| 59. | 15 | 5 | sludge digestion tanks, design of digestion tank | **To understand:** teritary treatment | Chalk and Talk | T1 |
| 60. | 15 | 5 | sludge digestion tanks, design of digestion tank | **To understand:** teritary treatment | Chalk and Talk | |
| 61. | 16 | 5 | factors affecting sludge digestion | **To understand:** teritary treatment | Chalk and Talk | |
| 62. | 16 | 5 | sludge disposal by drying | **To understand:** sludge disposal | Chalk and Talk | T1 |
| 63. | 16 | 5 | septic tanks and working principles and design | **To understand:** design of septic tank | Chalk and Talk | |
| 64. | 16 | 5 | soak pits, ultimate disposal of waste water | **To understand:** sewage disposal and sludge disposal | Chalk and Talk | |

| | **Beyond Syllabus** |
|---|---|
| 1. | 2. air quality standards and limits air pollution control |
| 3. | 4. noise pollution noise impact, measurement and control of pollution |
| 5. | 6. solid waste management |

**IX. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:**

| Course Objectives | Program Outcomes | | | | | | | | | | | | Program Specific Outcomes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| I | - | - | - | - | 3 | - | - | - | - | - | 2 | - | - | - | - |
| II | - | - | - | - | 3 | - | - | - | - | - | - | - | - | - | - |
| III | - | 3 | - | - | 3 | - | - | - | - | - | - | - | - | - | 3 |
| Average | - | 1 | - | - | 3 | - | - | - | - | - | 0.67 | - | - | - | 1 |

**1 = Small** **2=Supportive** **3=Highly related**

**X. QUESTION BANK: DESCRIPTIVE QUESTIONS: (WITH BLOOMS PHRASES)**

**UNIT-I**

**SHORT ANSWER QUESTIONS-**

| S.NO | Question | Blooms Taxonomy Level | Programme Out come |
|---|---|---|---|
| 1. | What do you mean by disinfection? | Understanding | 1 |
| 2. | Rainwater harvesting is the need of the hour – justify. | Understanding | 1 |
| 3. | List the commonly used disinfectants. | Understanding | 1 |
| 4. | What is meant by equalizing reservoirs? | Understanding | 1 |
| 5. | Define the term 'potable water'? | Understanding | 1 |
| 6. | State the causes for water pollution? | Understanding | 1 |
| 7. | What are intakes? | Understanding | 1 |
| 8. | Differentiate between 'dry' and 'wet' intake? | Understanding | 2 |
| 9. | What are the different types of Infiltration galleries? | Understanding & remembering | 1 |
| 10. | What are the general requirements of anunconfined aquifer? | Understanding & remembering | 1 |

**LONG ANSWER QUESTIONS-**

| S.No | Question | Blooms Taxonomy Level | Programme Out come |
|---|---|---|---|
| 1. | What are the various methods of population forecasts? The census records of a city show population as follows:<br>Present 50,000<br>Before one decade 47,100<br>Before two decades 43,500<br>Before three decades 41,000<br>Workout the probable population after one, two and three decades by using Incremental increase | Understanding & remembering | 5 |

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|---|---|---|---|
| | method? | | |
| 2. | What do you mean by disinfection? | Analyze | 5 |
| 3. | Rainwater harvesting is the need of the hour – justify. | Analyze | 5 |
| 4. | List the commonly used disinfectants. | Analyze & Apply | 5 |
| 5. | Define the term 'potable water'? | Analyze & Apply | 5 |
| 6. | State the causes for water pollution? | Analyze & Apply | 5 |
| 7. | Write the advantage of sub-surface sources? | Analyze & Apply | 5 |
| 8. | Define the term "Per capita demand"? | Analyze & Apply | 5 |
| 9. | Give a list of different sources of water. | Analyze & Apply | 5 |
| 10. | Describe in. Detail about infiltration galleries | Analyze | 5 |

**UNIT-2**

**SHORT ANSWER QUESTIONS-**

| S.N | Question | Blooms Taxonomy Level | Programme Out come |
|---|---|---|---|
| 1. | Explain about the uniform settling velocity of a particle? | Understanding & remembering | 5 |
| 2. | What are the different tests done during water analysis? | Understanding & remembering | 5 |
| 3. | List out the various methods of "Water Conservation" presently followed in India? | Understanding & remembering | 5 |
| 4. | Draw the sequence of treatment you would recommend for ground water free from Pollution but containing dissolved salts in large concentrations? | Understanding & remembering | 5 |
| 5. | State the effects when each of the following substances exceeds the prescribed limits in a water sample?<br>a. Nitrates Fluorides | Understanding & remembering | 5 |
| 6. | Define 'per capita demand'? | Understanding & remembering | 5 |
| 7. | List of the flow diagram of the water treatment program with neat sketches | Understanding and remembering | 5 |
| 8. | What are the different elements used as coagulants | Understanding and remembering | 5 |
| 9. | How many types of filters exist. What are they | Understanding and remembering | 5 |
| 10. | What Is disinfection? What is the simplest type of disinfection in use? | Understanding and remembering | 5 |

**LONG ANSWER QUESTIONS-**

| S.No | Question | Blooms Taxonomy Level | Programme Out come |
|---|---|---|---|
| 1. | Explain the process of Sedimentation with a neat sketch? | Understanding | 5 |
| 2. | Write the coagulants used in water treatment process? | Understanding | 5 |
| 3. | What is meant by super chlorination? | Understanding | 5 |
| 4. | Explain the working of Rapid gravity sand filters with a neat sketch? | Analyze & Apply | 5 |
| 5. | What are the problems faced in the operationof filters? | Analyze & Apply | 5 |
| 6. | Explain the types of disinfection withexamples? | Analyze & Apply | 5 |
| 7. | What are the various disinfection methods? | Analyze & Apply | 5 |
| 8. | What is Chlorine demand and how do youestimate chlorine demand of a given sample? | Analyze & Apply | 5 |
| 9. | Write about the design of a multimedia filter? | Analyze & Apply | 5 |
| 10. | What are the merits and demerits of the rapid sand filters as compared with slow sand filters? | Analyze & Apply | 5 |

**UNIT-3**

**SHORT ANSWER QUESTIONS-**

| S.No | Question | Blooms Taxonomy Level | Programme Out come |
|---|---|---|---|
| 1. | List out the various methods of "Water Conservation" presently followed in India? | understanding | 5 |
| 2. | What do you mean by conservancy system? | understanding | 5 |
| 3. | What do you mean by time of concentration. | understanding | 5 |
| 4. | What are the variousappurtenances? | understanding | 5 |
| 5. | Write a note on reuse of water | Understanding | 5 |
| 6. | What are valves? How are they used in distribution system? | Understanding | 5 |
| 7. | What is a tree(dead end) system? Explain with a neat sketch | Understanding | 5 |
| 8. | What is grid iron system? Explain with a neat sketch | Understanding | 5 |
| 9. | What are the methods of distribution in a community? Explain with sketches | Understanding | 5 |
| 10. | What is a radial system ? What are it's advantages | Understanding | 5 |

**LONG ANSWER QUESTIONS-**

| S.No | Question | Blooms Taxonomy Level | Programme Out come |
|---|---|---|---|
| 1. | What is air binding? What are its effects? | Understanding | 5 |
| 2. | What are the different methods of analyzing a given distribution system? Explain Hardz-Cross method of pipe network analysis? | Analyze & Apply | 5 |

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|---|---|---|---|
| 3. | Distinguish between Gravity system of distribution and pumping system of distribution? | Analyze & Apply | 5 |
| 4. | What are the general considerations of the water distribution system design? | Analyze & Apply | 5 |
| 5. | Describe the procedure for removal of iron from raw supplies in rural areas? | Analyze & Apply | 5 |
| 6. | What is the formula for estimating the strength of water using the relationship? | Analyze & Apply | 5 |
| 7. | What are the factors to be considered for locating a pumping station? | Analyze & Apply | 5 |
| 8. | What considerations govern the choice of a particular type of pump in water supply project? | Analyze & Apply | 5 |
| 9. | Write about various types of traps with neat sketches. | Analyze & Apply | 5 |
| 10. | Write advantages and disadvantages of water carriage systems. | Analyze & Apply | 5 |

**UNIT-4**

**SHORT ANSWER QUESTIONS-**

| S.No | Question | Blooms Taxonomy Level | Programme Out come |
|---|---|---|---|
| 1. | Write about characteristics of sewage. | understanding | l |
| 2. | What do you mean by 'hydraulicallybalanced network? | understanding | l |
| 3. | What do you mean by 'appurtenances? | remembering | l |
| 4. | Write a note on reuse of water? | remembering | l |
| 5. | What are super rate trickling filters? What is their loading capacity? | understanding | l |
| 6. | What is meant by Aeration? | remembering | l |
| 7. | What is a manhole? Explain with a sketch | Understanding | 1 |
| 8. | What is B.O.D? Detail the B.O.D equation | Remembering | 1 |
| 9. | What is C.O.D? How does it help in figuring out the quality of water | Understanding &remembering | 1 |
| 10. | List the treatment flow diagram for waste water treatment | Remembering | 1 |

**LONG ANSWER QUESTIONS-**

| S.No | Question | Blooms Taxonomy Level | Programme Out come |
|---|---|---|---|
| 1. | What is the relationship between B.O.D. and C.O.D? | Analyze &Apply | 5 |
| 2. | Write down the methods for the reuse of sewage and explain in detail about sewage composting? | Analyze &Apply | 5 |
| 3. | Explain about design of sewer. | Analyze &apply | 5 |
| 4. | Explain about inverted siphon with neat sketch. | Analyze &Apply | 5 |
| 5. | What is the definition of activated carbon? | Analyze &Apply | 5 |
| 6. | What is the process of activated sludge process? | Understanding | 5 |

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| 7. | Explain the principle involved in the design of biological treatment plant? | Understanding | 5 |
| 8. | Explain the working of Grit chambers?Write down the uses of skimming tanks? | Evaluate | 5 |
| 9. | Explain about Sedimentation tanks. | Evaluate | 5 |
| 10. | What are the factors that govern the design of Sedimentation tanks? | Analyze & Apply | 5 |

**UNIT-5**

**SHORT ANSWER QUESTIONS-**

| S.No | Question | Blooms Taxonomy Level | Programme Out come |
|---|---|---|---|
| 1. | How do you construct Oxidation ponds? | Understanding | 3 |
| 2. | What are the factors affecting digestion tank? | Remembering | 3 |
| 3. | What is mean by sludge digestion? | Remembering & Understanding | 3 |
| 4. | What are the various methods of sludge digestion? | Remembering & Understanding | 3 |
| 5. | What do you mean by Soaking pit? | Understanding | 3 |
| 6. | What is screening tank. Explain with neat sketch | Remembering & Understanding | 3 |
| 7. | What is a grit chamber. Explain with neat sketch | Remembering & Understanding | 3 |
| 8. | What is biological treatment of waste water. Briefly explain | Remembering & Understanding | 3 |
| 9. | What is tertiary treatment of waste water. Briefly explain | Remembering & Understanding | 3 |
| 10. | How is the sludge obtained from waste water dealt with. Explain in your own words | Understanding | 3 |

**LONG ANSWER QUESTIONS-**

| S.No | Question | Blooms Taxonomy Level | Programme Out come |
|---|---|---|---|
| 1. | What are Soak pits? Explain the construction of Soak pits with diagrams? | Analyze & Apply | 5 |
| 2. | What are the Sludge disposal methods? | Analyze & Apply | 5 |
| 3. | Design of septic tank? | Analyze & Apply | 5 |
| 4. | Design of oxidation pond? | Analyze & Apply | 5 |
| 5. | Explain about Sludge treatment. | Apply | 5 |
| 6. | Design of oxidation ditches? | Analyze & | 5 |
| 7. | Design of Soak pits? | Analyze & Apply | 5 |
| 8. | Design of Digestion tank? | Analyze & Apply | 5 |
| 9. | Explain about working principle of soak pits. | Analyze & Apply | 5 |
| 10. | Write about self purification of rivers. | Analyze & Apply | 5 |

**XI. OBJECTIVE QUESTIONS:**

**UNIT I**

1. The multiplying factor, as applied to obtain the maximum daily water demand, in relation to the average i.e per capita daily demand is
   a) 1.5 b) 1.8 c) 3 d) 2.7
2. The total water requirement of a city generally assessed on the basis of
   a) Maximum hourly demand b) maximum daily demand + fire demand
   c) Average daily demand + fire demand d) greater of (a) & (b)
3. Coincident draft in relation to water demand is based on:
   a) Peak hourly demand b) maximum daily demand
   c) Maximum daily + fire demand d) greater of (a) & (b)
4. One British degree of hardness equal to
   a) 1 ppm b) 10 ppm c) 14.25 ppm d) 17.15 ppm
5. Temporary hardness in water is caused by
   a) Bicarbonates of Ca & Mg b) Sulphates of Ca & Mg
   c) Chlorides of Ca & Mg d) Nitrates of Ca & Mg
6. The alkalinity and hardness of a water sample are 250 mg/l and 350 mg/l as $CaCo_3$ respectively. The water has 250 mg/l Carbonate hardness and 100 mg/l non-carbonate hardness
7. An infiltration gallery is
   a)A tube well with horizontal terms b)a horizontal well under the ground surface
   c) An artesian well d) a shallow well
8. Which one of the following would contain water with the maximum turbidity? *(C)*
   a) Lakes b) oceans c) rivers d) wells
9. Suspended impurities consist of *(C)*
   a) Iron b) chlorine c) bacteria d) all of this
10. The presence of..... Causes red colour in water *(A)*
    a) Iron b) manganese c) sodium fluoride d) calcium fluoride

**UNIT II**

1. The settling velocity of inorganic particles in a sedimentation tank of a water treatment plant is governed by *(B)*
   a) Darcy's law b) stokes law c) Dupuit's law d) none of the above
2. The settling velocity of inorganic particles of less than 0.1 mm dia, varies with the dia(d) in proportion: *(B)*
   a) $d^3$ b) $d^2$ c) d d) none of above
3. Surface loading or overflow rate of a sedimentation tank, passing a discharge Q, and having length=L, depth=D, width=B, is given by: *(B)*
   a) Q/(B.D) b) Q/(B.L) c) Q.B.D d) Q/(B.D.L)
4. The overflow rate for sedimentation tanks using coagulant is about *20 to 30 m3/day/m2*
   In a Plain sedimentation tank, under normal conditions, impurities are removed up to *(C)*
   a) 50% b) 60% c) 70% d) 80%
5. Bleaching powder is *(D)*
   a) Slaked lime b) chloride of lime c) hypo-chloride of limed) hypo chlorite of lime
6. Rate of filtration in slow sand filter in $1/hr/m^2$ is *(A)*
   a) 100 to 200 b) 3000 to 6000 c) 6000 to 15000 d) 15000 to 18000
7. Effective size of sand particles used in slow sand filters is *(A)*

a) 0.25 mm to 0.35 mm b) 0.45 mm to 0.7 mm
c) 0.6 mm to 1 mm d) 1 mm to 1.8 mm

8. Rapid sand filters remove bacteria to as much as *(B)*
   a) 70 to 80 % b) 80% to 90% c) 90% to 95%d) 98% to 99%
9. Slow sand filters remove bacteria to as much as *(D)*
   a) 70 to 80 % b) 80% to 90% c) 90% to 95%d) 98% to 99%
10. Rate of filtration in Rapid sand filter in $1/hr/m^2$ is *(B)*
    a) 100 to 200 b) 3000 to 6000 c) 6000 to 15000 d) 15000 to 18000
11. at break point chlorination the residual chlorine *(B)*
    a) Is zero b) is minimum c) is maximum d) reappears
12. The % of fresh of chlorine in fresh bleaching powder is *(C)*
    a) 10 to 15 b) 20 to 25 c) 30 to 35 d) 40 to 50
13. The valve used for controlling the flow is _____
14. Distribution layout in which a large no of scour valves required is _____

**UNIT III**

1. The ratio of minimum hourly flow to the average flow of sewage is *(A)*
   a) 1/3 b) 1/2 c) 2/3 d) 3
2. A minimum velocity should be maintained at sewer to *keep the suspended matter in suspension*
3. the most suitable section of a sewer in a combined sewerage system is: *(C)*
   a) Rectangular b) circular c) new egg shape d) parabolic
4. The self cleaning velocity recommended for Indian conditions in order to prevent settling down of sewage at bottom or sides of a large sewer is *0.75 m/s*
5. The pH of fresh sewage is usually: *(B)*
   a) <7 b) >7 c) =7 d) =0
6. $BOD_5$ represents 5-day biochemical oxygen demand at a temperature of $20^0c$
7. Standard 5 day BOD at $20^0$c when compared to ultimate is about *(B)*
   a) 58% b) 68% c) 98% d) none
8. The average $BOD_5$ of domestic sewage is 0.08 kg/day/person
9. The correct relationship between BOD, COD, TOD is *(B)*
   a) TOD>BOD>CODb) TOD>COD>BOD c) COD>BOD>TOD d) BOD>COD>TOD
10. The appropriate % of water in sewage is ----------

**UNIT IV**

1. Which of the following term appears in trickling filter treatment process? *(C)*
   a) Sludge volume index b) Thickening of sludge
   c) Scum removal d) recycling of effluent
2. The function of trickling filter unit is *(B)*
   a) Solid liquid separation b) removal of settleable solids
   c) Sloughing of biomass d) symbiotic reaction
3. Which of the following impurities are removed in trickling filter process? *(B)*
   a) Large floating matter b) Suspended inorganic
   c) Suspended organic matter d) Dissolved organic matter
4. Trickling filter plants are preferred for sewage treatment for: *(D)*
   a) Towns and smaller cities b) medium sized cities
   c) Large sized cities d) (a) and (b) both

5. The type of bacteria responsible for biological oxidation of dissolved solids in trickling filter is *(D)*
   a) Pathogenic bacteria b) facultative bacteria
   c) Anaerobic bacteria d) Aerobic bacteria
6. A reactor in which the surface area for growth of biofilm is provided by randomly packed solid medium is called *(B)*
   a) Activated sludge reactor b) trickling filter b) Stabilization pond d) mixed reactor
7. The sludge form secondary settling tanks in a trickling filter is called *(B)*
   a) leachate b) compost c) humus d) ashes
8. Trickling filter treatment process is classified as *(B)*
   a) Aerobic suspended culture b) aerobic attached culture
   c) Anaerobic digestion d) none
9. In a high rate trickling filter, the problem of ponding can be solved by *(C)*
   a) Flooding and raking b) chlorination and supply of air
   c) Raking and chlorination d) flooding and supply of air
10. The average normal efficiency of BOD removal in trickling filter process is *(B)*
    a) 95% b) 90% c) 60% d) 30%

**UNIT V**

1. In a shallow waste stabilization pond, the sewage is treated by: *(C)*
   a) Aerobic bacteria only b) Algae only
   c) Dual action of aerobic bacteria and algae d) Sedimentation

2. The waste stabilization ponds can be *(A)*
   a) Aerobic b) Anaerobic c) facultative d) any of the above
3. The function of algae in an oxidation pond is to *(A)*
   a) Provide a mat over the surface of the oxidation pond so as to prevent evaporation of water *(A)*
   b) Provide oxygen for bacteria to degrade organic matter
   c) Provide a greenish appearance to the pond
   d) Prevent there odour nuisance
4. The sewage in a waste stabilization pond is treated by *(C)*
   a) Aerobic bacteria b) algae c) aerobic bacteria and algae d) facultative bacteria
5. The waste stabilization ponds can be *(A)*
   a) Aerobic b) anaerobic c) facultative d) any of these
6. The gas from sludge digestion tank is mainly composed of *(B)*
   a) Nitrogen b) carbon dioxide c) hydrogen sulphide d) methane
7. The gas coming out frm a sludge digestion tank is *(C)*
   a) Methane only b) carbon dioxide
   c)70% methane and 30% carbon dioxide d) 30% methane and 70% carbon dioxide
8. The first stage of natural process of sludge digestion is *(B)*
   a) Hydrolysis b) acid fermentation c) Alkaline fermentation d) methane fermentation
9. Sludge digestion is done by the following bacteria *(A)*
   a) Aerobic b) anaerobic c) facultative d) pathogenic
10. The main useful gaseous component in the digestion process is *(B)*
    a) Ethane b) methane c) butane d) propane

**XII. GATE QUESTIONS:**

1.Some of the water quality parameters are measured by titrating a water sample with a titrant. Group-I gives a list of parameters and Group-IIgives the list of titrants.

Group-I Group-II

P.Alkalinity 1. N/35.5 AgNO3

Q. Hardness 2. N/40 Na2S2O3

R. Chloride 3. N/50 H2SO4

S. Dissolved oxygen 4. N/50 EDTA

The correct match of water quality parameters in Group-I with titrants in Group-II is:

(A)P-1, Q-2, R-3, S-4 (B) P-3, Q-4, R-1, S-2 (C) P-2, Q-1, R-4, S-3 (D) P-4, Q-3, R-2, S-1

2. A water treatment plant is designed to treat 1 m3/s of raw water. It has 14 sand filters. Surface area of each filter is 50 m2What is the loading rate in (m3/dayXm2)with two filters out of service for routine backwashing? _____

3. A student began experiment for determination of 5-day, 20°C BOD on Monday. Since the $5^{th}$ day fell on Saturday, the final DO readings were taken on next Monday. On calculation, BOD (i.e. 7 day, 20°C) was found to be 150 mg/L. What would be the5-day, 20°C BOD (in mg/L)? Assume value of BOD rate constant (k) at standard temperature of 20°C as 0.23/day (base e). _____

4. The following residual chlorine compounds are formed during chlorination of water:

A) 2,1,3,4 B) 1,2,4,3 C) 1,2,3,4 D) 2,1,4,3

5.The flow chart of water treatment plant is shown in the following figure. If it is proposed to defluoridate the water using 'Nalgonda treatment' then it should be done

A) After adjusting the dose of lime and alum B) After sedimation

C) After filtration D) Before aeration

6. Electrical conductivity (EC) of water and total dissolved solids (TDS) are interrelated. The value of EC will?

A) decrease with increase in TDS B) increase with increase in TDS

C) decrease initially and then increase with increase in TDS

D) increase initially and then decrease with increase in TDS

7. In transition of sewers from smaller diameter sewers to longer diameter sewers, the continuity of sewers is maintained at the?

A) bottom of the concrete bed of sewers B) inverts of the sewers

C) crowns of the sewers D) hydraulic gradients of the sewers

8. The slope of a 1.0 m diameter concrete sewer laid at a slope of 1 in 1000, develops a velocity of 1m/s, when flowing full. When it is flowing half-full, the velocity of flow through the sewer will be?

A) 0.5 m/s B) 1.0 m/s C) 2 m/s D) 2.0 m/s

9. Match List-I (Process) with List-II (Biological agent) and select the correct answer using the codes given below the lists: List-I List-II A. Oxidation ditch 1. Facultative bacteria B. Waste stabilization pond 2. Anaerobic bacteria C. Imhoff tank 3. Anaerobic bacteria

(suspended culture) D. Rotating Biological 4. Anaerobic bacteria (attached culture) Contractor (RBC) Codes?

A) 4 1 2 3 B) 3 1 2 4 C) 1 2 3 4 D) 3 4 1 2

10. One litre of sewage, when allowed to settle for 30 minutes gives a sludge volume of 27cm3 If the dry weight of this sludge is 3.0 grams, then its sludge volume index will be?
A) 9 B) 24 C) 30 D) 81
11. A polluted stream undergoes self-purification in four distinct zones: 1. Zone of clear water 2. Zone of active decomposition 3. Zone of degradation 4. Zone of recovery The correct sequence of the zones is?
A) 3,4,2,1 B) 2,3,4,1 C) 2,4,3,1 D) 3,2,4,1
12. Match List-I with List-II and select the correct answer using the codes given below the lists: List-I List-II A. Soil pipe 1. Ventilating pipe B. Soil pipe 2.Wash basin C. P-trap 3.Water closet waste D. Cowl 4.House drainage?
A) 3 4 1 2 B) 3 4 2 1 C) 4 3 2 1 D) 4 3 1 2
13. The following items consists of two statements; one labeled as 'Assertion (A)' and the other as 'Reason (R)'. You are to examine these two statements carefully and select the answers to these items using the codes given below : Assertion (A) : Tapered flocculation is more efficient when compared to the conventional process of flocculation. Reason (R) : In tapered flocculation, velocity gradient at the inlet is less than that at the outlet of the flocculation unit. ?
A) Both A and R are true and R is the correct explanation of A
B) Both A and R are true and R is not a correct explanation of A
C) A is true but R is false D) A is false but R is true
14. Assertion (A) : In waste-water treatment, waste stabilization ponds are more successful in sunny tropical regions . Reason (R) : The bacterial action of purification is achieved through photosynthetic bacteria.?
A) Both A and R are true and R is the correct explanation of A
B) Both A and R are true and R is not a correct explanation of A
C) A is true but R is false D) A is false but R is true
15. Assertion (A) : The tapered flocculation is more efficient compared to the conventional process of flocculation. Reason (R) : In tapered flocculation, velocity gradient at the inlet is lesser compared to that at the outlet end of the flocculation unit. ?
A) Both A and R are true and R is the correct explanation of A
B) Both A and R are true and R is not a correct explanation of A
C) A is true but R is false D) A is false but R is true
16. Match List-I (Name of impurity in water) withList-II (Removed by)and select the correct answer using the codes given below the lists: List-I List-II A. Flurides 1. Activated carbon B. Mangan 2. Activated alumina C. Taste and odour 3.Manganese zeolite?
A) 1 2 3 B) 2 3 1 C) 2 1 3 D) 3 2 1
17. Which one of the following pairs is not correctly matched??
A) Checked valve : To check water flow in all directions
B) Sluice valve : To control flow of water through pipelines
C) Air valve : To release the accumulated air
D) Scour valve : To remove silt in a pipeline
18. Which one of the following pairs would contain water with the maximum amount of turbidity ??

A) Lakes B) Oceans C) Rivers D) Wells

**IES QUESTIONS**

1. The type of valve, which is provided on the suction pipe in a tube-well, is
   a)air relief valve b)reflux valve c)pressure relief valve d)sluice valve

2. Which of the following values of pH represents a stronger acid?
   a)2 b)5b c)7c d)10

3. The population of a town in three consecutive years are 5000, 7000 and 8400 respectively. The population of the town in the fourth consecutive year according to geometrical increase method is
   a)9500 b)9800 c)10100 d)10920

4. Standard EDTA (ethylene diamine tetra acetic acid) solution is used to determine the
   a)hardness in water b)turbidity in water

   c)dissolved oxygen in water d)residual chlorine in water

5. The distribution mains are designed for
   a)maximum daily demand b)maximum hourly demand

   c)average daily demand d)maximum hourly demand on maximum day

6. The maximum discharge of a tube-well is about
   a)litres/sec b)50 litres/sec c)500 litres/sec d)1000 litres/see

7. The maximum permissible limit for flouride in drinking water is
   a)mg/litre b)mg/litre c)mg/litre d)10 mg/litre

8. The polluted water is one which
   a) contains pathogenic bacteria

   b )consists of undesirable substances rendering it unfit for drinking and domestic use

   c) is safe and suitable for drinking and domestic use

   d )is contaminated

9. The depression of water table in a well due to pumping will be maximum
   a) at a distance R from the well b)close to the well

   c) at a distance R/2 from the well d)none of the above

10. The suitable method of forecasting population for a young and rapidly increasing city is
    a) arithmetical increase method b)geometrical increase method

    c) incremental increase method d)graphical method

## XIII. WEBSITES:

a. www.aerfindia.org
b. www.hcn.ogn.
c. www.inderscience.com
d. cat.org.uk

## XIV. EXPERT DETAILS

a. Dr. B.K. Dubey
   Department of Civil Engineering\
   Indian Institute of Technology Kharagpur

## XV. JOURNALS (NATIONAL AND INTERNATIONAL)

a. Environmental Research –AERF India .org
b. Environmental news.
c. Journal of Environmental Engineering.
d. International Journal of Environmental Engineering.
e. Journal of Environmental Engineering & Science.

## XVI. LIST OF TOPICS FOR STUDENT SEMINARS

a. Protected water supply
b. Layout and general outline of water treatment units.
c. Types of disinfection
d. Laying and testing of pipe lines.

## XVII. CASE STUDIES / SMALL PROJECTS

a. Water quality and testing.
b. Layouts of distribution system.
c. Sewage and storm water estimation.
d. Design of sludge digestion tanks.