

# **INDUSTRIAL WASTE WATER TREATMENT**

Subject code: **CE864PE**

Regulations: R16-JNTUH

Class: IV Year B. Tech CE II Sem



DEPARTMENT OF CIVIL ENGINEERING  
BHARAT INSTITUTE OF ENGINEERING AND TECHNOLOGY  
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## INDUSTRIAL WASTE WATER TREATMENT–(CE864PE) COURSE PLANNER

### I. COURSE OVERVIEW:

This course provides an understanding of the mechanisms and processes used to treat waters that have been contaminated in some way by anthropogenic industrial or commercial activities prior to its release into the environment or its re-use. To understand various terms used in industrial wastewater treatment and to acquaint with different steps involved in treatment of industrial waste water. This subject also explains design and treatment of different types of biological treatment.

### II. PREREQUISITE(S):

Level	Credits	Periods/Week	Prerequisites
UG	3	4	Environmental Engineering

### III. Course Objectives:

- To present the information of wastewater generation from various industries
- To inform about the conventional treatment processes for specific industrial wastewaters
- To explain about the new developments in industrial wastewater treatment technologies

**IV. Course Outcomes:** At the end of the course, the student should be able to:

S.No	Course Outcomes	Blooms Taxonomy Level
1	Identify the characteristics of industrial wastewaters	<b>L2: Understanding</b>
2	Describe pollution effects of disposal of industrial effluent	<b>L2: Understanding</b>
3	Identify and design treatment options for industrial wastewater	<b>L2: Understanding</b>
4	Formulate environmental management plan	<b>L2: Understanding</b>

### V. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Level	Proficiency assessed by
PO1	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1.25	Assignments, Exams

PO2	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	1.25	Assignments, Exams
PO3	<b>Design/development of solutions:</b> Design solutions for complex engineering problems 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	0.75	Assignments
PO4	<b>Conduct investigations of complex problems:</b> 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.	1.25	Assignments
PO5	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	-	-
PO6	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	-	Exams
PO7	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	0.5	Exams, Assignments
PO8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	-	Quizzes, Discussions
PO9	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	-	Lectures, Discussions
PO10	<b>Communication:</b> 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.	0.5	Lectures, Discussions

PO11	<b>Project management and finance:</b> 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.	0.5	Possible Projects
PO12	<b>Life-long learning:</b> 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.	-	Discussions

**N –NotApplicable**

**S –Supportive**

**H - HighlyRelated**

#### **VI.HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:**

<b>Program specific outcomes</b>		<b>Level</b>	<b>Proficiency Assessed By</b>
PSO1	<b>ENGINEERING KNOWLEDGE:</b> Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.	2.75	Lectures, Assignments, Exams
PSO2	<b>BROADNESS AND DIVERSITY:</b> Graduates will have a broad understanding of economical, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.	1.75	Lectures, Assignments, Exams
PSO3	<b>SELF-LEARNING AND SERVICE:</b> Graduates will be motivated for continuous self-learning in engineering practice and/ or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly.	1	Guest Lectures, Possible Group Projects, Industrial Internship

#### **VII SYLLABUS:**

##### **Course Objectives:**

- To present the information of wastewater generation from various industries
- To inform about the conventional treatment processes for specific industrial wastewaters
- To explain about the new developments in industrial wastewater treatment technologies

**Course Outcomes:** At the end of the course, the student should be able to:

- Identify the characteristics of industrial waste waters
- Describe pollution effects of disposal of industrial effluent
- Identify and design treatment options for industrial waste water
- Formulate environmental management plan

#### **UNIT - I**

Introduction: Wastewater Characteristics, Standards of Disposal, Treatment Objective and Strategies, Layouts of Primary, Secondary and Advanced Treatment Units.

#### **UNIT - II**

Design of Preliminary and Primary Treatment Operations: Screens, Grit Chambers, Skimming Tank, Primary and Secondary Sedimentation Tanks.

#### **UNIT - III**

Biological Treatment Processes: Types, Kinetics of Plug Flow and Completely Mixed Systems. Attached Growth Processes: Trickling Filters (Standard Rate, High Rate), Biofilters, Practices, Features and Design, Operational Difficulties and Remedial Measures, Rotating Biological Contactors. Suspended Growth Processes:

#### **UNIT - IV**

Activated Sludge Process, Modifications and Design Equations, Process Design Criteria, Oxygen and Nutrient Requirements - Classification and Design of Oxidation Ponds, Lagoons.

#### **UNIT - V**

Sludge Treatment and Disposal: Sludge Thickening, Aerobic and Anaerobic Sludge Digestion Processes, Design of Digester Tank, Sludge Dewatering, Ultimate Disposal, Sludge Drying Beds, Other Methods of Sludge Treatment.

#### **TEXT BOOKS:**

1. Wastewater Treatment – Concepts and Design Approach, by G L Karia and R A Christian, Prentice Hall of India,2006
2. Environmental Engineering by Gerard Kiely, McGraw Hill Education (India) Pvt Ltd, 2013
3. Environmental Engineering – A Design Approach by A. P. Sincero and G A Sincero, Prentice Hall of India,2014

#### **REFERENCES:**

1. Wastewater Engineering - Collection, Treatment, Disposal and Reuse by Metcalf and Eddy, , McGraw Hill Education (India) Pvt Ltd,2013
2. Industrial Waste Treatment by Nelson Leonard Nemerow, Butterworth-Heinemann, 2007.
3. Biological Process Designs for Wastewater Treatment by Benefield L.D. and Randall C.D. Prentice Hall Pub.Co., 1980.

**NPTEL WEB COURSE:**

<http://nptel.ac.in/courses/105106119/36>

**NPTEL VIDEO COURSE:**

<http://nptel.ac.in/courses/105106119/36#>

**GATE SYLLABUS:**

NA

**IES SYLLABUS:**

NA

**VIII.COURSEPLAN:**

Lecture No	Week	Unit	Topics to be covered	Learning Objective	Teaching Methodology	References
1.	1	1	Introduction to IWWT & Sources of pollution	Define different terms of IWWT and Understand the different sources of pollution	Chalk and Talk	<b>R1: 1-3,</b>
	1	1				
2	1	1	Physical, Chemical, organic and Biological properties of Industrial Wastes with standards	Understand the physical chemical and biological properties of IWWT with standards	Chalk and Talk	<b>R1: 1-4 R1: 2-3, 2-4, 2-6,2-8</b>
	1	1				
	2	1				
	2	1				
3	2	1	Layouts of different treatment units including advanced treatment	Understand the different types of Primary, secondary treatment units and advanced treatment system.	Chalk and Talk	<b>R1: 2.15-20</b>
	2	1				
4	3	2	Preliminary Treatment	Understand the design and operation of preliminary treatment of Industrial wastewater	Chalk and Talk	<b>R1: 3.1-3</b>
	3	2				

5	3	2	Grit chamber and skimming tanks	Understand the design and operation of Grit chamber and skimming tanks	Chalk and Talk	<b>R1: 3.5-14</b>
	3	2				
6	4	2	Primary sedimentation tanks	Understand the design and operation of primary sedimentation tanks	Chalk and Talk	<b>R1: 6.1-5</b>
	4	2				
7	4	2	Secondary sedimentation tanks	Understand the design and operation of secondary sedimentation tanks	Chalk and Talk	<b>R1: 9.1-5</b>
	4	2				
8	5	3	Biological treatment system	Define and understand the different biological treatment system	Chalk and Talk	<b>R1: 9.6-7</b>
	5	3				
9	5	3	Plug flow and completely mixed flow systems	Understand the principle and operation of plug flow and completely mixed flow systems	Chalk and Talk	<b>R1: 9.7-15</b>
	5	3				
10	6	3	Attached Growth Process	Understand the principles involved in attached growth process and different types.	Chalk and Talk	<b>R1: 9.15-20</b>
	6	3				
11	6	3	Trickling Filter	Understand the Design and operation of Trickling Filter.	Chalk and Talk	<b>R1:9.21-25</b>
	6	3				
12	7	3	Biofilter and Rotating Biological Contactors	Understand the Design and operation of Biofilter and Rotating Biological	Chalk and Talk	<b>R1: 10.1-5</b>
	7	3				

				Contactors		
13	7	3	Suspended Growth Process	Understand the Suspended growth process.	Chalk and Talk	<b>R1: 10.5-7</b>
	7	3				
14	8	4	Activated Sludge Process	Understand the concept of Activated sludge process	Chalk and Talk	<b>R1: 10.7</b>
15	8	4	Activated Sludge Process	Understand the different types of operation of Activated sludge process.	Chalk and Talk	
16	8	4	Activated Sludge process	Understand and design of Activated sludge process and nutrient requirement	Chalk and Talk	<b>R1: 10.8-10</b>
	8	4				
17	9	4	Activated Sludge process	Design the aeration equipment with oxygen and requirement	Chalk and Talk	<b>R1: 11.1-7</b>
	9	4				
18	9	4	Oxidation Pond	Design and operation of Oxidation pond	Chalk and Talk	<b>R1: 4.1</b>
	9	4				
	10	4	Lagoons	Design and operation of Aerated Lagoon.	Chalk and Talk	<b>R1: 4.2-8</b>
19.	10	4				
20	10	4	Oxidation pond and Lagoons	Design and operation of entries system of oxidation pond and lagoons	Chalk and Talk	<b>R1: 5.1-8</b>
	10	4				
21	11	5	Characteristics of Sludge	Analyze and understand the characteristics of sludge	Chalk and Talk	<b>R1: 7.1-3</b>
	11	5				
22	11	5	Sludge Thickening	Design and	Chalk and	



	1 1	5		operation of sludge thickening process	Talk	<b>R1: 7.4-7</b>
23	1 2	5	Aerobic and anaerobic sludge digestion process	Understand the principle and operation of aerobic and anaerobic sludge digestion process	Chalk and Talk	<b>R1: 12.1-3</b>
	1 2	5				
24	1 2	5	Sludge Digester Tank	Understand and Design the Digester tank	Chalk and Talk	<b>R1: 12.4-11</b>
	1 2	5				
25	1 3	5	Sludge Dewatering and Disposal	Understand the sludge dewatering process and different types of disposal methods	Chalk and Talk	<b>R1: 13.1-10</b>
	1 3	5				
26	1 3	5	Sludge Drying beds and sludge treatment	Understand the design procedure of sludge drying beds and treatment of sludge.	Chalk and Talk	<b>R1: 14.1-8</b>
	1 3	5				

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

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
<b>I</b>	2	3											3		2
<b>II</b>	3	2											3	2	
<b>III</b>	-	-		3			2						3	2	
<b>IV</b>	-		3	2						2	2		2	3	2
<b>AVG</b>	1.25	1.25	0.75	1.25	-	-	0.5	-	-	0.5	0.5	-	2.75	1.75	1

**X.QUESTION BANK:****UNIT-I****SHORT ANSWER QUESTIONS:**

<b>S.No</b>	<b>Question</b>	<b>Blooms Taxonomy Level</b>	<b>Course Outcome</b>
1.	Define wastewater	Remember	2
2.	Define wastewater treatment	Remember	2
3.	Write a short note on effluent and Influent of a Industry	Understand	1
4.	What are different sources of pollution	Understand	2
5.	Write the physical properties of Industrial Waste Water.	Understand	2
6.	Write the Chemical properties of Industrial Waste Water	Remember	1
7.	Write the Organic properties of Industrial Waste Water.	Remember	2
8.	Write the Biological properties of Industrial Waste Water	Remember	2
9.	Write a short note on Domestic waste water	Remember	2
10.	Write a short note on Industrial waste water	Remember	2

**LONG ANSWER QUESTIONS:**

<b>S.No</b>	<b>Question</b>	<b>Blooms Taxonomy Level</b>	<b>Course Outcome</b>
1.	Explain in detail about the different sources of Industrial waste waters	Remember	1
2.	Discuss in detail about the Physical properties of Industrial wastewater	Understand	1
3.	Discuss in detail about the Chemical properties of Industrial wastewater	Understand	2
4.	Discuss in detail about the Organic properties of Industrial wastewater	Remember	2
5.	Discuss in detail about the Biological properties of Industrial wastewater	Understand	2
6.	Explain the difference between Industrial and Municipal wastewaters	Remember	2
7.	Explain in detail the effects of Industrial effluents on sewers	Understand	2
8.	Explain in detail the effects of Industrial effluents on Natural water bodies	Understand	1
9.	Give the detailed information with respect to Waste water sources and its characteristics	Understand	1
10.	Explain and draw the layouts of primary, secondary and advance treatment units	Remember	1

## UNIT-II

### SHORT ANSWER QUESTIONS:

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	List the different stages of waste water treatment	Remember	2
2.	Draw the neat sketch of different stages of wastewater treatment plant	Remember	3
3.	Write a short note on Pre-treatment of waste water treatment	Understand	3
4.	Write a short note on Primary-treatment of waste water treatment	Remember	3
5.	Write the different ways involved in Strength Reduction of Industrial waste water	Remember	3
6.	Write a short on Volume Reduction of Industrial waste water	Remember	3
7.	Write a short on Neutralization of Industrial waste water	Understand	3
8.	Write a short on different types of screens	Understand	3
9.	Write a short on Grit Chamber operation	Remember	3
10.	Give a short note on Skimming operation	Remember	3

### LONG ANSWER QUESTIONS:

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	Explain the necessity of equalization and proportioning for industrial waste water treatment	Understand	3
2.	Enumerate the basic theories of Industrial wastewater Management and Explain the strength reduction.	Understand	4
3.	What is volume reduction? List and explain any four methods of the volume reduction in industrial wastewater	Understand	4
4.	What is the necessity of Neutralization in Industrial waste treatment? Explain the working of the same with suitable examples.	Understand	4
5.	Explain the different types of screens	Understand	3
6.	Explain design procedure of Grit chamber	Understand	3
7.	Explain the design procedure of skimming tank	Understand	4
8.	Discuss the phenomenon of discrete sitting of particles In Primary treatment.	Understand	4
9.	Explain the various methods of volume and strength reduction adopted for the industrial waste	Remember	3

10.	Write a short on theory of sedimentation, grit chamber and its importance	Understand	4
11.	Explain the process of coagulation and sedimentation	Understand	3

### UNIT-III

#### SHORT ANSWER QUESTIONS:

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	List the different biological treatment methods of Wastewater	Remember	5
2.	Write a short on Nitrification of Industrial waste water	Understand	5
3.	Write a short on plug flow reactors	Understand	5
4.	Brief the completely mixed system reactor	Understand	5
5.	Write a short note Biological treatment	Understand	5
6.	What is the principles of attached growth process	Understand	5
7.	Brief the principles of biofilter treatment	Remember	5
8.	Write short note on Rotating Biological Contactors	Remember	5
9.	Write a short on suspended growth process	Understand	5
10.	What is the process involved in Trickling filter	Remember	5

#### LONG ANSWER QUESTIONS:

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	Write an essay on different types of biological treatment systems	Understand	5
2.	Describe the kinetics of plug flow reactors	Remember	5
3.	Explain the procedure of Completely Mixed Flow Reactors	Remember	6
4.	What do you understand by equalization, neutralization and Proportioning?	Understand	6
5.	Write the design procedure of standard rate trickling filter system	Understand	6
6.	Explain briefly biofilter treatment.	Understand	6
7.	Describe the operational procedure of Rotating biological contactor	Understand	6

8.	Describe the operational procedure of High Rate Trickling filter operation	Understand	6
9.	Describe the operational difficulties of Trickling filter operation	Remember	6
10.	Explain briefly the suspended growth process	Understand	6

#### UNIT-IV

#### SHORT ANSWER QUESTIONS:

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	Give a brief note on Activated sludge process	Remember	7
2.	What are the different types involved in Activated sludge process	Remember	7
3.	Draw a neat sketch of the layout of conventional activated sludge process	Remember	7
4.	Write a short note on Return sludge	Remember	7
5.	Briefly outline mean cell residence time	Understand	7
6.	Distinguish between Tapered aeration and step aeration of activated sludge process	Remember	7
7.	Distinguish high rate treatment of activated sludge process	Understand	7
8.	Briefly outline extended aeration method in oxidation ponds	Remember	7
9.	Write a short note on oxidation pond	Understand	7
10.	Write a short note on Lagoon	Understand	7

#### LONG ANSWER QUESTIONS:

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	Characterize and discuss the various methods of activated sludge processes	Remember	7
2.	Describe the Design criteria involved in activated sludge process	Understand	7
3.	Describe the operational procedure of high rate activated sludge process	Remember	7

4.	Discuss the B.O.D load and percentage reduction of B.O,D by aeration unit and settling tank	Understand	7
5.	Discuss the extended aeration and contact stabilization process in activated sludge process	Remember	7
6.	Discuss the operation of activated sludge plant including oxygen and nutrient requirements	Understand	7
7.	What are the design procedure of two stage aeration of activated sludge process with layout	Understand	7
8.	Discuss the design and operational procedure of Oxidation ditch with neat sketch	Remember	7
9.	Discuss oxidation pond with neat sketch	Understand & Remember	7
10.	Discuss Lagoons and its operational procedure with neat sketch	Understand	7

#### UNIT-V

#### SHORT ANSWER QUESTIONS:

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	Give a brief note on sludge thickening	Understand	7
2.	What are the differences between aerobic and anaerobic sludge digestion process	Remember	7
3.	Draw a neat sketch of the sludge digestion process	Remember	7
4.	Write a shot note on sludge dewatering	Remember	7
5.	Write down the design principles of digestion tank	Remember	7
6.	Give a brief note on sludge disposal	Understand	7
7.	Write briefly about sludge drying beds	Remember	7
8.	Draw a neat sketch of the sludge drying beds	Remember	7
9.	Briefly outline the land disposal of sludge	Understand	7
10.	What are all the methods of sludge treatment?	Remember	7

#### LONG ANSWER QUESTIONS:

S.No	Question	Blooms Taxonomy Level	Course Outcome
1.	Discuss the sludge treatment methods and its operation	Understand	7
2.	Discuss the design and operational procedure of aerobic sludge digestion process	Understand	7
3.	Discuss the design and operational procedure of anaerobic sludge digestion process	Understand	7
4.	Explain the sludge thickening and dewatering process with design procedure.	Remember	7
5.	Write down the operational procedure of digestion tank with neat sketch	Remember	7
6.	Discuss the sludge drying beds with neat sketch	Create	7
7.	Explain the ultimate disposal of sludge	Remember	7
8.	Describe the characteristics of sludge	Understand	7
9.	Describe the merits of biological treatment of sludge and disposal	Understand	7
10.	Explain the process involved in Joint treatment of Industrial sludge and Domestic Sewage	Understand	7

### OBJECTIVE QUESTIONS:

#### UNIT-I

- The minimum recommended diameter of sewers, is  
A.5cm      B.10cm      C.15 cm      D.20 cm.
- Which of the following used for phosphorous removal? []  
1) Membrane bioreactors 2) chemical precipitation 3) absorption 4) adsorption  
a) 1 only b) 1, 2, 3 only c) 2, 3, 4 only d) 1 and 2 only
- Which of the following is the unit process in industrial waste water treatment? []  
1) oxidation, reduction 2) coagulation, Ph correction 3) mixing, flotation 4) sedimentation  
a) 1 & 2 only b) 1,3,4 only c) 2,3 only d) 3,4 only
- The ratio of COD/BOD for industrial water is always ----- than domestic water [ ]  
a) Higher b) lower c) some times higher sometimes lower d) always equal
- Ammonia, Arsenic are the toxic pollutants produced from ----- industries [ ]  
a) Petrochemicals b) metallurgical c) coke ovens d) fertilizers
- In denitrification process []  
a) nitrate converts to nitrogen b) nitrites to nitrates c) ammonia to nitrites d) nitrogen to nitrites
- represents the heavier inert matter in waste water

8. ----- is actually refers to zero discharge.
9. ----- treatment removes odour
10. ----- removes the coarse material

### UNIT-II

1. PH is property of industrial waste water []  
a) Physical b) Chemical c) Physiochemical d) Non
2. Addition of organic matter to water increases []  
a) DOD b) COD c) NOD d) BO
3. Inorganic salts of nitrogen and phosphorous increases the growth of []  
a) Aquatic life b) animal life c) plants life c) none
4. The strength of the wastes reduced by []  
a) Process change, by-product recovery b) classification of wastes, re-using  
c) Adding H<sub>2</sub>SO<sub>4</sub> to alkaline waste d) better mixing.
5. Match the following[] Industry origin of major wastes  
a) Textiles e) Unhairing, Soaking, Delining, Bating of hides  
b) Dairy f) Cooking of fibres, desizing of fabric.  
c) Paper & pulp g) cooking, refining, washing d) Tannery h) dilution of milk, separated milk  
a) a-f,b-g,c-h,d-e b) a-f,b-h,c-g,d-e c) a-h,b-g,c-f,d-e d) a-g,b-e,c-h,d-f
6. ----- type of treatment is the coarse screen
7. Activated carbon is classified as ----- treatment
8. ----- treatment is usually prior to reverse osmosis
9. Tube settlers are classified as -----type of treatment
10. Settling of particles in sedimentation occurs on the basis of----- law

### UNIT-III

1. Aerobic bacterias  
A. flourish in the presence of free oxygen B. consume organic matter as their food  
C. oxidize organic matter in sewage D. All the above.
2. Pick up the correct statement from the following:  
A. pH value indicates acidity and alkalinity of sewage  
B. In acidic sewage, the pH value is less than 7  
C. In alkaline sewage, the pH value is more than 7  
D. Fresh sewage is generally alkaline  
E. All the above.
3. Pick up the correct statement from the following:  
A. In treated sewage, 4 ppm of D.O. is essential  
B. Only very fresh sewage contains some dissolved oxygen  
C. The solubility of oxygen in sewage is 95% that is in distilled water  
D. All the above.
4. For the survival of fish in a river stream, the minimum dissolved oxygen is prescribed  
A. 3 PPM B. 4 PPM C. 5 Pm D. 10 ppm.
5. In a fully mechanized composting plant, involves



- A. mechanized receipt    B. mechanized segregation  
 C. mechanized pulverizing of refuse    D. all of these.
5. In ----- filter system waste water sprinkled on top of the filter
  6. ----- contactor works on the principle of attached growth process
  7. ----- system is used for removal of organic matter.
  8. Trickling filtration is the ----- stage of treatment
  9. Aerobic treatment filtration is called-----
  10. ----- treatment microorganism attached on the rotating discs.

#### UNIT-IV

1. Bio-chemical oxygen demand (BOD) for the first 20 days is generally referred to  
 A. initial demand B. first stage demand C. carbonaceous demand D. all of these.
2. For the COD test of sewage, organic matter is oxidized by  $K_2Cr_2O_7$  in the presence of  
 A.  $H_2SO_4$     B.  $HNO_3$     C. HCl    D. none of these.
3. For the survival of fish in a river stream, the minimum dissolved oxygen is prescribed  
 a) 4 PPM    b) 3 PPM    c) 10 ppm.    d) 5 PPM
4. Activated sludge process works on the ----- growth process
5. The cell retention time is also called-----
- 6.----- is called extended aeration process
7. Activated sludge process functions by supplying ----- through aerators
8. Recirculation ratio of activated sludge process is between-----
9. Diffused air supplied through ----- at the bottom of aeration tank
10. Activated sludge process removes ----- percentages of B.O.D

#### UNIT-V

1. Chlorination of water is done for the removal of  
 A. bacteria    B. suspended solids    C. sediments    D. hardness.
2. In a fully mechanised composting plant, involves  
 a) Mechanized segregation b) Mechanized receipt  
 c) all of these.    D) mechanized pulverising of refuse
3. The non-clog pump which permits solid matter to pass out with the liquid sewage, is  
 a) none of these. b) centrifugal pump c) pneumatic ejector d)  
 reciprocating pump
4. Aerobic bacteria  
 a) flourish in the presence of free oxygen b) consume organic matter as their food

c) oxidise organic matter in sewage      d) all

5. A rainfall may be classified as acidic if its pH value is less or equal to a)4      b)5      c)6      d)7

6. Primary sludge includes-----

7. ----- sludge includes treated sewage sludge

8. ----- helps in reducing the treatment costs

9. -----process is used in rural communities.

10. ----- is a process of producing manure

### **XI.GATEQUESTIONS:NA**

**IES :NA**

### **XII.WEBSITES:**

1. [www.aerfindia.org](http://www.aerfindia.org)
2. [www.hcn.ogn](http://www.hcn.ogn).
3. [www.inderscience.com](http://www.inderscience.com)
4. [cat.org.uk](http://cat.org.uk)

### **XIII.EXPERT DETAILS:**

1. Prf. M.M. Ghangrekar  
Professor  
Department of Civil Engineering  
Indian Institute of Technology, Kharagpur
2. Dr. B. K. Dubey  
Professor  
Department of Civil Engineering  
Indian Institute of Technology, Kharagpur

### **XIV.JOURNALS:**

0970-1141	Thesis Digest on Civil Engineering	1987
0973-8061	International Engineering and Technology Journal of Civil and Structure	2007
0975-5314	International journal of civil engineering	2009
0975-6744	Journal of information knowledge and research in civil engineering	2009
0976-6308	International journal of civil engineering and technology	2010
2249-426X	International Journal of Civil Engineering and Applications	2011
2249-8753	Recent Trends in Civil Engineering and Technology	2011
2277-5986	World Research Journal of Civil Engineering	2011
2277-7032	International Journal of Structural and Civil Engineering	2012
2278-9987	International Journal of Civil Engineering (IJCE)	2012

**XV.LIST OF TOPICS FOR STUDENTSEMINARS:**

1. Protected water supply
2. Layout and general outline of water treatment units.
3. Types of disinfection
4. Laying and testing of pipelines.

**XVI.CASE STUDIES / SMALLPROJECTS:**

1. Water quality and testing.
2. Layouts of distribution system.
3. Sewage and storm water estimation.
4. Design of sludge digestion tanks.