



CE811PE: SOLID WASTE MANAGEMENT

I. Course Overview:

A solid waste management course provides a comprehensive understanding of the entire waste management process, from generation and collection to treatment and disposal. It covers the technical, environmental, social, financial, and institutional aspects of managing solid waste, including various waste streams like municipal, industrial, and hazardous waste. The course also explores different waste management techniques, such as landfilling, composting, incineration, and recycling, along with their associated costs and benefits.

II. PREREQUISITE(S):

Level	Credits	Periods	Prerequisite
UG	3	4	ENVIRONMENTAL ENGINEERING

III. COURSE OBJECTIVES:

The objectives of the course are to enable the student;

Define the terms and Understands the necessity of solid waste management. Explain the strategies for the collection of solid waste Describe the solid waste disposal methods. Categorize Hazardous Waste.

IV. COURSE OUTCOMES:

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

S.No	Course Outcomes	Blooms Taxonom Level
1	Identify the physical and chemical composition of solid wastes.	L2: Understanding
2	Analyze the functional elements for solid waste management.	L2: Understanding
3	Understand the techniques and methods used in transformation, conservation, and recovery of materials from solid wastes.	L3: Apply

V. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program outcomes		Level	Proficiency assessed by
PO1	Engineering knowledge: To Apply the knowledge of environmental engineering, 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 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.	-	Exercise
PO4	Conduct investigation 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
PSO1	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
PSO2	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 with in multidisciplinary teams with Competence in modern tool usage.	-	Tutorials
PSO3	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:

JNTUHS SYLLABUS

UNIT – I

Solid Waste: Definitions, Types of solid wastes, sources of solid wastes, Characteristics, and perspectives; properties of solid wastes, Sampling of Solid wastes, Elements of solid waste management - Integrated solid waste management, Solid Waste Management Rules 2016.

UNIT– II

Engineering Systems for Solid Waste Management: Solid waste generation; on-site handling, storage and processing; collection of solid wastes; Stationary container system and Hauled container systems – Route planning - transfer and transport; processing techniques –

UNIT– III

Engineering Systems for Resource and Energy Recovery: Processing techniques; materials recovery systems; recovery of biological conversion products – Composting, pre and post processing, types of composting, Critical parameters, Problems with composting - recovery of thermal conversion products; Pyrolysis, Gasification, RDF - recovery of energy from conversion products; materials and energy recovery systems



UNIT– IV

Landfills: Evolution of landfills – Types and Construction of landfills – Design considerations – Life of Landfills- Landfill Problems – Lining of landfills – Types of liners – Leachate pollution and control – Monitoring landfills – Landfills reclamation.

UNIT– V

Hazardous waste Management: – Sources and characteristics, Effects on environment, Risk assessment – Disposal of hazardous wastes – Secured landfills, incineration - Monitoring – Biomedical waste disposal, E-waste management, Nuclear Wastes, Industrial waste Management

TEXT.

SUGGESTED BOOKS:

TEXT BOOKS:

1. Tchobanoglous G, Theisen H and Vigil SA 'Integrated Solid Waste Management, Engineering Principles and Management Issues' McGraw-Hill, 1993.
2. Vesilind PA, Worrell W and Reinhart D, 'Solid Waste Engineering' Brooks/Cole Thomson

REFERENCE BOOKS:

1. Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, 'Environmental Engineering', McGraw Hill Inc., New York, 1985.
2. Qian X, Koerner RM and Gray DH, 'Geotechnical Aspects of Landfill Design and

MOOC'S- SWAYAM/ NPTEL:

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

GATE SYLLABUS:

Waste 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.



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:

Le ctu re No .	U ni t N o.	Topic to be covered	Link for PPT	Link for PDF	Course learning outcomes	Teaching Methodology	Refer ence
1	U ni t 1	Introduction, water borne diseases, water supply schemes - protected water supply	https://drive.google.com/drive/folders/19ushHpFjPEuLQcVbkXzYVNH0TEgRmBUk?usp=sharing	https://drive.google.com/drive/folders/1qUUu9hVQHUaVa6ZqOztdlhauSyQaVUII?usp=sharing	To understand about water born diseases, to know different water supply schemes	Chalk and Talk, ppt	T1, T2
2		population forecasts	https://drive.google.com/drive/folders/19ushHpFjPEuLQcVbkXzYVNH0TEgRmBUk?usp=sharing	https://drive.google.com/drive/folders/1qUUu9hVQHUaVa6ZqOztdlhauSyQaVUII?usp=sharing	Problematic approach of population forecasts	Chalk and Talk, PPT	T1, T4
3		design period, water demand - types of demand	https://drive.google.com/drive/folders/19ushHpFjPEuLQcVbkXzYVNH0TEgRmBUk?usp=sharing	https://drive.google.com/drive/folders/1qUUu9hVQHUaVa6ZqOztdlhauSyQaVUII?usp=sharing	to learn design period, water demand	Chalk and Talk, ppt	T1, T2



5		factors affecting fluctuations- fire demand, water quality parameters and testing	https://drive.google.com/drive/folders/19ushHpFjPEuLQcVbkXzYVNH0TEgRmBUk?usp=sharing	https://drive.google.com/drive/folders/1qUUu9hVQHUaVa6ZqOztdlhauSyQaVULI?usp=sharing	to understand about fire demand, to know water quality	Chalk and Talk, PPT	T1, T3
6							
8		drinking water standards	https://drive.google.com/drive/folders/19ushHpFjPEuLQcVbkXzYVNH0TEgRmBUk?usp=sharing	https://drive.google.com/drive/folders/1qUUu9hVQHUaVa6ZqOztdlhauSyQaVULI?usp=sharing	to understand drinking water standards	Chalk and Talk, PPT	T1, T2
9		sources of water	https://drive.google.com/drive/folders/19ushHpFjPEuLQcVbkXzYVNH0TEgRmBUk?usp=sharing	https://drive.google.com/drive/folders/1qUUu9hVQHUaVa6ZqOztdlhauSyQaVULI?usp=sharing	to know the source of water	Chalk and Talk, PPT	T1, T2
10		comparison from quality and quantity and other considerations	https://drive.google.com/drive/folders/19ushHpFjPEuLQcVbkXzYVNH0TEgRmBUk?usp=sharing	https://drive.google.com/drive/folders/1qUUu9hVQHUaVa6ZqOztdlhauSyQaVULI?usp=sharing	differentiate quality and quantity	Chalk and Talk, ppt	T1, T2
12		intakes- infiltration galleries	https://drive.google.com/drive/folders/19ushHpFjPEuLQcVbkXzYVNH0TEgRmBUk?usp=sharing	https://drive.google.com/drive/folders/1qUUu9hVQHUaVa6ZqOztdlhauSyQaVULI?usp=sharing	to know about intakes	Chalk and Talk, ppt	T1, T2
13	Unit 2	layout and general outline of water treatment units	https://drive.google.com/drive/folders/19ushHpFjPEuLQcVbkXzYVNH0TEgRmBUk?usp=sharing	https://drive.google.com/drive/folders/1qUUu9hVQHUaVa6ZqOztdlhauSyQaVULI?usp=sharing	to know about water treatment units	Chalk and Talk, PPT	T3, T4



14	sedimentation, principles	https://drive.google.com/drive/folders/19ushHpFjPEuLQcVbkXzYVNH0TEgRmBUk?usp=sharing	https://drive.google.com/drive/folders/1qUUu9hVQHUaVa6ZqOztdlhauSvQaVUII?usp=sharing	to understand sedimentation	Chalk and Talk, ppt	T3, T4
16	design factors of sedimentation		https://drive.google.com/drive/folders/1xNlpIkLVfgr2CAB-PwXFjr0TL0L9drHN?usp=sharing	to understand about sedimentation	Chalk and Talk	T3, T4
17	coagulation, flocculation, clarifier design		https://drive.google.com/drive/folders/1xNlpIkLVfgr2CAB-PwXFjr0TL0L9drHN?usp=sharing	to design clarifier	Chalk and Talk	T3, T4
18	coagulants-feeding arrangements, filtration-theory	https://www.researchgate.net/figure/Layout-of-the-waste-water-treatment-plant_fig1_267418168	https://drive.google.com/drive/folders/1xNlpIkLVfgr2CAB-PwXFjr0TL0L9drHN?usp=sharing	to know filtration theory	Chalk and Talk, PPT	T3, T4
20	working of slow and rapid gravity filters		https://drive.google.com/drive/folders/1xNlpIkLVfgr2CAB-PwXFjr0TL0L9drHN?usp=sharing	to know gravity filters	Chalk and Talk	T3, T4
21	multimedia filters - design of filters	https://drive.google.com/drive/folders/14zZwUrWvg0U3JaNv1vFysygtFcme?usp=sharing	https://drive.google.com/drive/folders/1xNlpIkLVfgr2CAB-PwXFjr0TL0L9drHN?usp=sharing	multimedia filter	Chalk and Talk, PPT	T3, T4



22		troubles in operations, comparison of filters	https://drive.google.com/drive/folders/14zZwUrWvg0U3JaNv1vFysygtFcme-scme?usp=sharing	https://drive.google.com/drive/folders/1xNlpIkLVfgr2CAB-PwXFjr0TL0L9drHN?usp=sharing	to know about filters	Chalk and Talk	T3, T4
24		disinfection, types and methods of disinfection, theory of chlorination & chlorine demand	https://drive.google.com/drive/folders/14zZwUrWvg0U3JaNv1vFysygtFcme-scme?usp=sharing	https://drive.google.com/drive/folders/1xNlpIkLVfgr2CAB-PwXFjr0TL0L9drHN?usp=sharing	to know disinfection methods	Chalk and Talk	T3, T4
25		other disinfection methods,	https://drive.google.com/drive/folders/14zZwUrWvg0U3JaNv1vFysygtFcme-scme?usp=sharing	https://drive.google.com/drive/folders/1xNlpIkLVfgr2CAB-PwXFjr0TL0L9drHN?usp=sharing	to know more about different type of treatment methods	Chalk and Talk	T3, T4
26		Design of distribution system, pipe apparatus	https://drive.google.com/drive/folders/14zZwUrWvg0U3JaNv1vFysygtFcme-scme?usp=sharing	https://drive.google.com/drive/folders/1xNlpIkLVfgr2CAB-PwXFjr0TL0L9drHN?usp=sharing	to design distribution system	Chalk and Talk, PPT	T3, T4
28		Unit III Characteristics of sewage & wastewater collection, Estimation of waste water and storm water – decomposition of sewage,	https://drive.google.com/drive/folders/17dU9fC41YyY57qVWR9vv3mkAtDvn3ff0?usp=sharing	https://drive.google.com/drive/folders/1xNlpIkLVfgr2CAB-PwXFjr0TL0L9drHN?usp=sharing	to design distribution system	Chalk and Talk, ppt	T3, T4
29	Unit 3	examination of sewage – B.O.D. Equation – C.O.D. Design of sewers – shapes and materials, Design of sewers –	https://drive.google.com/drive/folders/17dU9fC41YyY57qVWR9vv3mkAtDvn3ff0?usp=sharing	https://drive.google.com/drive/folders/1Zhp8treWdPOHHHV2RuUXUQgObjz4ave?usp=sharing	to know about BOD, COD	Chalk and Talk	T1, T4
30							



32	Unit 3	shapes and materials, sewer appurtenances, manholes, inverted siphon – catch basins – flushing tanks, ejectors, pumps and pump houses – house drainage	https://drive.google.com/drive/folders/17dU9fC41YyY57qVWR9vv3mkAtDvn3ff0?usp=sharing	https://drive.google.com/drive/folders/1Zhp8treWdPOHHHV2RuUXUQgObjz4ave?usp=sharing	to understand pump house	Chalk and Talk, ppt	T1, T4
33		plumbing requirements – sanitary fittings – traps	https://drive.google.com/drive/folders/17dU9fC41YyY57qVWR9vv3mkAtDvn3ff0?usp=sharing	https://drive.google.com/drive/folders/1Zhp8treWdPOHHHV2RuUXUQgObjz4ave?usp=sharing	to know plumbing requirements	presentation	T1, T4
34		one pipe and two pipe systems of plumbing – ultimate disposal of sewage	https://drive.google.com/drive/folders/17dU9fC41YyY57qVWR9vv3mkAtDvn3ff0?usp=sharing	https://drive.google.com/drive/folders/1Zhp8treWdPOHHHV2RuUXUQgObjz4ave?usp=sharing	to know plumbing requirements	Chalk and Talk	T1, T4
36		sewage farming – self-purification of rivers.	https://drive.google.com/drive/folders/17dU9fC41YyY57qVWR9vv3mkAtDvn3ff0?usp=sharing	https://drive.google.com/drive/folders/1Zhp8treWdPOHHHV2RuUXUQgObjz4ave?usp=sharing	to understand self purification of streams	Chalk and Talk, PPT	T1, T4
37	Unit 4	Wastewater treatment plant – Flow diagram	https://drive.google.com/drive/folders/1l6qWcGKkk0yTg6Eoi1TVxh4XJhJB6NAa?usp=sharing		illustrate flow diagram of waste water treatment plant	Chalk and Talk, PPT	T2, T4
38		primary treatment Design of screens – grit chambers –	https://drive.google.com/drive/folders/1l6qWcGKkk0yTg6Eoi1TVxh4XJhJB6NAa?usp=sharing	https://drive.google.com/drive/folders/1pxUTpMws6zAzjbk7ZRJuL4y3-uC1lZY5?usp=sharing	illustrate flow diagram of waste water treatment plant	Chalk and Talk, ppt	T2, T4



40	skimming tanks – sedimentation tanks – principles of design		https://drive.google.com/drive/folders/1pxUTpMws6zAzjbk7ZRJuL4y3-uC1lZY5?usp=sharing	to understand sedimentation tanks	Chalk and Talk	T2, T4
41	Biological treatment – trickling filters – ASP	https://drive.google.com/drive/folders/1l6qWcGKkk0yTg6Eoi1TVxb4XJhJB6NAa?usp=sharing	https://drive.google.com/drive/folders/1pxUTpMws6zAzjbk7ZRJuL4y3-uC1lZY5?usp=sharing	to know biological treatments	Chalk and Talk, PPT	T2, T4
42	Construction and design of oxidation ponds. Sludge digestion		https://drive.google.com/drive/folders/1pxUTpMws6zAzjbk7ZRJuL4y3-uC1lZY5?usp=sharing	to understand construction and design of oxidation ponds	Chalk and Talk	T2, T4
44	Sludge digestion – factors affecting – design of Digestion tank	https://drive.google.com/drive/folders/1l6qWcGKkk0yTg6Eoi1TVxb4XJhJB6NAa?usp=sharing	https://drive.google.com/drive/folders/1pxUTpMws6zAzjbk7ZRJuL4y3-uC1lZY5?usp=sharing	to know design of digestion tank	Chalk and Talk, PPT	T2, T4
45	design of Digestion tank, Sludge disposal by drying		https://drive.google.com/drive/folders/1pxUTpMws6zAzjbk7ZRJuL4y3-uC1lZY5?usp=sharing	to know design of digestion tank	Chalk and Talk	T2, T4
46	septic tanks working principles and design – soak pits	https://drive.google.com/drive/folders/1l6qWcGKkk0yTg6Eoi1TVxb4XJhJB6NAa?usp=sharing	https://drive.google.com/drive/folders/1pxUTpMws6zAzjbk7ZRJuL4y3-uC1lZY5?usp=sharing	to design soak pit and septic tank	Chalk and Talk, PPT	T2, T4



48		Septictankdesign,Soakpitdesign		https://drive.google.com/drive/folders/1pxUTpMws6zAzjbk7ZRJuL4y3-uC1lZY5?usp=sharing	todesign soakpitand septic tank	Chalkand Talk	T2,T 4
49	Unit 5	Airpollution–classificationofair pollution, Effects air pollution– Global effects	https://drive.google.com/drive/folders/1jZjq2iRFw9C0Z3bQK3SAYS1evc3fb1F5?usp=sharing	https://drive.google.com/drive/folders/1pxUTpMws6zAzjbk7ZRJuL4y3-uC1lZY5?usp=sharing	tounderstand about air pollution	Chalkand Talk,PPT	T1,T 4
50		Meteorologicalparametersaffecting air pollution–	https://drive.google.com/drive/folders/1jZjq2iRFw9C0Z3bQK3SAYS1evc3fb1F5?usp=sharing	https://drive.google.com/drive/folders/1pxUTpMws6zAzjbk7ZRJuL4y3-uC1lZY5?usp=sharing	tounderstand about air pollution	Chalkand Talk,PPT	T2,T 4
52		Atmosphericstability–Plume behavior		https://drive.google.com/drive/folders/1Ob85JmfN8xpAtKFe6D2Q_4HsMDxuqWqa?usp=sharing	tounderstand about air pollution	Chalkand Talk	T2,T 4
53		Controlofparticulates,Gravity settlers		https://drive.google.com/drive/folders/1Ob85JmfN8xpAtKFe6D2Q_4HsMDxuqWqa?usp=sharing	tounderstand about air pollution	presentati on	T2,T 4
54		cyclonefilters,ESPs	https://drive.google.com/drive/folders/1jZjq2iRFw9C0Z3bQK3SAYS1evc3fb1F5?usp=sharing	https://drive.google.com/drive/folders/1Ob85JmfN8xpAtKFe6D2Q_4HsMDxuqWqa?usp=sharing	tounderstand about air pollution	Chalkand Talk.,PPT	T2,T 4



56		Control of gaseous pollutants, Automobile pollution	https://drive.google.com/drive/folders/1jZjq2iRFw9C0Z3bQK3SAYS1evc3fb1F5?usp=sharing	https://drive.google.com/drive/folders/1Ob85JmfN8xpAtKFe6D2Q_4HsMDxuqWqa?usp=sharing	to understand about air pollution	Chalk and Talk. PPT	T2, T4
57		design of screens revision	https://drive.google.com/drive/folders/1jZjq2iRFw9C0Z3bQK3SAYS1evc3fb1F5?usp=sharing	https://drive.google.com/drive/folders/1Ob85JmfN8xpAtKFe6D2Q_4HsMDxuqWqa?usp=sharing		Chalk and Talk	T1, T2, T3, T4
58		design of screens revision	https://drive.google.com/drive/folders/1jZjq2iRFw9C0Z3bQK3SAYS1evc3fb1F5?usp=sharing	https://drive.google.com/drive/folders/1Ob85JmfN8xpAtKFe6D2Q_4HsMDxuqWqa?usp=sharing		Chalk and Talk	T1, T2, T3, T4
60		Revision of all units					T1, T2, T3, T4

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. QUESTIONBANK:DESCRIPTIVEQUESTIONS:(WITHBLOOMSPHRASES)

UNIT-I

SHORTANSWER QUESTIONS-

S.NO	Question	Blooms TaxonomyLevel	Programm eOutcome
1.	Whatdoyoumeanbydisinfection?	Understanding	1
2.	Rainwater harvestingistheneed ofthehour –justify.	Understanding	1
3.	Listthecommonlyused disinfectants.	Understanding	1
4.	Whatismeantbyequalizingreservoirs?	Understanding	1
5.	Definetheterm‘potable water’?	Understanding	1
6.	Statethe causesforwaterpollution?	Understanding	1
7.	Whatare intakes?	Understanding	1
8.	Differentiatebetween‘dry’and‘wet’ intake?	Understanding	2
9.	WhatarethedifferenttypesofInfiltrationgalleries?	Understanding& remembering	1
10.	Whatarethe generalrequirementsofanunconfined aquifer?	Understanding& remembering	1

LONGANSWERQUESTIONS-

S.No	Question	BloomsTaxonomy Level	Programme Out come
1.	What arethe various methods ofpopulation forecasts?Thecensusrecordsofacityshow population as follows: Present 50,000 Beforeonedecade 47,100 Beforetwodecades 43,500 Beforethreedecades 41,000 Workouttheprobablepopulationafterone,twoand three decades by using Incremental increase method?	Understanding& remembering	5
2.	Whatdoyoumeanbydisinfection?	Analyze	5
3.	Rainwaterharvestingistheneedofthehour – justify.	Analyze	5
4.	Listthecommonlyused disinfectants.	Analyze&Apply	5
5.	Definethe term‘potable water’?	Analyze&Apply	5
6.	Statethe causesforwaterpollution?	Analyze&Apply	5
7.	Writethe advantageofsub-surface sources?	Analyze&Apply	5
8.	Definetheterm“Per capitademand”?	Analyze&Apply	5
9.	Givealistofdifferentsourcesofwater.	Analyze&Apply	5
10.	Describe in.Detailaboutinfiltrationgalleries	Analyze	5



UNIT-2

SHORTANSWER QUESTIONS-

S.N	Question	BloomsTaxonomy Level	Progra mmeOut come
1.	Explainabouttheuniformsettlingvelocityofa particle?	Understanding& remembering	5
2.	Whatarethedifferenttestsdoneduringwater analysis?	Understanding& remembering	5
3.	Listoutthevariousmethodsof“WaterConservation” presently followed in India?	Understanding& remembering	5
4.	Drawthesequenceoftreatmentyouwouldrecommendfor groundwaterfreefromPollutionbutcontaining dissolvedsaltsinlargeconcentrations?	Understanding& remembering	5
5.	Statetheeffectswheeachofthe followingsubstances exceeds the prescribed limits in a water sample? a.Nitrates Fluorides	Understanding& remembering	5
6.	Define‘percapitademand’?	Understanding& remembering	5
7.	Listofthe flowdiagramofthewatertreatment program with neat sketches	Understandingand remembering	5
8.	Whatarethedifferentelementssusedascoagulants	Understandingand remembering	5
9.	Howmanytypesoffiltersexist.Whatarethey	Understandingand remembering	5
10.	WhatIsdisinfection?What isthesimplesttypeof disinfection in use?	Understandingand remembering	5

LONGANSWERQUESTIONS-

S.No	Question	BloomsTaxonomy Level	Program me Out come
1.	ExplaintheprocessofSedimentationwithaneat sketch?	Understanding	5
2.	Writethecoagulantsusedinwatertreatmentprocess?	Understanding	5
3.	Whatismeantbysuperchlorination?	Understanding	5
4.	ExplaintheworkingofRapidgravitysand filterswith a neat sketch?	Analyze&Apply	5
5.	Whataretheproblemsfacedintheoperationoffilters?	Analyze&Apply	5
6.	Explainthetypesofdisinfectionwithexamples?	Analyze&Apply	5
7.	Whatarethevariousdisinfectionmethods?	Analyze&Apply	5
8.	What isChlorinedemandandhowdoyouestimate chlorine demand of a given sample?	Analyze&Apply	5
9.	Writeaboutthedesignofamultimediafilter?	Analyze&Apply	5



10.	What are the merits and demerits of the rapids 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.	Explain with a neat sketch "Self purification of streams".	understanding	5
2.	At what point in a pipe system you will provide a single acting and double acting air valve and why?	understanding	5
3.	What is the object of flushing tank?	understanding	5
4.	Define B.O.D. How is it estimated?	understanding	5
5.	What are the advantages of Flushing tank	Understanding	5
6.	What are the advantages of inverted siphons	Understanding	5
7.	What is C.O.D? How does it help in figuring out the quality of water	Understanding	5
8.	What do you mean by 'appurtenances'?	Understanding	5
9.	List the treatment flow diagram for wastewater treatment	Understanding	5
10.	What is C.O.D? How does it help in figuring out the quality of water	Understanding	5

LONG ANSWER QUESTIONS-

S.No	Question	Blooms Taxonomy Level	Programme Out come
1.	A sanitary sewer is to serve a uniformly distributed population of 10,000 along a 1.000 m road. The average ground slope for first 500 m is 1 in 400, and for the remaining is 1 in 900. Design the sewer. Give expected peak, average and minimum velocities. Make suitable assumptions, and State them clearly.	Understanding	5



2.	Differentiate between single stack and one pipe systems of plumbing for drainage.	Analyze & Apply	5
3.	What is the relationship between B.O.D. and C.O.D?	Analyze & Apply	5
4.	What is a manhole? Explain with a sketch	Analyze & Apply	5
5.	Explain about design of sewer.	Analyze & Apply	5
6.	Write about characteristics of sewage.	Analyze & Apply	5
7.	What is B.O.D? Detail the B.O.D equation	Analyze & Apply	5
8.	Explain about inverted siphon with neat sketch.	Analyze & Apply	5
9.	Describe the different stages of sludge digestion process. b) With neat sketch explain the self-purification of streams.	Analyze & Apply	5
10.	Explain One pipe and two pipe systems of pumping	Analyze & Apply	5

UNIT-4

SHORT ANSWER QUESTIONS-

S.No	Question	Blooms Taxonomy Level	Programme Out come
1.	What is meant by sludge digestion?	understanding	1
2.	What are the various methods of sludge digestion?	understanding	1
3.	What is a grit chamber. Explain with neat sketch	remembering	1
4.	What is biological treatment of wastewater. Briefly explain	remembering	1
5.	Discuss the relationship between algae and bacteria during the treatment of sewage in an oxidation pond.	understanding	1
6.	Explain the principle and operation of primary sedimentation tanks.	remembering	1
7.	Why is sludge digested anaerobically in a conventional sewage treatment plant	Understanding	1
8.	Discuss the characteristics of sludge.	Remembering	1
9.	Write a short note on skimming tank.	Understanding & remembering	1
10.	Write about the design criteria of septic tank.	Remembering	1



LONG ANSWER QUESTIONS-

S.No	Question	Blooms Taxonomy Level	Programme Out come
1.	In designing a rectangular grit chamber for the following data: Flow = 40 mld., grit of specific gravity = 2.65 and size = 0.2 mm to be removed. Find a) Settling velocity of 0.2 mm particles, b) Critical horizontal velocity of flow, and c) Size of the grit chamber.	Analyze & Apply	5
2.	What is ASP? Give the advantages and disadvantages of it. b) What is activated sludge process	Analyze & Apply	
3.	Design a grit chamber for population 50,000 with water consumption of 135 LPCD	Analyze & apply	5
4.	Explain in detail the process flow of trickling filters.	Analyze & Apply	5
5.	A main sewer is to be designed to receive a flow from 1 square kilometre area of a community where the population density is 300 persons per hectare. The average sewage flow is 150 lpcd. What is the design flow for the main sewer?	Analyze & Apply	5
6.	Explain the principle and working of a trickling filter with neat sketch. b) What is the purpose of preliminary treatment of sewage? Write a brief note on the various units employed for the same. How are grit and screenings disposed off?	Understanding	5
7.	Construction of Oxidation ponds.	Understanding	5
8.	Explain sludge disposal by drying	Evaluate	5
9.	Explain septic tank working principles	Evaluate	5
10.	Factors affecting sludge digestion	Analyze & Apply	5



UNIT-5

SHORTANSWER QUESTIONS-

S.No	Question	BloomsTaxonomy Level	Programme Out come
1.	What is air pollution?	Understanding	3
2.	Classification of air pollution?	Remembering	3
3.	What are the effects of air pollution?	Remembering & Understanding	3
4.	What are the meteorological parameters affecting air pollution?	Remembering & Understanding	3
5.	What is the function of ESP?	Understanding	3
6.	What is ESP filter?	Remembering & Understanding	3
7.	What are the methods of controlling air pollution?	Remembering & Understanding	3
8.	Generalize air pollution	Remembering & Understanding	3
9.	Which filter system controls gaseous emission?	Remembering & Understanding	3
10.	What is plume in air pollution?	Understanding	3

LONGANSWERQUESTIONS-

S.No	Question	BloomsTaxonomy Level	Programme Out come
1.	Explain cyclone filters and how it works?	Analyze & Apply	5
2.	What is the working principle of ESP?	Analyze & Apply	5
3.	Write about automobile pollution and control?	Analyze & Apply	5
4.	Working principle of gravity settlers?	Analyze & Apply	5
5.	What are the global effects of air pollution?	Apply	5
6.	Merits and demerits of ESP	Analyze &	5
7.	Write note on gravity settlers and cyclone filters	Analyze & Apply	5
8.	What are the parameters affecting air pollution?	Analyze & Apply	5
9.	Control of gaseous pollutants?	Analyze & Apply	5
10.	What is plume behaviour?	Analyze & Apply	5

XI. OBJECTIVE QUESTIONS:

UNIT I

- The multiplying factor, as applied to obtain the maximum daily water demand, in relation to the average i.e. per capita daily demand is
 - 1.5
 - 1.8
 - 3
 - 2.7
- The total water requirement of a city generally assessed on the basis of
 - Maximum hourly demand
 - Maximum daily demand + fire demand
 - Averaged daily demand + fire demand
 - Greater of (a) & (b)



10. Rate of filtration in Rapid sand filter in $1/\text{hr}/\text{m}^2$ is (B)
a) 100 to 200 b) 3000 to 6000 c) 6000 to 15000 d) 15000 to 18000
11. At breakpoint chlorination the residual chlorine (B)
a) Is zero b) is minimum c) is maximum d) reappears
12. The % of fresh 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 _____

UNIT III

1. _____ is the amount of oxygen required to oxidize only organic matter in sewage (b)
a) Turbidity b) BOD c) COD d) DO
2. An inverted siphon is designed generally for
(a) 3 pipes b) 2 pipes c) 4 pipes d) 1 pipe
3. The minimum recommended diameter of sewers, is (c)
4. 5 cm b) 10 cm c) 15 cm d) 20 cm
5. Oxygen demanding wastes improve DO. (False)
a) True b) False
6. The correct relationship between BOD, COD, TOD is (B)
a) $\text{TOD} > \text{BOD} > \text{COD}$ b) $\text{TOD} > \text{COD} > \text{BOD}$ c) $\text{COD} > \text{BOD} > \text{TOD}$ d) $\text{BOD} > \text{COD} > \text{TOD}$

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
3. Trickling filter plants are preferred for sewage treatment for: (D)
a) Towns and small cities b) medium sized cities
c) Large sized cities d) (a) and (b) both
4. 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
5. 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 c) Stabilization pond d) mixed reactor
6. The sludge from secondary settling tanks in a trickling filter is called (B)
a) leachate b) compost c) humus d) ashes
7. Trickling filter treatment process is classified as (B)
a) Aerobic suspended culture b) aerobic attached culture
c) Anaerobic digestion d) none
8. 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
9. The average normal efficiency of BOD removal in trickling filter process is (B)
a) 95% b) 90% c) 60% d) 30%



X. GATEQUESTIONS:

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-II gives the list of titrants.

Group-I Group-II

- | | |
|---------------------|---|
| P. Alkalinity | 1. N/35.5 AgNO ₃ |
| Q. Hardness | 2. N/40 Na ₂ S ₂ O ₃ |
| R. Chloride | 3. N/50 H ₂ SO ₄ |
| 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 m². What is the loading rate in (m³/day X m²) with two filters out of service for routine backwashing? _____

3. A student began an experiment for determination of 5-day, 20°C BOD on Monday. Since the 5th 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 the 5-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 flowchart 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 sedimentation
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) invert of the sewers
C) crown of the sewers D) hydraulic gradient 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 1 m/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) 4123 B) 3124 C) 1234 D) 3412



10. One litre of sewage, when allowed to settle for 30 minutes gives a sludge volume of 27 cm³. 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) 3412 B) 3421 C) 4321 D) 4312
13. The following items consist 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 answer 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) with List-II (Removed by) and select the correct answer using the codes given below the lists:
List-I List-II
A. Fluorides 1. Activated carbon
B. Manganese 2. Activated alumina
C. Taste and odour 3. Manganese zeolite
A) 123 B) 231 C) 213 D) 321
17. Which one of the following pairs is not correctly matched?
A) Check 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) 5 c) 7 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 (ethylenediaminetetraacetic 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/sec
7. The maximum permissible limit for fluoride 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
b) incremental increase method d) graphical method



XI. WEBSITES:

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

XII. EXPERTDETAILS

- a. Dr.B.K.Dubey
Department ofCivilEngineering\
IndianInstituteofTechnologyKharagpur

XIII. JOURNALS(NATIONALANDINTERNATIONAL)

- a. EnvironmentalResearch–AERFIndia.org
- b. Environmentalnews.
- c. JournalofEnvironmentalEngineering.
- d. InternationalJournalofEnvironmentalEngineering.
- e. JournalofEnvironmentalEngineering&Science.

XIV. LISTOFTOPICSFOR STUDENTSEMINARS

- a. Protected watersupply
- b. Layoutand generaloutline ofwater treatmentunits.
- c. Typesofdisinfection
- d. Layingandtestingofpipelines.

XV. CASESTUDIES/SMALLPROJECTS

- a. Waterqualityandtesting.
- b. Layoutsofdistributionsystem.
- c. Sewage andstormwaterestimation.
- d. Designofsludgedigestiontanks.