Department of Civil Engineering

Course File

ENVIRONMENTAL ENGINEERING
(Course Code: CE603PC)

III B.Tech II Semester

2023-24

N.SATISH
Assistant Professor

Ananthagiri, Kodad, Telangana 508 206, India.

Anurag ENGINEERING COLLEGE (An Autonomous Institution)

Department of Civil Engineering

ENVIRONMENTAL ENGINEERING

Check List

Department of Civil Engineering

Int. Marks:30 Ext. Marks:70 Total Marks:100

ENVIRONMENTAL ENGINEERING

Course code:CE603PC **L/T/P/C:3/0/0/3**
III Year II Semester

UNIT- I

INTRODUCTION: waterborne diseases – protected water supply – populations forecast,design period – water demand – types of demand – factors affecting – fluctuations – firedemand – storage capacity – water quality and testing – drinking water standards.

SOURCES OF WATER: Selection of water source based on quality, quantity and otherconsiderations – intakes – infiltration galleries, confined and unconfined aquifersdistribution system – requirements – methods and layouts.

UNIT -II

LAYOUT AND GENERAL OUTLINE OF WATER TREATMENT UNITS – sedimentation,uniform settling velocity – Principles – design factors – surface loading – jar test – optimum dosage of coagulant – coagulation fluctuations clarifier design – coagulants – feeding arrangements

THEORY OF FILTRATION– working of slow and rapid gravity filters – multimedia filters –design of filters – troubles in operation comparison of filters – disinfection – types of disinfection theory of chlorination - chlorine demand other disinfection treatment methods.

UNIT –III

DISTRIBUTION SYSTEMS – types of layouts of distribution systems – design of distribution System – Hardy cross and equivalent pipe methods and service reservoirs –joints, valves such as sluice valves, air valves, scour valves and check valves water meter–laying and testing of pipe lines – pump house. Conservancy and water carriage systems– sewage and storm water estimation –time of concentration – storm water over flows combined flow. Layouts and general outline of various units in a waste water treatment plant – primary treatment design of screens – grit chambers – skimming tanks –sedimentation tanks – principles and design of biological treatment – tricking filters –standard and high rate.

UNIT- IV

CHARACTERISTICS OF SEWAGE – cycle of decay – decomposition of sewage, examination of sewage – BOD – COD. Equations , design of sewers – shape and materials –sewer appurtenances man holes – inverted siphon – catch basins – flushing tanks – ejectors, pumps and pump houses and house drainage – components requirements – sanitary fittings – traps – one pipe 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 –grid chambers – skimming tanks –sedimentation tanks – principles of design –biological Treatments – trickling filters – standard and high rate - Construction and design of oxidation ponds. Sludge digestion tanks – factor affecting – design of digestion tanks –sludge disposal by drying – septic tanks working principles and design – soak pits.

TEXT BOOKS:

1. K.N. Duggal, Elements of Public Health Engineering, S Chand, 1988
2. P.N. Modi, Water Supply Engineering - Environmental Engineering (Vol I), Standard Book House, 2006

REFERENCE BOOKS:

1. S.K. Garg, Environmental Engineering Vol I: Water Supply Engineering, Khanna Publishers, 2004.
2. Gurucharan Singh Water Supply and Sanitary Engineering Vol, 1; Standard Publishers, Distributors, 2013.
3. J. Mark Hammer Water and Wastewater Technology; John Wiley and Sons, 2013.
4. Environmental Engineering I and II by BC Punmia, Std. Publications.
5. Manual on Water Supply and Treatment; CPH and EEO, Ministry of Urban Development; Govt, of India, New Delhi.
6. Environmental Pollution and Control Engineering CS Rao,Wiley Publications

Department of Civil Engineering

Timetable

III B.Tech. II Semester – E.E

Day/Hour	9.30-10.20	10.20-11.10	11.20-12.10	12.10-01.00	01.40-2.25	2.25-3.10	3.15-4.00
Monday							
Tuesday							
Wednesday		E.E					
Thursday						E.E	
Friday		E.E					
Saturday			E.E		E.E		

Department of Civil Engineering

Vision of the Institute

To be a premier Institute in the country and region for the study of Engineering, Technology and Management by maintaining high academic standards which promotes the analytical thinking and independent judgment among the prime stakeholders, enabling them to function responsibly in the globalized society.

Mission of the Institute

To be a world-class Institute, achieving excellence in teaching, research and consultancy in cutting-edge Technologies and be in the service of society in promoting continued education in Engineering, Technology and Management..

Quality Policy

To ensure high standards in imparting professional education by providing world-class infrastructure, top-quality-faculty and decent work culture to sculpt the students into Socially Responsible Professionals through creative team-work, innovation and research.

Vision of the Department

To impart knowledge, skill and excellence in civil engineering with a global perspective to enable the students as competent, qualitative & ethically strong engineers with an intuition to improve quality of life for the benefit of the society.

Mission of the Department

- To train the students in the civil engineering domain.
- To develop knowledge and skill to solve regional and global problems.
- To transform into qualitative and ethically strong professional engineers through research and Development.

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Department of Civil Engineering

Program Educational Objectives (B.Tech. – CE)

Graduates will be able to

PEO I: To provide knowledge in mathematics, science and engineering principles for a successful career in sectors of civil engineering and allied industry and/or higher education

PEO II: To develop an ability to identify, formulate, solve problems along with adequate analysis, design, synthesizing and interpretation skills in civil engineering systems.

PEO III: To exhibit professionalism, ethics, communication skills and team work in their profession and engaged in lifelong Learning of contemporary civil engineering trends

Program Outcomes (B.Tech. – CE)

At the end of the Program, a graduate will have the ability to

PO 1: An ability to apply knowledge of mathematics, science, and engineering.

PO 2: An ability to design and conduct experiments, as well as to analyze and interpret data.

PO 3: An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability.

PO 4: An ability to function on multidisciplinary teams.

PO 5: An ability to identify, formulates, and solves engineering problems.

PO 6: An understanding of professional and ethical responsibility.

PO 7: An ability to communicate effectively.

PO 8: The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

PO 9: A recognition of the need for, and an ability to engage in lifelong learning.

PO 10: A knowledge of contemporary issues.

PO11: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

PO 12: An ability to carry out research in different areas of Civil Engineering including latest technology like GIS/Remote Sensing resulting in design, development, analyze and journal publications and technology development.

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COURSE OBJECTIVES

On completion of this Subject/Course the student shall be able to:

S.No	Objectives
1	To make students conversant with basic principles of water supply Engineering.
2	To provide the knowledge of source of water and its distribution.
3	To impart the knowledge of various treatment required for potable water
4	To provide the knowledge of characteristics of sewage and its treatment.
5	To make the students in various designing of treatment unit operation system

COURSE OUTCOMES

The expected outcomes of the Course/Subject are:

S.No	Outcomes
1.	Apply procedures to forecast population and compute future water demand
2.	Develop on Environmental Management Systems for characteristics of water
3.	Explain different methodologies for collection and conveyance systems
4.	Examine layout and analyze water distribution systems
5.	Analysis and Design the various treatment plant units

Signature of faculty

Note: Please refer to Bloom's Taxonomy, to know the illustrative verbs that can be used to state the outcomes.

Department of Civil Engineering

GUIDELINES TO STUDY THE COURSE / SUBJECT

Course Design and Delivery System (CDD):

- The Course syllabus is written into number of learning objectives and outcomes.
- Every student will be given an assessment plan, criteria for assessment, scheme of evaluation and grading method.
- The Learning Process will be carried out through assessments of Knowledge, Skills and Attitude by various methods and the students will be given guidance to refer to the text books, reference books, journals, etc.

The faculty be able to –

- Understand the principles of Learning
- Understand the psychology of students
- Develop instructional objectives for a given topic
- Prepare course, unit and lesson plans
- Understand different methods of teaching and learning
- Use appropriate teaching and learning aids
- Plan and deliver lectures effectively
- Provide feedback to students using various methods of Assessments and tools of Evaluation
- Act as a guide, advisor, counselor, facilitator, motivator and not just as a teacher alone

Signature of HOD

Date:

Signature of faculty

Date:

Department of Civil Engineering

COURSE SCHEDULE

The Schedule for the whole Course / Subject is:

S. No.	Description	Duration (Date)		Total No. of Periods
		From	To	
1.	**UNIT- I** **INTRODUCTION:** waterborne diseases – protected water supply – populations forecast, design period – water demand – types of demand – factors affecting – fluctuations – fire demand – storage capacity – water quality and testing – drinking water standards. SOURCES OF WATER: Selection of water source based on quality, quantity and other considerations – intakes infiltration galleries, confined and unconfined aquifers distribution system – requirements – methods and layouts.	22.01.2024	15.02.2024	12
2.	**UNIT -II** **LAYOUT AND GENERAL OUTLINE OF WATER TREATMENT UNITS –** sedimentation, uniform settling velocity – Principles – design factors – surface loading – jar test – optimum dosage of coagulant – coagulation fluctuations clarifier design – coagulants – feeding arrangements THEORY OF FILTRATION– working of slow and rapid gravity filters – multimedia filters –design of filters – troubles in operation comparison of filters – disinfection – types of disinfection theory of chlorination - chlorine demand other disinfection treatment methods.	17.02.2024	06.03.2024	09
3.	**UNIT –III** **DISTRIBUTION SYSTEMS –** types of layouts of distribution systems – design of distribution System – Hardy cross and equivalent pipe methods and service reservoirs – joints, valves such as sluice valves, air valves, scour valves and check valves water meter–laying and testing of pipe lines – pump house. Conservancy and water carriage systems– sewage and storm water estimation –time of concentration – storm water over flows combined flow. Layouts and general outline of various units in a waste water treatment plant – primary treatment design of screens – grit chambers – skimming tanks –sedimentation tanks – principles and design of biological treatment – tricking filters standard and high rate.	7.03.2024	30.03.2024	13
4.	**UNIT- IV** **CHARACTERISTICS OF SEWAGE** – cycle of decay – decomposition of sewage,examination of sewage – BOD – COD. Equations , design of sewers – shape and materials –	30.03.2024	20.04.2024	10

	sewer appurtenances man holes – inverted siphon – catch basins – flushing tanks – ejectors, pumps and pump houses and house drainage – components requirements – sanitary fittings – traps – one pipe and two pipe systems of plumbing ultimate disposal of sewage – sewage farming – dilution.			
5.	**UNIT- V** **WASTE WATER TREATMENT PLANT-** Flow diagram – primary treatment design of screens –grid chambers – skimming tanks –sedimentation tanks – principles of design – biological Treatments – trickling filters – standard and high rate - Construction and design of oxidation ponds. Sludge digestion tanks – factor affecting – design of digestion tanks –sludge disposal by drying – septic tanks working principles and design – soak pits.	20.04.2024	12.06.2024	18

Total No. of Instructional periods available for the course: 62 Hours

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SCHEDULE OF INSTRUCTIONS - COURSE PLAN

Unit No.	Lesson No.	Date	No. of Periods	Topics / Sub-Topics	Objectives & Outcomes Nos.	References (Textbook, Journal)
1.	1	22.01.2024	1	Introduction of water supply Engineering	1 1	P.N. Modi, Water Supply Engineering - Environmental Engineering
	2	22.01.2024	1	waterborne diseases	1 1	P.N. Modi, Water Supply Engineering - Environmental Engineering
	3	24.01.2024	1	protected water supply	1 1	P.N. Modi, Water Supply Engineering - Environmental Engineering
	4	27.01.2024	1	populations forecast, design period	1 1	P.N. Modi, Water Supply Engineering - Environmental Engineering
	5	30.01.2024	1	water demand – types of demand – factors affecting	1 1	P.N. Modi, Water Supply Engineering - Environmental Engineering
	6	02.02.2024	1	fluctuations – fire demand	1 1	P.N. Modi, Water Supply Engineering - Environmental Engineering
	7	06.02.2024	1	storage capacity – water quality and testing	1 1	P.N. Modi, Water Supply Engineering - Environmental Engineering
	8	07.02.2024	1	Drinking Water Standards. Sources Of Water	1 1	P.N. Modi, Water Supply Engineering - Environmental Engineering

	9	08.02.2024	1	intakes infiltration galleries,	1 1	P.N. Modi, Water Supply Engineering - Environmental Engineering
	10	14.02.2024	1	confined and unconfined aquifers	1 1	P.N. Modi, Water Supply Engineering - Environmental Engineering
	11	15.02.2024	1	requirements – methods and layouts.	1 1	P.N. Modi, Water Supply Engineering - Environmental Engineering
	1	17.02.2024	1	Unit -II Layout And General Outline Of Water Treatment Units	2 2	P.N. Modi, Water Supply Engineering - Environmental Engineering
	2	21.02.2024	1	sedimentation, uniform settling velocity	2 2	P.N. Modi, Water Supply Engineering - Environmental Engineering
	3	23.02.2024	1	Principles – design factors – surface loading	2 2	P.N. Modi, Water Supply Engineering - Environmental Engineering
	4	27.02.2024	1	jar test – optimum dosage of coagulant	2 2	P.N. Modi, Water Supply Engineering - Environmental Engineering
	5	28.02.2024	1	coagulation fluctuations clarifier design	2 2	P.N. Modi, Water Supply Engineering - Environmental Engineering
	6	29.02.2024	1	coagulants – feeding arrangements	2 2	P.N. Modi, Water Supply Engineering - Environmental Engineering

	7	1.03.2024	1	theory of filtration– working of slow and rapid gravity filters – multimedia filters	2 2	P.N. Modi, Water Supply Engineering - Environmental Engineering
2	8	2.03.2024	1	troubles in operation comparison of filters	2 2	P.N. Modi, Water Supply Engineering - Environmental Engineering
	9	6.03.2024	1	disinfection – types of disinfection theory of chlorination - chlorine demand	2 2	P.N. Modi, Water Supply Engineering - Environmental Engineering
3.	1	7.03.2024	1	Unit –III Distribution Systems	3 3	P.N. Modi, Water Supply Engineering - Environmental Engineering
	2	11.03.2024	1	types of layouts of distribution systems	3 3	P.N. Modi, Water Supply Engineering - Environmental Engineering
	3	14.03.2024	1	design of distribution System – Hardy cross and equivalent pipe methods	3 3	P.N. Modi, Water Supply Engineering - Environmental Engineering
	4	15.03.2024	1	service reservoirs – joints, valves such as sluice valves, air valves, scour valves and check valves	3 3	P.N. Modi, Water Supply Engineering - Environmental Engineering
	5	16.03.2024	1	water meter–laying and testing of pipe lines	3 3	P.N. Modi, Water Supply Engineering - Environmental Engineering
	6	20.03.2024	1	pump house. Conservancy and water carriage systems	3 3	P.N. Modi, Water Supply Engineering - Environmental Engineering

	7	21.03.2024	1	sewage and storm water estimation	3 3	P.N. Modi, Water Supply Engineering - Environmental Engineering
	8	22.03.2024	1	time of concentration – storm water over flows	3 3	P.N. Modi, Water Supply Engineering - Environmental Engineering
	9	23.03.2024	2	time of concentration – storm water over flows	3 3	P.N. Modi, Water Supply Engineering - Environmental Engineering
	10	26.03.2024	1	grit chambers –skimming tanks –sedimentation tanks	3 3	P.N. Modi, Water Supply Engineering - Environmental Engineering
	11	27.03.2024	1	principles and design of biological treatment	3 3	P.N. Modi, Water Supply Engineering - Environmental Engineering
	12	30.03.2024	1	tricking filters standard and high rate.	3 3	P.N. Modi, Water Supply Engineering - Environmental Engineering
4	1	30.03.2024	1	Unit- IV Characteristics Of Sewage	4 4	P.N. Modi, Water Supply Engineering - Environmental Engineering
	2	3.04.2024	1	cycle of decay – decomposition of sewage	4 4	P.N. Modi, Water Supply Engineering - Environmental Engineering
	3	4.04.2024	1	examination of sewage – BOD – COD	4 4	P.N. Modi, Water Supply Engineering - Environmental Engineering

	4	6.04.2024	2	design of sewers – shape and materials –sewer appurtenances man holes	4 4	P.N. Modi, Water Supply Engineering - Environmental Engineering
	5	8.04.2024	1	inverted siphon – catch basins – flushing tanks	4 4	P.N. Modi, Water Supply Engineering - Environmental Engineering
	6	12.04.2024	1	pumps and pump houses and house drainage	4 4	P.N. Modi, Water Supply Engineering - Environmental Engineering
	7	18.04.2024	1	components requirements – sanitary fittings	4 4	P.N. Modi, Water Supply Engineering - Environmental Engineering
	8	19.04.2024	1	one pipe and two pipe systems of plumbing	4 4	P.N. Modi, Water Supply Engineering - Environmental Engineering
	9	20.04.2024	1	ultimate disposal of sewage – sewage farming – dilution.	4 4	P.N. Modi, Water Supply Engineering - Environmental Engineering
5	1	20.04.2024	1	Unit- V Waste Water Treatment Plant	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering
	2	24.04.2024	1	Flow diagram – primary treatment	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering
	3	25.04.2024	1	design of screens –grid chambers	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering

	4	26.04.2024	1	skimming tanks – sedimentation tanks	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering
	5	27.04.2024	2	principles of design – biological Treatments	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering
	6	01.05.2024	1	Problems on tickling filter	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering
	7	02.05.2024	1	Construction ponds.	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering
	8	4.05.2024	1	design of oxidation ponds.	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering
	9	06.05.2024	1	Sludge digestion tanks	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering
	10	10.05.2024	1	septic tanks working principles	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering
	11	3.06.2024	1	design of digestion tanks	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering
	12	4.06.2024	1	sludge disposal by drying	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering

Department of Civil Engineering

	13	06.06.2024	1	Problems sludge disposal	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering
	14	07.06.2024	1	Construction of septic tank	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering
	15	10.06.2024	1	Working principles of septic tank	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering
	16	11.06.2024	1	Design of soak pit	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering
	17	12.06.2024	1	Revision of waste water treatment plant	5 5	P.N. Modi, Water Supply Engineering - Environmental Engineering

Signature of HOD

Date:

Signature of faculty

Date:

Note:

1. Ensure that all topics specified in the course are mentioned.
2. Additional topics covered, if any, may also be specified in bold.
3. Mention the corresponding course objective and outcome numbers against each topic.

Department of Civil Engineering
LESSON PLAN (U-I)

Lesson No: 01, 02 Duration of Lesson: 1hr 40 min

Lesson Title: Introduction of water supply Engineering, waterborne diseases

Instructional / Lesson Objectives:

- To make students conversant with basic principles of water supply Engineering
- To familiarize students waterborne diseases, water demand – types of demand
- To understand students the water quality and testing – drinking water standards
- To provide information on Selection of water source intakes – infiltration galleries, confined and unconfined aquifers

Teaching AIDS : black Board

Time Management of Class :

5 min for taking attendance 80 min for the lecture delivery 15 min for doubts session

Assignment / Questions:

(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-I)

Lesson No: 03, 04 Duration of Lesson: 1hr40 MIN

Lesson Title: protected water supply, populations forecast, design period

Instructional / Lesson Objectives:

- To make students conversant with basic principles of water supply Engineering
- To familiarize students waterborne diseases, water demand – types of demand
- To understand students the water quality and testing – drinking water standards
- To provide information on Selection of water source intakes – infiltration galleries, confined and unconfined aquifers.

Teaching AIDS : Black Board
Time Management of Class :

5 min for taking attendance 15 for revision of previous class 65 min for lecture delivery 15 min for doubts session

Assignment / Questions:
(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment – I & tutorial-I sheets

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-I)

Lesson No: 05, 06 Duration of Lesson: 1hr40 MIN

Lesson Title: water demand – types of demand – factors affecting, fluctuations – fire demand

Instructional / Lesson Objectives:

- To make students conversant with basic principles of water supply Engineering
- To familiarize students waterborne diseases, water demand – types of demand
- To understand students the water quality and testing – drinking water standards
- To provide information on Selection of water source intakes – infiltration galleries, confined and unconfined aquifers.

Teaching AIDS : Black Board
Time Management of Class :

5 min for taking attendance 15 for revision of previous class 70 min for lecture delivery 10 min for doubts session

Assignment / Questions:
(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-I & tutorial-I sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-I)

Lesson No: 07, 08 Duration of Lesson: 1hr40 MIN

Lesson Title: storage capacity – water quality and testing,

Instructional / Lesson Objectives:

- To make students conversant with basic principles of water supply Engineering
- To familiarize students waterborne diseases, water demand – types of demand
- To understand students the water quality and testing – drinking water standards
- To provide information on Selection of water source intakes – infiltration galleries, confined and unconfined aquifers.

Teaching AIDS : Black Board
Time Management of Class :

5 min for taking attendance 15 for revision of previous class 60 min for lecture delivery 20 min for doubts session

Assignment / Questions:
(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-I & tutorial-I sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-I)

Lesson No: 09, 10 Duration of Lesson: 1hr40 MIN

Lesson Title: intakes infiltration galleries storge, confined and unconfined aquifers

Instructional / Lesson Objectives:

- To make students conversant with basic principles of water supply Engineering
- To familiarize students waterborne diseases, water demand – types of demand
- To understand students the water quality and testing – drinking water standards
- To provide information on Selection of water source intakes – infiltration galleries, confined and unconfined aquifers.

Teaching AIDS : Black Board
Time Management of Class :

5 min for taking attendance 15 for revision of previous class 70 min for lecture delivery 10 min for doubts session

Assignment / Questions:
(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-I & tutorial-I sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-I)

Lesson No: 11 Duration of Lesson: 50 MIN

Lesson Title: requirements – methods and layouts.

Instructional / Lesson Objectives:

- To make students conversant with basic principles of water supply Engineering
- To familiarize students waterborne diseases, water demand – types of demand
- To understand students the water quality and testing – drinking water standards
- To provide information on Selection of water source intakes – infiltration galleries, confined and unconfined aquifers.

Teaching AIDS : Black Board
Time Management of Class :

5 min for taking attendance 5 for revision of previous class 30 min for lecture delivery 10 min for doubts session

Assignment / Questions:
(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-I & tutorial-I sheets.

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Department of Civil Engineering

LESSON PLAN (U-II)

Lesson No: 1,2,3 Duration of Lesson: 2hr 30 MIN

Lesson Title: Layout And General Outline Of Water Treatment Units, sedimentation, uniform settling velocity, Principles – design factors – surface loading

Instructional / Lesson Objectives:

- To make students provide the knowledge of source of water and its distribution.
- To familiarize students sedimentation, uniform settling velocity – Principles – design factors – surface loading
- To understand students the jar test – optimum dosage of coagulant – coagulation fluctuations clarifier design – coagulants – feeding arrangements
- To provide information on working of slow and rapid gravity filters – multimedia filters.

Teaching AIDS :PPTs, Black Board
Time Management of Class :

5 min for taking attendance 15 for revision of previous class 120 min for lecture delivery 10 min for doubts session

Assignment / Questions:
(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-II & tutorial-II sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-II)

Lesson No: 4,5 Duration of Lesson: 1hr 40 MIN

Lesson Title: jar test – optimum dosage of coagulant, jar test – optimum dosage of coagulant

Instructional / Lesson Objectives:

- To make students provide the knowledge of source of water and its distribution.
- To familiarize students sedimentation, uniform settling velocity – Principles – design factors – surface loading
- To understand students the jar test – optimum dosage of coagulant – coagulation fluctuations clarifier design – coagulants – feeding arrangements
- To provide information on working of slow and rapid gravity filters – multimedia filters.

Teaching AIDS : Black Board
Time Management of Class :

5 min for taking attendance 10 for revision of previous class 80 min for lecture delivery 5 min for doubts session

Assignment / Questions:
(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-II & tutorial-II sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-II)

Lesson No: 6,7 Duration of Lesson: 1hr 40 MIN

Lesson Title: coagulants – feeding arrangements, theory of filtration– working of slow and rapid gravity filters – multimedia filters

Instructional / Lesson Objectives:

- To make students provide the knowledge of source of water and its distribution.
- To familiarize students sedimentation, uniform settling velocity – Principles – design factors – surface loading
- To understand students the jar test – optimum dosage of coagulant – coagulation fluctuations clarifier design – coagulants – feeding arrangements
- To provide information on working of slow and rapid gravity filters – multimedia filters.

Teaching AIDS : Black Board
Time Management of Class :

5 min for taking attendance 10 for revision of previous class 80 min for lecture delivery 5 min for doubts session

Assignment / Questions:
(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-II & tutorial-II sheets.

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Department of Civil Engineering

LESSON PLAN (U-II)

Lesson No: 8,9 Duration of Lesson: 1hr 40 MIN

Lesson Title: troubles in operation comparison of filters, disinfection – types of disinfection theory of chlorination - chlorine demand

Instructional / Lesson Objectives:

- To make students provide the knowledge of source of water and its distribution.
- To familiarize students sedimentation, uniform settling velocity – Principles – design factors – surface loading
- To understand students the jar test – optimum dosage of coagulant – coagulation fluctuations clarifier design – coagulants – feeding arrangements
- To provide information on working of slow and rapid gravity filters – multimedia filters.

Teaching AIDS : Black Board
Time Management of Class :

5 min for taking attendance 10 for revision of previous class 80 min for lecture delivery 5 min for doubts session

Assignment / Questions:
(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-II & tutorial-II sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-III)

Lesson No: 1,2,3 Duration of Lesson: 2hr 30 MIN

Lesson Title: Distribution Systems. types of layouts of distribution systems, design of distribution System – Hardy cross and equivalent pipe methods

Instructional / Lesson Objectives:

- To impart the knowledge of various treatment required for potable water
- To familiarize students distribution systems – design of distribution System – Hardy cross and equivalent pipe methods and service reservoirs –joints, valves
- Conservancy and water carriage systems– sewage and storm water estimation –time of concentration
- Layouts and general outline of various units in a waste water treatment plant

Teaching AIDS :PPTs, Black Board

Time Management of Class :

5 min for taking attendance 15 for revision of previous class 120 min for lecture delivery 10 min for doubts session

Assignment / Questions:

(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-III & tutorial-III sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-III)

Lesson No: 4,5,6 Duration of Lesson: 2hr 30 MIN

Lesson Title: design of sewers – shape and materials –sewer appurtenances man holes, inverted siphon – catch basins – flushing tanks, pump house. Conservancy and water carriage systems

Instructional / Lesson Objectives:

- To impart the knowledge of various treatment required for potable water
- To familiarize students distribution systems – design of distribution System – Hardy cross and equivalent pipe methods and service reservoirs –joints, valves
- Conservancy and water carriage systems– sewage and storm water estimation –time of concentration
- Layouts and general outline of various units in a waste water treatment plant

Teaching AIDS :PPTs, Black Board

Time Management of Class :

5 min for taking attendance 15 for revision of previous class 120 min for lecture delivery 10 min for doubts session

Assignment / Questions:

(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-III & tutorial-III sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-III)

Lesson No: 7,8,9 Duration of Lesson: 2hr 30 MIN

Lesson Title: sewage and storm water estimation, time of concentration – storm water over flows, time of concentration – storm water over flows

Instructional / Lesson Objectives:

- To impart the knowledge of various treatment required for potable water
- To familiarize students distribution systems – design of distribution System – Hardy cross and equivalent pipe methods and service reservoirs –joints, valves
- Conservancy and water carriage systems– sewage and storm water estimation –time of concentration
- Layouts and general outline of various units in a waste water treatment plant

Teaching AIDS :PPTs, Black Board

Time Management of Class :

5 min for taking attendance 15 for revision of previous class 120 min for lecture delivery 10 min for doubts session

Assignment / Questions:

(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-III & tutorial-III sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-III)

Lesson No: 10,11,12 Duration of Lesson: 2hr 30 MIN

Lesson Title: grit chambers –skimming tanks –sedimentation tanks, principles and design of biological treatment, tricking filters standard and high rate.

Instructional / Lesson Objectives:

- To impart the knowledge of various treatment required for potable water
- To familiarize students distribution systems – design of distribution System – Hardy cross and equivalent pipe methods and service reservoirs –joints, valves
- Conservancy and water carriage systems– sewage and storm water estimation –time of concentration
- Layouts and general outline of various units in a waste water treatment plant

Teaching AIDS :PPTs, Black Board

Time Management of Class :

5 min for taking attendance 15 for revision of previous class 120 min for lecture delivery 10 min for doubts session

Assignment / Questions:

(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-III & tutorial-III sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-IV)

Lesson No: 1,2,3 Duration of Lesson: 2hr 30 MIN

Lesson Title: Characteristics Of Sewage, cycle of decay – decomposition of sewage, examination of sewage – BOD – COD

Instructional / Lesson Objectives:

- To provide the knowledge of characteristics of sewage and its treatment
- cycle of decay – decomposition of sewage,examination of sewage – BOD – COD. Equations
- sewer appurtenances man holes – inverted siphon – catch basins – flushing tanks – ejectors
- one pipe and two pipe systems of plumbing ultimate disposal of sewage – sewage farming – dilution Teaching AIDS :PPTs, Black Board
- Time Management of Class :

5 min for taking attendance 15 for revision of previous class 120 min for lecture delivery 10 min for doubts session

Assignment / Questions:
(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-IV & tutorial-IV sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-IV)

Lesson No: 4,5,6 Duration of Lesson: 2hr 30 MIN

Lesson Title: design of sewers – shape and materials –sewer appurtenances man holes, inverted siphon – catch basins – flushing tanks, pumps and pump houses and house drainage

Instructional / Lesson Objectives:

- To provide the knowledge of characteristics of sewage and its treatment
- cycle of decay – decomposition of sewage,examination of sewage – BOD – COD. Equations
- sewer appurtenances man holes – inverted siphon – catch basins – flushing tanks – ejectors
- one pipe and two pipe systems of plumbing ultimate disposal of sewage – sewage farming – dilution

Teaching AIDS :PPTs, Black Board

Time Management of Class :

5 min for taking attendance 15 for revision of previous class 120 min for lecture delivery 10 min for doubts session

Assignment / Questions:

(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-IV & tutorial-IV sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-IV)

Lesson No: 7,8,9 Duration of Lesson: 2hr 30 MIN

Lesson Title: components requirements – sanitary fittings, one pipe and two pipe systems of plumbing, ultimate disposal of sewage – sewage farming – dilution

Instructional / Lesson Objectives:

- To provide the knowledge of characteristics of sewage and its treatment
- cycle of decay – decomposition of sewage,examination of sewage – BOD – COD. Equations
- sewer appurtenances man holes – inverted siphon – catch basins – flushing tanks – ejectors
- one pipe and two pipe systems of plumbing ultimate disposal of sewage – sewage farming – dilution Teaching AIDS : Black Board
- Time Management of Class :

5 min for taking attendance 15 for revision of previous class 120 min for lecture delivery 10 min for doubts session

Assignment / Questions:
(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-IV & tutorial-IV sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-V)

Lesson No:1,2,3, Duration of Lesson: 2hr 30 MIN

Lesson Title: Waste Water Treatment Plant, Flow diagram – primary treatment, design of screens –grid chambers

Instructional / Lesson Objectives:

- To make the students in various designing of treatment unit operation system
- Flow diagram – primary treatment design of screens –grid chambers – skimming tanks –sedimentation tanks
- principles of design –biological Treatments – trickling filters – standard and high rate
- Construction and design of oxidation ponds. Sludge digestion tanks – factor affecting – design of digestion tanks –sludge disposal by drying – septic tanks

Teaching AIDS :PPTs, Black Board

Time Management of Class :

5 min for taking attendance 15 for revision of previous class 120 min for lecture delivery 10 min for doubts session

Assignment / Questions:

(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-V & tutorial-V sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-V)

Lesson No:4,5,6, Duration of Lesson: 2hr 30 MIN

Lesson Title: skimming tanks –sedimentation tanks, principles of design –biological Treatments, Problems on tickling filter

Instructional / Lesson Objectives:

- To make the students in various designing of treatment unit operation system
- Flow diagram – primary treatment design of screens –grid chambers – skimming tanks –sedimentation tanks
- principles of design –biological Treatments – trickling filters – standard and high rate
- Construction and design of oxidation ponds. Sludge digestion tanks – factor affecting – design of digestion tanks –sludge disposal by drying – septic tanks

Teaching AIDS :PPTs, Black Board

Time Management of Class :

5 mins for taking attendance 15 for revision of previous class 120 min for lecture delivery 10 min for doubts session

Assignment / Questions:

(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-V & tutorial-V sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-V)

Lesson No:7,8,9,10 Duration of Lesson: 3hr 20 MIN

Lesson Title: Construction ponds, design of oxidation ponds., Sludge digestion tanks, septic tanks working principles

Instructional / Lesson Objectives:

- To make the students in various designing of treatment unit operation system
- Flow diagram – primary treatment design of screens –grid chambers – skimming tanks –sedimentation tanks
- principles of design –biological Treatments – trickling filters – standard and high rate
- Construction and design of oxidation ponds. Sludge digestion tanks – factor affecting – design of digestion tanks –sludge disposal by drying – septic tanks

Teaching AIDS :PPTs, Black Board

Time Management of Class :

5 min for taking attendance 15 for revision of previous class 150 min for lecture delivery 30 min for doubts session

Assignment / Questions:
(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-V & tutorial-V sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-V)

Lesson No:11,12,13,14 Duration of Lesson: 3hr 20 MIN

Lesson Title: design of digestion tanks, sludge disposal by drying, Problems sludge disposal, Construction of septic tank

Instructional / Lesson Objectives:

- To make the students in various designing of treatment unit operation system
- Flow diagram – primary treatment design of screens –grid chambers – skimming tanks –sedimentation tanks
- principles of design –biological Treatments – trickling filters – standard and high rate
- Construction and design of oxidation ponds. Sludge digestion tanks – factor affecting – design of digestion tanks –sludge disposal by drying – septic tanks

Teaching AIDS :PPTs, Digital Board, Black Board

Time Management of Class :

5 min for taking attendance 15 for revision of previous class 170 min for lecture delivery 10 min for doubts session

Assignment / Questions:
(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-V & tutorial-V sheets.

Signature of faculty

Department of Civil Engineering

LESSON PLAN (U-V)

Lesson No:15,16,17 Duration of Lesson: 2hr 30 MIN

Lesson Title: Working principles of septic tank, Design of soak pit, Revision of waste water treatment plant

Instructional / Lesson Objectives:

- To make the students in various designing of treatment unit operation system
- Flow diagram – primary treatment design of screens –grid chambers – skimming tanks –sedimentation tanks
- principles of design –biological Treatments – trickling filters – standard and high rate
- Construction and design of oxidation ponds. Sludge digestion tanks – factor affecting – design of digestion tanks –sludge disposal by drying – septic tanks

Teaching AIDS :PPTs, Black Board

Time Management of Class :

5 mins for taking attendance 15 for revision of previous class 120 min for lecture delivery 10 min for doubts session

Assignment / Questions:

(Note: Mention for each question the relevant Objectives and Outcomes Nos.1,2,3,4 & 1,3..)

Refer assignment-V& tutorial-V sheets.

Signature of faculty

Department of Civil Engineering

ASSIGNMENT – 1

This Assignment corresponds to Unit No. 1

Question No.	Question	Objective No.	Outcome No.
1	Explain in detail about population forecasting methods.	1	1
2	What are the factors affecting per capita demand.	1	1
3	Define water demand and write about water quality tandards	1	1

Signature of HOD

Date:

Signature of faculty

Date:

Department of Civil Engineering

ASSIGNMENT – 2

This Assignment corresponds to Unit No. 2

Question No.	Question	Objective No.	Outcome No.
1	Explain the jar test with neat sketch	2	2
2	What is disinfection.Expain about five different methods in detail.	2	2
3	Expain about five different methods in detail.	2	2

Signature of HOD

Date:

Signature of faculty

Date:

Department of Civil Engineering

ASSIGNMENT – 3

This Assignment corresponds to Unit No. 3

Question No.	Question	Objective No.	Outcome No.
1	Define distribution system	3	3
2	Explain briefly about layout of water distribution system	3	3

Signature of HOD

Date:

Signature of faculty

Date:

Department of Civil Engineering

ASSIGNMENT – 4

This Assignment corresponds to Unit No. 4

Question No.	Question	Objective No.	Outcome No.
1	Write a short note on the following I)BOD ii) COD iii) Sewage iv) Sewerage v) Sewerage farming vi) catch basin	4	4
2	What is BOD how it is estimated.	4	4
3	Explain about working principle of manhole used in sewerage system	4	4

Signature of HOD

Date:

Signature of faculty

Date:

Department of Civil Engineering

ASSIGNMENT – 5

This Assignment corresponds to Unit No. 5

Question No.	Question	Objective No.	Outcome No.
1	Explain the complete construction and design parameters of a septic tank.	5	5
2	Explain the methods of sludge treatment	5	5
3	Explain the principle and working of activated sludge process.	5	5

Signature of HOD

Date:

Signature of faculty

Date:

Department of Civil Engineering

TUTORIAL SHEET – 1

This tutorial corresponds to Unit No. 1 (Objective Nos.: 1, Outcome Nos.: 1)

Q1. The average quantity of water required for domestic purposes according to IS code is
a) 100 b) 120 c) 70 d) 135

Q2. Water lost in theft and waste contributes to how much % of total consumption.
a) 5 b) 10 c) 15 d) 20

Q3. What are the factors affecting per capita demand?
a) size of the city b) size of the city,habit of people c) cost of water,quality of water , size of the city d) cost of water,quality of water , size of the city, habit of people

Q4. What is the design period for the water treatment unit.
a) 10 years b) 15years c) 20 years d) 30 years

Signature of HOD

Date:

Signature of faculty

Date:

Department of Civil Engineering

TUTORIAL SHEET – 2

This tutorial corresponds to Unit No. 2 (Objective Nos.: 2, Outcome Nos.: 2)

Q1. Which of the coagulant is more suitable..
a) alum b) copperas c) ferric chloride d) ferric sulphate

Q2. The proess of removing pathogenic bacteria is called
a) disinfection b) chlorination c) sedimentation d) coagulation

Q3. The slow sand filter is able to remove ……% of bacteria in water
a) 90 b) 95 c) 98-99 d) 100

Signature of HOD

Date:

Signature of faculty

Date:

Department of Civil Engineering

TUTORIAL SHEET – 3

This tutorial corresponds to Unit No. 3 (Objective Nos.: 3, Outcome Nos.: 3)

Q1.which of the following distribution system is more reliable ?

a) radial system b) tree system c) ring system d) all are reliable

Q2 the method of distribution of water is divided into how many types?
a) 1 b) 2
c) 3 d) 4

Q3.what are the sanitary fitting
a) wash basins b) sinks c) water closets d) all of the above

Signature of HOD

Date:

Signature of faculty

Date:

Department of Civil Engineering

TUTORIAL SHEET – 4

This tutorial corresponds to Unit No. 4 (Objective Nos.: 4, Outcome Nos.: 4)

Q1.the amount of oxygen consumed by the aerobic bacteria which cause the aerobic biological decomposition of sewage is known as
a) bio chemical oxygen demand b) dissolved oxygen demand
c) chemical oxygen demand d) all of the above

Q2. Natue of the fresh sewage
a) acidic b) alkaline c) party acidic and party alkaline d) neutral

Q3. The ratio of oxygen available to the oxygen required for stabilization of sewage is called
a) relative stability b) bacterial stability factor c) biological oxygen demand d) oxygen ion concentration.

Signature of HOD

Date:

Signature of faculty

Date:

Department of Civil Engineering

TUTORIAL SHEET – 5

This tutorial corresponds to Unit No. 5 (Objective Nos.: 5, Outcome Nos.: 5)

Q1. Skimming tank are
a) used to remove the grease and oil b) used for self cleaning c) used to store waste water d)used to mix chlorine

Q2.one of the following is commonly used in secondary treatment of sewage.

a) intermittent filter b) trickling filter c) contact bed d) all of the above

Q3. The treatment of grit chamber
a) primary tratment b) preliminary treatment c) secondary treatment d) tertiary treatment

Signature of HOD

Date:

Signature of faculty

Date:

Department of Civil Engineering

EVALUATION STRATEGY

Target (s)

a. Percentage of Pass : 95%

Assessment Method (s) (Maximum Marks for evaluation are defined in the Academic Regulations)

a. Daily Attendance
b. Assignments
c. Online Quiz (or) Seminars
d. Continuous Internal Assessment
e. Semester / End Examination

List out any new topic(s) or any innovation you would like to introduce in teaching the subjects in this semester

Case Study of any one existing application

Signature of HOD

Date:

Signature of faculty

Date:

Department of Civil Engineering

COURSE COMPLETION STATUS

Actual Date of Completion & Remarks if any

Units	Remarks	Objective No. Achieved	Outcome No. Achieved
Unit 1	completed on 15.02.2024	1	1
Unit 2	completed on 06.03.2024	2	2
Unit 3	completed on 30.03.2024	3	3
Unit 4	completed on 20.04.2024	4	4
Unit 5	completed on 12.06.2024	5	5

Signature of HOD

Date:

Signature of faculty

Date:

Department of Civil Engineering

Mappings

1. Course Objectives-Course Outcomes Relationship Matrix

(Indicate the relationships by mark "X")

Course-Objectives \ Course-Outcomes	1	2	3	4	5
1	H		M		
2		H			
3			H		
4				H	
5					H

2. Course Outcomes-Program Outcomes (POs) & PSOs Relationship Matrix

(Indicate the relationships by mark "X")

C-Outcomes \ P-Outcomes	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
1	H			M									H	
2		M	H			M							H	H
3					H				M		M			M
4						M	H						M	
5										H				

Department of Civil Engineering

Rubric for Evaluation

Performance Criteria	Unsatisfactory	Developing	Satisfactory	Exemplary
	1	2	3	4
Research & Gather Information	Does not collect any information that relates to the topic	Collects very little information some relates to the topic	Collects some basic Information most relates to the topic	Collects a great deal of Information all relates to the topic
Fulfill team role's duty	Does not perform any duties of assigned team role.	Performs very little duties.	Performs nearly all duties.	Performs all duties of assigned team role.
Share Equally	Always relies on others to do the work.	Rarely does the assigned work - often needs reminding.	Usually does the assigned work - rarely needs reminding.	Always does the assigned work without having to be reminded
Listen to other team mates	Is always talking—never allows anyone else to speak.	Usually doing most of the talking-- rarely allows others to speak	Listens, but sometimes talks too much.	Listens and speaks a fair amount.

III B.TECH VI SEMESTER I MID EXAMINATIONS - MARCH 2024

Branch : B.Tech. (CE) | **Subject : ENVIRONMENTAL ENGINEERING,CE603PC** | **Max. Marks : 20M**

Date : 19.03.2024 FN | **Time : 90 Minutes**

PART - A

ANSWER ALL THE QUESTIONS. **5 X 1M = 5M**

Q.No	Question	CO	BTL
1.	Define the water demand?	CO1	1
2.	what is water born diseases.	CO1	1
3.	distinguish between slow and rapid gravity filters.	CO2	1
4.	write a short note on jar test.	CO2	1
5.	what is distribution system..	CO3	1

PART - B

ANSWER ALL THE QUESTIONS. **3 X 5M = 15M**

Q.No	Question	CO	BTL
6.	population of a town as obtained from census report of 5 decades are 1965,1975.1985,1995,2005 and their population are 40000,51500,66000,78500,88000.estimate the population in the year of 2015,2025 by arithmetical,geometrical and incremental increase method.	CO1	3
	OR		
7.	Define infiltration gallery? Explain the types of infiltration galleries.	CO1	2
8.	Describe various types of coagulation commonly used in water treatment.	CO2	2
	OR		
9.	discuss about principle and design of plain sedimentation along with sketch.	CO2	2
10.	what are various methods of layout of distribution system	CO3	3
	OR		
11.	explain the grid iron distribution system in detail.	CO3	2

III B.TECH VI SEMESTER II MID EXAMINATIONS - JUNE 2024

Branch : B.Tech. (CE) **Max. Marks : 20M**
Date : 19-Jun-2024 Session : Morning **Time : 90 Min**
Subject : ENVIRONMENTAL ENGINEERING,CE603PC

PART - A

ANSWER ALL THE QUESTIONS **5 X 1M = 5M**

Q.No	Question	CO	BTL
1.	Define screening and grit chamber.	CO3	L1
2.	List out sanitary fitting.	CO4	L2
3.	Define sewer?write the names of shapes of sewer.	CO4	L1
4.	Explain about soak pit.	CO5	L2
5.	Draw the flow diagram of waste water treatment plant?	CO5	L2

PART - B

ANSWER ALL THE QUESTIONS **3 X 5M = 15M**

Q.No	Question	CO	BTL
6.	layout and general outline of various units in waste water treatment plant.	CO3	L3
	OR		
7.	Explain about hardy cross and equivalent pipe methods.	CO3	L2
8.	Write a short note on sewage,sewer,sewerage ,catch basin and sewage farming.	CO4	L2
	OR		
9.	Explain briefly about COD .	CO4	L2
10.	What is septic tank ? Explain the working principles and design of septic tank.	CO5	L3
	OR		
11.	Explain briefly about activated sludge process.	CO5	L2

First Internal Examination Marks

Programme**: BTech** Year: **III** Course: **Theory** **A.Y: 2023-24**

Course: **Environmental Engineering** Section: A Faculty Name: **N.Satish**

S.No.	H.T.No.	Name of the Student	Mid - I	Assignment - I	Mid - I Total	Mid - II	Assignment - II	Mid - II Total	AVG
1	21C11A0101	Amulya Barmavath	19	5	24	20	5	25	25
2	21C11A0103	Arif Shaik	13	5	18	13	5	18	18
3	21C11A0104	Gopi Bhukya	AB	AB	0	AB	AB	0	0
4	21C11A0105	Gowthami Gadde	15	5	20	18	5	23	22
5	21C11A0106	Kartheek Goud Mekapothula	14	5	19	17	5	22	21
6	21C11A0107	Karthik Sriloju	17	5	22	18	5	23	23
7	21C11A0108	Meghana Pavurala	19	5	24	20	5	25	25
8	21C11A0110	Nagavaraprasad Panugothu	AB	AB	0	AB	AB	0	0
9	21C11A0111	Nandini Komera	11	5	16	17	5	22	19
10	21C11A0112	Nikitha Gandham	13	5	18	19	5	24	21
11	21C11A0114	Prathyusha Bhukya	19	5	24	19	5	24	24
12	21C11A0115	Rishitha Ponna	18	5	23	19	5	24	24
13	21C11A0116	Sai Kumar Banothu	12	5	17	15	5	20	19
14	21C11A0117	Saikiran Maheshwarapu	17	5	22	19	5	24	23
15	21C11A0118	Srilatha Doppalapudi	19	5	24	19	5	24	24
16	22C15A0101	Anusha Gunti	16	5	21	19	5	24	23

17	22C15A0102	Bhavya Sri Rayapudi	20	5	25	20	5	25	25
18	22C15A0103	Ganesh Daravath	18	5	23	18	5	23	23
19	22C15A0104	Kushal Mididoddi	17	5	22	20	5	25	24
20	22C15A0105	Nagaraju Daggula	17	5	22	19	5	24	23
21	22C15A0106	Rakesh Rajaboina	17	5	22	20	5	25	24
22	22C15A0107	Saisanjay Badisa	12	5	17	19	5	24	21
23	22C15A0108	Shaik Moulana	14	5	19	20	5	25	22
24	22C15A0109	Swathi Karingula	10	5	15	17	5	22	19
25	22C15A0110	Umyasri Rathod	17	5	22	18	5	23	23

No. of Absentees: 02

Total Strength: 25

Signature of Faculty

:

Signature of HoD

ANURAG ENGINEERING COLLEGE

(An Autonomous Institution)

(Approved by AICTE, New Delhi, Affiliated to JNTUH, Hyderabad, Accredited by NAAC with A+ Grade)

Ananthagiri (V & M), Kodad, Suryapet (Dist), Telangana.

Program		
B.Tech. ✓	M.Tech.	M.B.A.

HALL TICKET NO.									
2	2	C	1	5	A	0	1	0	2

Course: Environmental engineering

Q.No. and Marks Awarded										
1	2	3	4	5	6	7	8	9	10	11
1	1	1	1	5				5		5

YEAR	SEMESTER	MID EXAMINATION
III	II	I

Regulation: 18 | Branch or Specialization: Civil

Signature of Student: D. Bhavya Sri

Signature of Invigilator with date: 19/12/24

Signature of the Evaluator: N. C.

Maximum Marks: 20 | Marks Obtained: 20

(Start Writing From Here)

PART - A

1) **Water Demand:**

The Water Demand is defined as the Quantity of water which is used to supply to the consumer to reach their demands (standards) is called Water Demand.

→ The sufficient water is supply to the consumer to their needs.

2) **Water born diseases:**

The diseases which are born or spreads due to contaminated water is known as water born diseases.

Examples:

1) Typhoid
2) Malaria
3) Choalora etc...

(3)

Slow Gravity filters	Rapid gravity filters
1. The process of time taken is more i.e slow process.	2. The time taken for filteration is less i.e) Rapid process.
2. The sand filters are fine sands.	2. The sand filters are coarse.
3. The size of the tank is 100 to 2000 m^2	3. The size of the tank is 100 - 300 m^2 only
4. The Area is required more.	4. The Areas is required less.

(4) Jar test:

The Jar test is conducted to determine the optimum dosage of coagulant required for water (un-treated).

→ The Alum (Aluminium sulphate) is used as coagulant in 1000ml water.

→ The No. of beakers are required is '6', and magnetic stirrer is used.

→ upto 3minutes Rapid mix and after that 25 - 30 minutes slow mix (stirring) is done to form floc on surface.

(5) Distribution system:

Distribution system is one of the part in treatment of water.

→ It is used to supply the treated water

PART-B

1) Grid-Iron Distribution system:

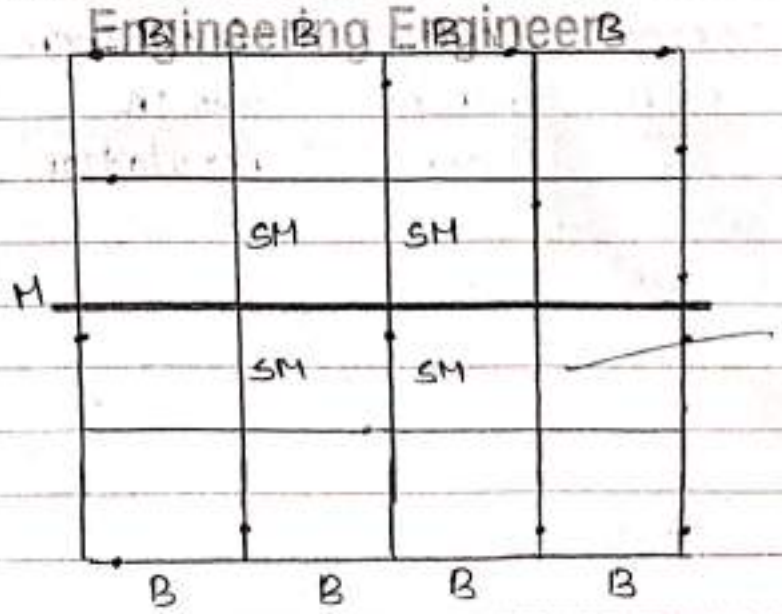
→ Grid-Iron Distribution system is also known as Interlaced system.

→ This method is used to connect the Dead end points in the Dead end system that means continous flow of water.

→ The water is does not contaminated because there is no storage of water, it is continuously revolve.

→ This Method is used for cities which are Rectangular Patterns.

→ The cities like well designed and advanced places to supply water in Grid-Iron method.



M - Main

Grid-Iron system

Advantages:

* The water doesn't contaminated because No storing of water.
* This system give more accurate results than Dead end system.
* This system is economical and used by Rectangular pattern cities.
* 100% efficiency in supplying water.

Disadvantages:

* The Number of Pipes and Piping systems are used more.
* The cost for laying pipes is more.
* The usage of energy is more.

(6) Given data,

Year	Population	Increase in population	% of Increase in population	Incremental Increase population (y)
1965	40000	0	–	–
1975	51500	11500	28.75	–
1985	66000	14500	28.155	-14500
1995	78500	12500	18.94	1200

$$\bar{x} = \frac{48000}{4} = 12000$$

$$\bar{y} = \frac{7500}{2} = 3750$$

Arithmetical Increase method:

$$P_n = P_0 + n\bar{x}$$

$$P_{2015} = 88000 + 1 \times (12000)$$

$$P_{2015} = 100000$$

$$P_{2025} = P_0 + n\bar{x}$$

$$= 88000 + 2 \times (12000)$$

$$P_{2025} = 112000$$

Geometrical Increase method:

$$P_n = P_0 \left[1 + \frac{r}{100}\right]^n$$

$$r = (r_1 * r_2 * r_3 * \cdots * r_n)^{1/n}$$

20.75

$$r = (28.75 \times 28.155 \times 18.94 \times 12.10)^{1/4}$$

$$r = 20.75$$

Now,

$$P_{2025} = 8800\left[1 + \frac{20.75}{100}\right]^2$$

$$\boxed{P_{2025} = 128309}$$

Incremental increase method:

$$\boxed{P_n = P_0 + n\bar{x} + \left[\frac{n(n+1)}{2}\right]\bar{y}}$$

$$P_{2015} = 88000 + 1(12000) + \left[\frac{1(1+1)}{2}\right] \times 3750$$

$$\boxed{P_{2015} = 103750}$$

$$P_{2025} = 88000 + 2(12000) + \left[\frac{2(2+1)}{2}\right] \times 3750$$

$$\boxed{P_{2025} = 123250}$$

9) Sedimentation:

Sedimentation means settlement of suspended particles by natural i.e gravity (or) by chemicals is called sedimentation.

→ The particles are settle down at bottom of the tank when it's specific gravity is more than 1.

→ Because specific gravity of water is 1.

→ The particles which have sp.gravity less than 1, They are finely suspended particles they are Removed by chemicals or next process.

→ The sedimentations are two methods.

1. plane sedimentation
2. sedimentation with coagulation.

1. Plane sedimentation:

→ The Plane sedimentation means the suspended particles are settle down by gravity i.e natural process without using any chemicals.

→ This method is economical and reliable.

→ The Methods in plane sedimentation are:

1) Intermitted method / quiescent method
2) Combined continuous supply flow method
   (a) Horizontal supply flow
      [Rectangular tanks]

Design of plain sedimentation:

1) Surface over flow:

The Quantity of water is sended into the tank with respect to the Area of the tank i.e Width and height of the particular tank.

$$SOF = \frac{Q}{BL}$$

where,

Q = Quantity of water

B = Width of the sedimentation tank

L = Height / length of the sedimentation tank

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2) Detension time:

The time of the settlement of particles in the sedimentory tank is depend upon the Horizontal flow, Vertical flow and Size & shape of the particles

→ And Temperature & viscosity also plays a major role.

3) Design Period:

The Design period is also Important in sedimentation process.

Assignment - IV

Name :- B. Amulya

Hall ticket No: 21C11A0110

Environmental Engineering

Branch :- Civil

1. Write a short note on the following

i) BOD ii) COD iii) Sewerage iv) Sewage v) Sewerage farming vi) Catch basin.

i) BOD (Biological oxygen Demand) :- BOD may be defined as the amount of oxygen required for the micro-organisms to carry out biological decomposition of biodegradable organic matter under aerobic conditions at a specified temperature (20°c) & for a specified duration (15 days)

ii) COD (chemical oxygen demand) :- The amount of oxygen required to oxidise the biodegradable & non-biodegradable organic matter is known as "chemical oxygen demand".

iii) Sewerage :- A sewerage system is a system for waste-water collection it is a network of pipes & pumping stations, that convey sewage from it's point of origin to the point of treatment and disposal.

iv) Sewage :- sewage is the process of removing contaminants from waste water and household sewage both effluents & domestic. It includes physical, chemical & biological processes to remove physical, chemical & biological contaminants.

v) Sewerage farming :- Sewerage farming is an agricultural practice where treated sewage or waste water is used to irrigate & fertilize crops.

vi) Catch basin :- A catch basin is a type of drainage structure designed to collect and manage surface water runoff.

2. What is BOD. How it is Estimated.

BOD :-

BOD may be defined as the amount of oxygen required

for the micro-organism to carry out biological decomposition biodegradable organic matter under aerobic condition.

BOD Test (Dilution method) :-

* BOD test can be performed by dilution method.
* This the commonly used method.
* In this method the sample is suitably diluted with a specially prepared dilution water.
* Initial Dissolved oxygen (DO) measured in the beginning for the sample diluted with water.
* Then the diluted Sample incubated for 5 days at 20°C in air light glass vessel.
* Final Dissolved oxygen (DO) of the sample measured after 5 days.
* BOD then completed from the relation.

$BOD_5^{20°C}$ = (oxygen consumed) * dilution ratio

$BOD_5^{20°C}$ = [Initial DO - Final DO] x dilution ratio

Dilution ratio (or) Dilution factor :-

$$\text{Dilution factor} = \frac{\text{volume of diluted sample}}{\text{volume of un-diluted sewage sample}}$$

$$= \frac{A+B}{A} = \frac{\text{Total volume}}{\text{Sewage volume}}$$

A → vol. of sewerage sample.

B → vol. of distilled water

(or)

Dilution factor :- Number of times sewage is diluted with distilled water.

Ex :- For 2 % solution

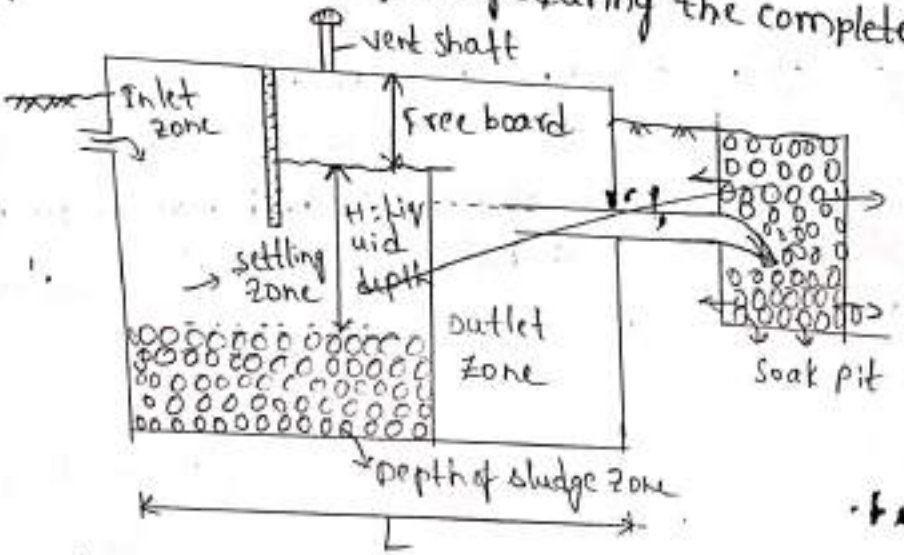
$$\text{Dilution Factor} = \frac{100}{2} = 50$$

Assignment - V

% Explain the complete construction and design parameters of a septic tank.

Septic tank construction :-

Septic tank is constructed with masonary (or) concrete
→ It is a single chambered rectangular tank with a water tight concrete floor at bottom.
→ Inside of the tank is provided with a water tight plastering preferably mixed with water proofing material.
→ It consist of an inlet pipe and outlet pipe of tee - section
→ Also consist of an outlet & inlet baffles to avoid scum to enter into pipes.
→ The top of the septic tank is covered with a RCC slab and is provided with a manhole.
→ A vertical pipe is provided for ventilation and covered with perforated cap at the top foul gases escape from this pipe.
→ The tank is so designed that there is sufficient space for sedimentation, digestion and storage during the complete operation period.



Design of septic tank :-

=> capacity of septic tank (volume) = volume of settling zone + volume of sludge zone

* Volume of settling zone = $Q \times D_t$.

$Q = Q_{DWF}$ = no. of users x per capita sewage flow.

Q_{DWF} => Dry weather flow

D_t → Detention time → 24 to 48 hours

* Plan area (or) Surface area of septic tank (L x B) = $\frac{\text{volume of settling zone}}{\text{liquid depth}}$

= $\frac{\text{volume of septic tank}}{\text{Effective depth}}$.

* Volume of sludge (or) Sludge zone volume = Rate of sludge produced x no. of users x desludging period.

* Rate of sludge production = 30 to 40 lit/person/year.

* Desludging period (or) cleaning period => 1 year to 3 year

* $\frac{L}{B}$ ratio => $\frac{2}{1}$ to $\frac{4}{1}$

* Depth of tank varies from 1.5 m to 2.5 m.

Q.-i) Explain the methods of sludge treatment.

Sludge treatment involves various methods to reduce the volume stabilize the organic materials and remove pathogens from the sludge generated during wastewater treatment. Here are the main methods used.

1. Thickening :-

Gravity thickening :- uses gravity to settle the solids, increasing sludge concentration.

Floatation thickening :- Air bubbles attach to sludge particles causing them to float and form a thickened sludge layer.

Centrifugal thickening :- uses centrifugal force to separate

solids from liquids.

2. Stabilization :-

i) Anaerobic digestion :- Sludge is decomposed by micro-organisms in the absence of oxygen, producing biogas.

ii) Aerobic Digestion :- Micro-organisms break down organic matter in the presence of oxygen

iii) Lime stabilization :- Lime is added to raise pH, inhabiting the growth of pathogens and reducing odor.

3. Dewatering :-

i) Centrifugation :- uses centrifugal force to separate water from sludge

ii) Belt filter press :- gravity and pressure to dewater sludge.

4. Conditioning :-

i) Chemical conditioning :- Addition of chemicals (polymers, ferric chloride) to improve dewaterability.

ii) Heat conditioning :- Heating sludge to enhance dewatering and pathogen destruction.

5. Disinfection :-

i) Heat Treatment :- High temperatures kill pathogens.

ii) Alkaline stabilization :- High pH conditions kill pathogens.

6. Reduction :- By thermal hydrolysis high temperature and high pressure process that break down sludge into more easily digestible components for anaerobic digestion.

7. Final disposal :-

i) Land application :- Treated sludge is used as a soil conditioner (or) fertilizer

ii) Landfill disposal :- Sludge is deposited in landfills.

iii) Incineration :- combustion of sludge reduces volume and destroys organic contaminants.

ii) Explain the principle and working of activated sludge process.

Activated sludge :- It is a sludge containing a large concentration of highly active aerobic micro organisms.

Principle :-

* Activated sludge is mixed with raw sewage along with large quantity of air for about 4 to 8 hours in a aeration tank.
* The settled sludge in secondary sedimentation tank (SST) is called activated sludge. It is again recycled to the head of aeration tank to be mixed with sewage being treated.

Flow Diagram :-

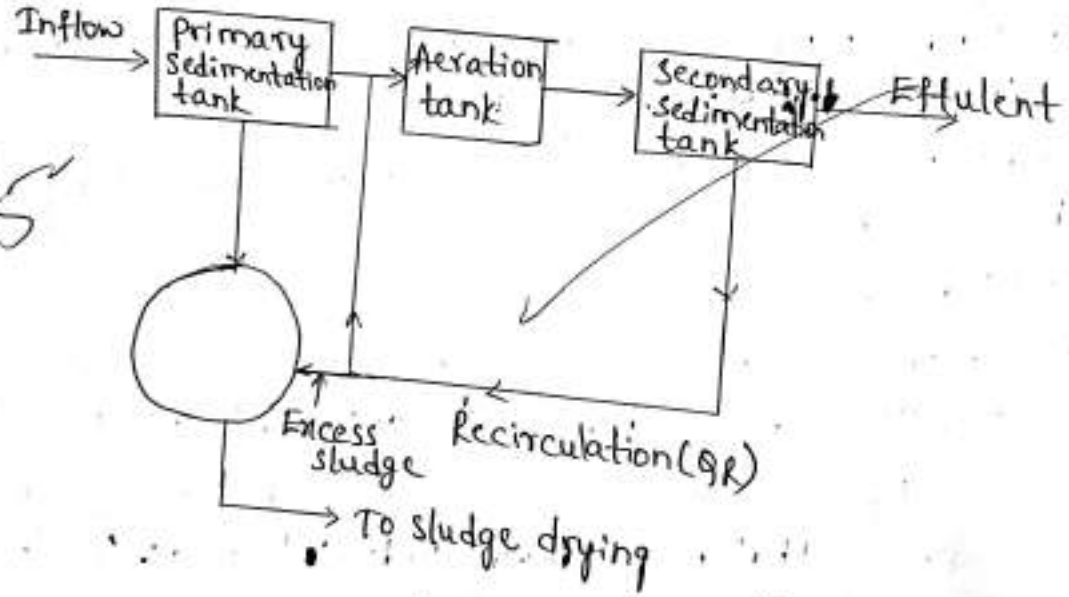


Fig :- Activated Sludge Process

UNIT-III

Water * Distribution System *

Introduction:

→ After complete treatment of water, it becomes necessary to distribute it to a number of houses, estates, industries & public places by means of a network of distribution system.

⇒ The distribution system consists of,

(i) Pipes: Mains, sub mains, branches, Laterals
⇒ It consist of pipes of various sizes. The pipe lines carry the water to each and every street/road.

(ii) Valves: Valves control the flow of water through the pipes.

(iii) Hydrants: Hydrants are provided to connect the water to the fire fighting equipments during fire.

(iv) Meters: Meters are provided to measure the quantity of water consumed by individual as well as by town.

(v) Service reservirs: For storing the treated water & stabilizing the pressures

(vi) Pumps: Pumps are provided to pump the water to the elevated service reservirs (or) directly in the water mains to obtain the required pressure in the pipe lines.

Note: distribution system involves 40 to 70% of total cost of water supply scheme

* Requirements of a good distribution system:

⇒ Following are the requirements of good distribution system

1. It should convey the treated water upto the consumers with the same degree of purity
2. The water should reach to every consumer with the required pressure head.
3. Sufficient quantity of treated water should reach for the dimestic & Industrial use.
4. The distribution system should be economical & easy to maintain & operate.
5. It should be able to transport sufficient quantity of water during emergency such as fire-fighting
6. It should be reareliable so that even during breakdown (or) repair of one line; water should reach that locality from other line.
7. During repair work, it should not cause obstruction to the traffic.
8. It should be safe against any future pollution. The pipe lines as far possible should not be laid below the sewer lines
9. The quality of the pipes laid should be good & it should not burst.
10. It should be water-tight & water losses due to leakage should be minimum as far as possible.

* Methods or Systems of Distribution :

→ For efficient distribution it is required that water should reach to every consumer with required rate of flow

⇒ The method of distribution depends upon the topography of the area.

⇒ The following methods or systems may be adopted for distribution

1. Granty system
2. Pumping system
3. Dual or Combined granty & pumping system

1. Gravity System:

→ Water is distributed by granty only, to the consumer points.

→ It is suitable for situations where the source of water is located at a sufficiently higher level than the town

→ This system is economical and reliable since no pumping is involved at any stage

→ It needs a lake or storage reservoirs as a source of supply located at a sufficient higher level

→ The designs of the distribution system pipes are done in such way that head available at the consumer's door is just minimum required & remaing head is fully consumed in frictional & other losses.

→ This will reduce the leakage & wastes to the minimum.

→ But in this case the water will have to be pumped during fires

2. Pumping System:

→ Treated water is directly pumped into the distribution pipes by means of high lift pumps without storing any where

→ Pumps should be capable of being operated at various speeds to meet the maximum and minimum demand and maintain sufficient residual pressure at various points of consumption.

→ this is not economical. so this system is not commonly preferred.

→ Advantage is that during fire accidents, large quantities of water at high pressures can be pumped to put off the fire.

3. Dual (or combined system):

→ This is also known as combined gravity & pumping system

→ the pump is connected to the mains as well as to an elevated reservoir.

→ In this system water comes from two sources one from reservoir & second from pumping station, it is called dual system.

→ In this system, the treated water is pumped at constant rate into an elevated reservior as well as directly into distribution system

→ This is most widely adopted system in water supply schemes for its obvious advantages such as pumps can be operated with uniform speed at their rated capacities

Advantages of Dual system:

→ It is a reliable system as there is always some reserve water in elevated tanks to augment the supply during peak demands

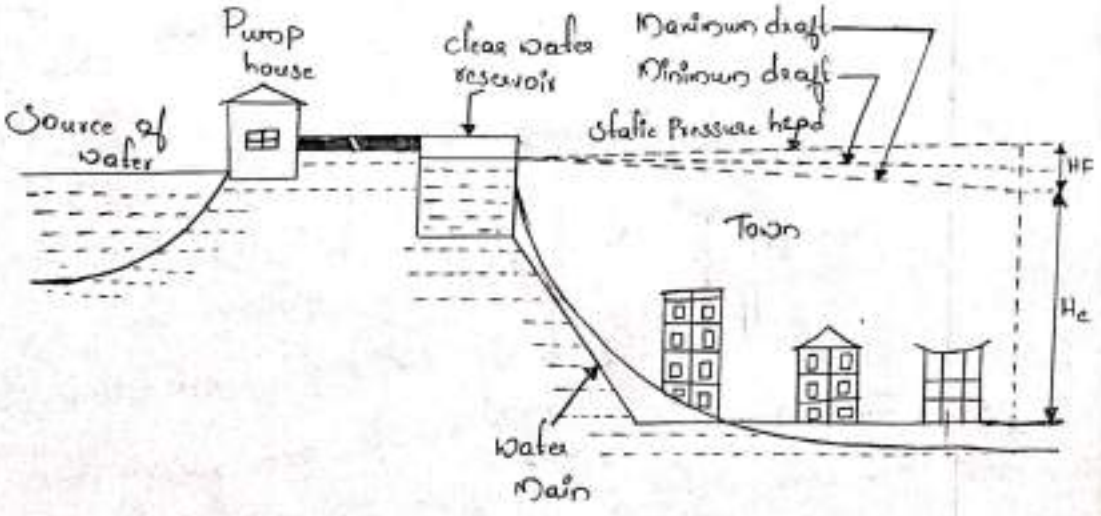
→ In case of fire accidents large quantities of water can be drawn

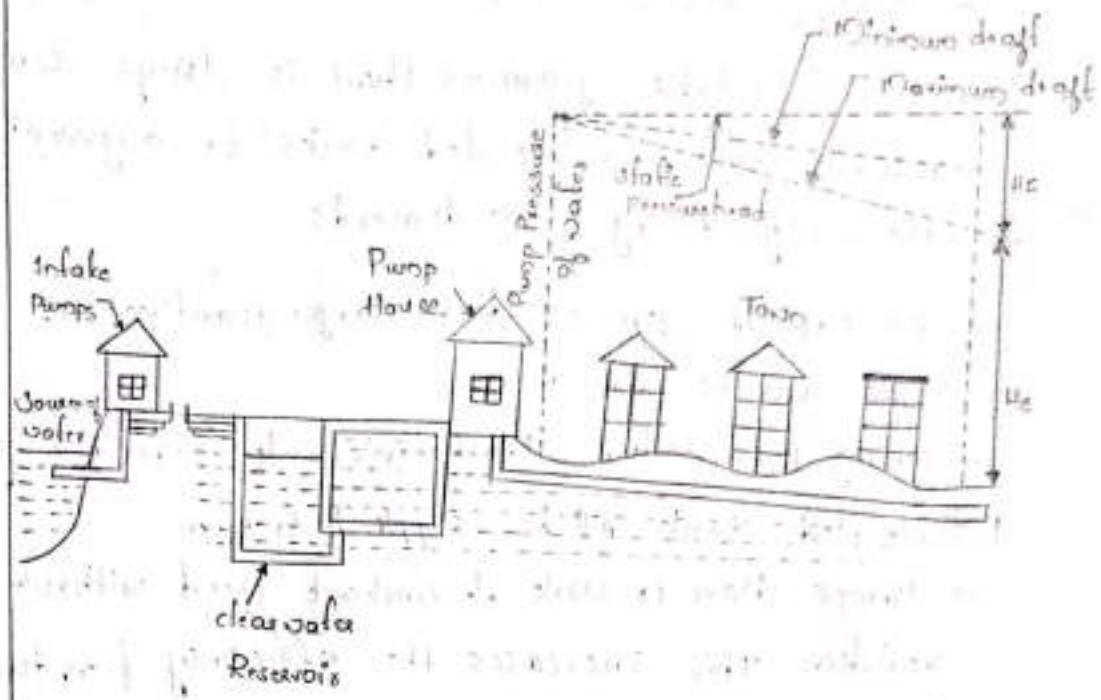
→ During power failure, the balance water stored in the elevated tank will be supplied to town

→ Pumps have to work at constant speed without any variation. This increases the efficiency & reduces the wear & tear of the pumps.

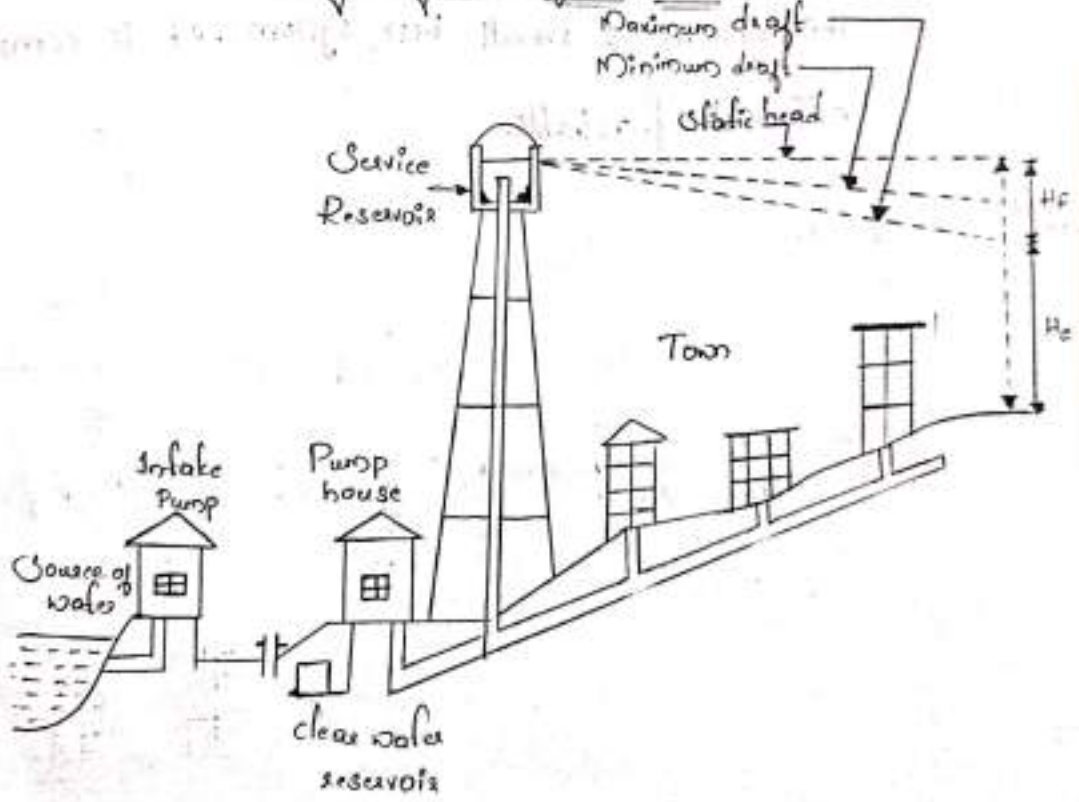
→ This system is overall best system. It is economical, efficient & reliable

DISTRIBUTION SYSTEM





Pumping System of Distribution



Dual System of Distribution

* Layout of Distribution systems:

→ There are four principal methods of laying out distribution system, they are

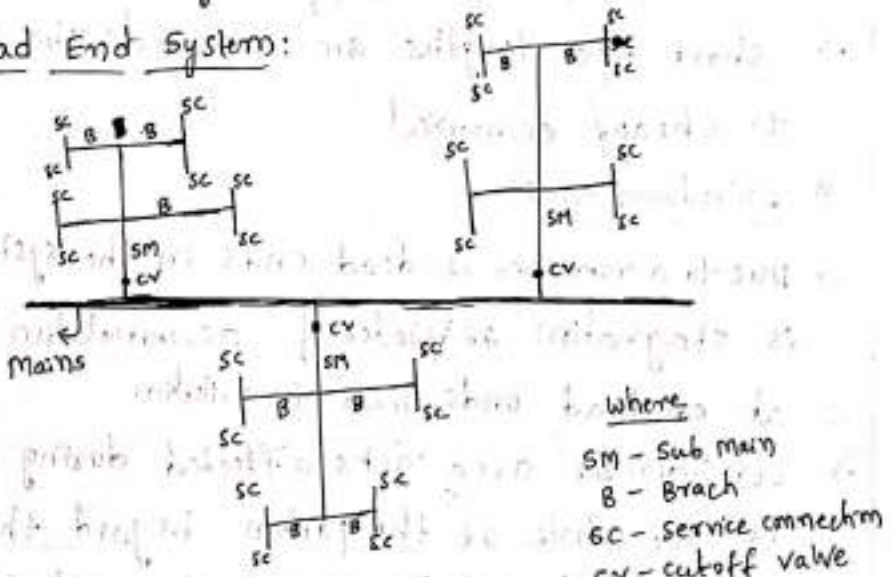
(i) Dead End System (or) Tree-System

(ii) Grid Iron system, or Reticulation system (or) Interlaced system

(iii) Circular system or Ring system

(iv) Radial system.

(i) Dead End System:



Where,
SM - Sub main
B - Brach
SC - service connection
CV - cutoff valve

Fig 1: Dead End System

⇒ A supply main starting from the service reservoir is laid along the main road.

→ The sub mains are connected to the main in both the directions along the other roads

→ Sub mains are divided into branch lines

→ service connections are taken from these branches to the individual houses.

Suitability: For old towns & cities with irregular & unplanned development this method is best suitable.

* Advantages:

→ The design calculations are simple & easy
→ It is possible to determine the discharge & pressure in each pipe very accurately
→ Less number of cutoff valves required
→ Easier expansions of pipe lines
→ short pipe lengths are required. This leads to cheap & economical

* Disadvantages:

→ Due to a number of dead ends in the system, there is stagnation of water & accumulation of sediment at dead ends leads to pollution
→ considerable area gets affected during repairs i.e the whole of the portion beyond that point to the end will be required to be cutoff completely
→ This system is less successful in maintaining satisfactory pressure in the remote parts.
→ Water rate of supply cannot be increased in case of fire breakouts.

(iii) Grid Iron system:

→ If the dead ends of the Dead end system are interconnected, water can be made to circulate continuously through the whole of the distribution system. this system is therefore also known as the "Interlaced system"

→ Mains, submains & branches are interconnected with each other.

→ Main line runs through the centre of area.

Suitability: This system is ideal for cities laid out on rectangular plan resembling a grid-iron.

→ Suitable for well planned cities

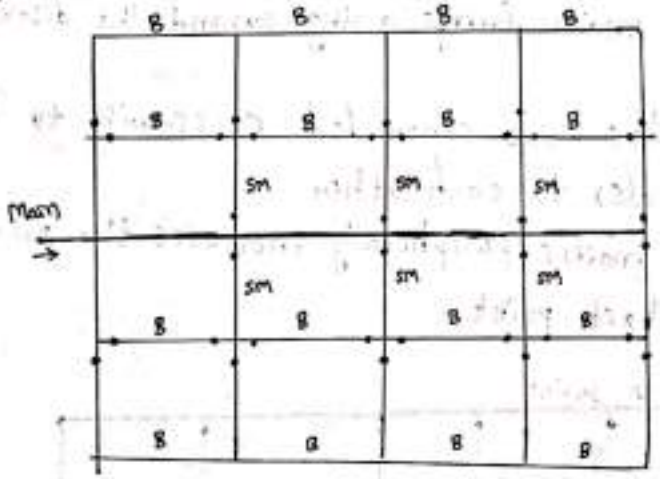


Fig: Grid-Iron system

* Advantages:

→ There is free circulation of water, without any stagnation or sediment deposit. The chances of pollution due to stagnation are not there

→ Since water reaches from different directions, sizes of pipes gets reduced

→ Very small area gets affected in case of repairs
→ More water can be diverted in case of fire break down.

* Dis-advantages:
→ The large number of cutoff values are required
→ The system require longer pipe lengths
→ The analysis of discharge, pressure & velocities in the pipes is difficult
→ The cost of laying water pipes is more.

(iii) Circular (or) Ring system:
→ Main pipe is laid peripherally
→ The supply main forms a ring around the distribution district
→ The branches are connected cross-wise to the mains & also to each other
→ Laying of mains peripherally increases the pressure at farthest point

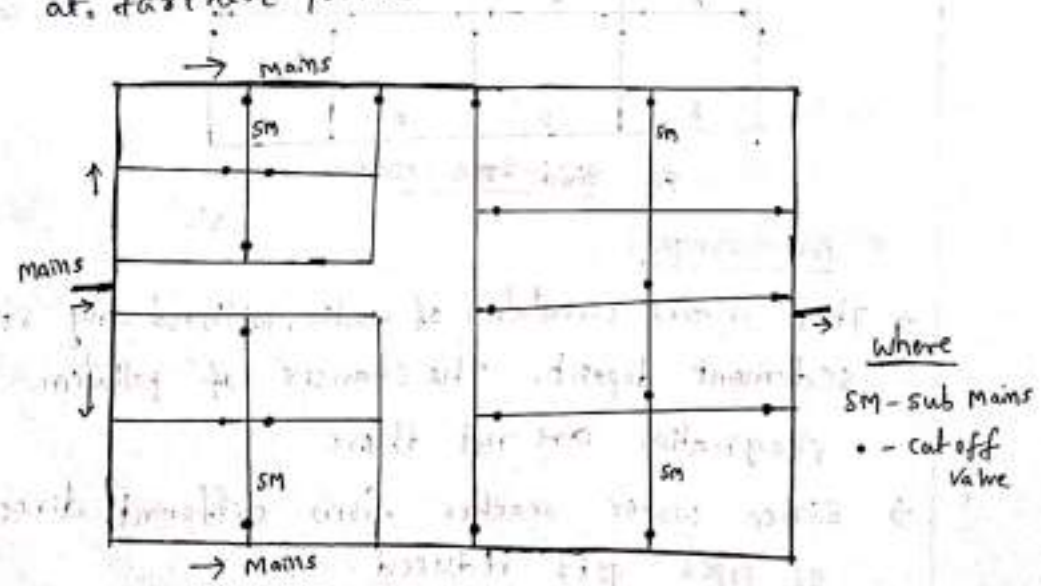


Fig: Ring system

* Suitability: Suitable for towns & cities having well planned roads

→ Advantages & disadvantages are same as Grid Iron system.

(iv) Radial system:

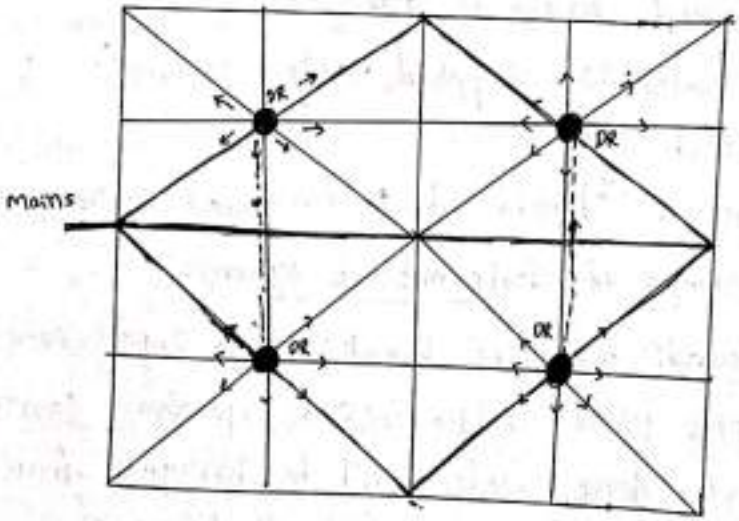
→ This system is just the reverse of the circular system.

→ The area is divided into small distribution zones and in the center of each zone a distribution reservoir is provided

→ Water from these reservoirs is supplied through radially laid distribution pipes running towards the periphery of the zone.

⇒ This method ensures high pressure & efficient water distribution

* Suitability: Suitable for cities with radial roads.



Where

DR → Distribution Reservoir

* Systems of water supply:

→ Water may be supplied to the consumers by the following two systems

(i) Continuous System

(ii) Intermittent System

(i) Continuous System: In the continuous system, water is available to the consumers for all the 24 hour of a day.

→ No doubt, this is the best system since water is available as & when it is needed, but this leads to wasteful use of water.

→ This system is possible when there is adequate quantity of water for supply.

→ In this system water is available for fire-fighting purpose.

(ii) Intermittent system:

→ If plenty of water is not available, the supply of water is divided into zones & each zone is supplied with water for the fixed hours in a day.

→ As the water is supplied after intervals, it is called intermittent system.

→ This system should not be continued on long term policy.

* Dis-advantages of Intermittent system:

(i) Fire demand: If fire breaks in a supply zone during non-supply period, the rescue operation cannot be effectively done. water can't be brought from other zones quickly & fire damage will be more.

(ii) Domestic Storage: It requires provision of small storage tanks in individual houses so that sanitary fitting in the house can work effectively during periods of no supply

(iii) Pollution in supply: During a non-supply period, the pressure in the supply line may fall below atmospheric pressure. This may induce suction through leaking joints. When the pipe line laid near the sewers etc. this may lead to severe pollution & contamination problems

(iv) Size of pipes: Greater sizes of pipe will be required since the supply of whole day has to be made in a shorter period

(v) Wastage from taps: During the non-supply period, the water taps may be left open unknowingly or due to negligence This leads to waste of water

→ Large number of valves required in maintaining this system.

* Pressure in Distribution system:

→ Adequate pressure should be available in distribution mains at all points located even at the remotest spots.

→ The desired pressure depends on following

(i) The height to which water is required to be supplied

(ii) Fire fighting requirements

(iii) Whether the supply is metered or not

(iv) Availability of funds

⇒ The following pressures are considered satisfactory

→ the manual on water supply & treatment prepared by Ministry of Urban Development, gives the following recommendations for minimum residual pressure at ferrule points

→ Single story building – 7m

→ Two story building – 12m

→ Three story building – 17m

⇒ Distribution system should not ordinarily be designed for residual pressure exceeding 22 meters.

⇒ Multistory buildings needing higher pressure should be provided with boosters.

⇒ For multistory structures the following pressure are considered satisfactory

upto 3 storeys : 2 kg/cm²

from 3 to 6 storeys : 2 to 4 kg/cm²

from 6 to 10 storeys : 4 to 5.5 kg/cm²

Above 10 storeys : 5.5 to 7 kg/cm²

* Minimum pipe sizes:

→ The manual recommends the following minimum pipe sizes

Towns with population upto 50,000 – 100mm dia

Towns with population above 50,000 – 150 mm dia

⇒ The minimum velocity in pipe line should not be less than 0.6 m/sec & maximum velocity should not be more than 3 m/sec for best results the velocities in different pipes should be as follows.

Diameter of pipe		Velocity
10 cm	–	0.9 m/sec
15 cm	–	1.2 m/sec
25 cm	–	1.5 m/sec
40 cm	–	1.8 m/sec

* Storage & Distribution Reservoirs:

→ Distribution reservoirs are also known as service reservoirs and are mainly provided for storing the treated water for supplying water to town (or) city.

→ These are used in a distribution system to meet fluctuations in demand of water, to provide storage for fire fighting & emergencies such as breakdowns, repairs etc & to stabilize pressure in the distribution system

⇒ Following are the main functions of storage & Distribution reservoirs

→ To store the treated water till it is distributed to the city.

→ They absorb the hourly variations in demand

→ If pumps are used, the provision of reservoirs makes it possible to run pumps at uniform rate

→ Distribution reservoirs lead to an overall economy by reducing the sizes of pumps, pipe lines & treatment units

→ They serve as storage for emergencies such as out break of fire, failure of pumps (or) bursting of mains

→ They maintain the desired pressure in the main constantly

→ operation of distribution system becomes very easy

* Types of storage & Distribution Reservoirs

⇒ According to the situation with respect to ground the distribution reservoirs are classified in the following three types

1. Surface reservoirs
2. Elevated reservoirs
3. Stand pipes

1) Surface Reservoirs: constructed at ground level (or) below ground level

→ surface reservoirs are made mostly of masonry (or) concrete

→ surface reservoirs should be located at high points in the distribution system

2. Elevated Reservoirs: constructed at an elevation from ground level. These are also called as over head tanks.

→ they may be constructed by stone masonry, RCC (or) steel

→ These may be of rectangular, circular, conical (or) elliptical shapes

3. Stand pipes: They boost the pressure

→ A stand pipe is a vertical cylindrical tank resting just above the ground

* Storage capacity of Distribution Reservoir:

⇒ The storage capacity of a distribution reservoir to be provided is based on the following requirements

(i) Balancing storage (or) Equalizing storage (or) Operating storage

(ii) Breakdown storage (or) Emergency storage

(iii) Fire storage

Total capacity of Distribution Reservoir = Balancing storage + Breakdown storage + Fire storage

(i) Balancing Storage:

→ The quantity of water required to be stored in the reservoir for balancing (or) equalizing the variable demand of water against the constant rate of pumping is known as balancing storage.

⇒ The balancing storage of distribution reservoir can be determined by the following two methods

(a) Hydrograph Method

(b) Mass curve Method

(a) Hydrograph Method

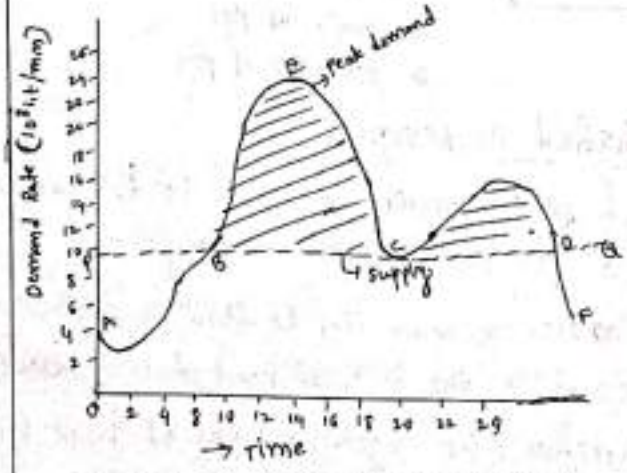
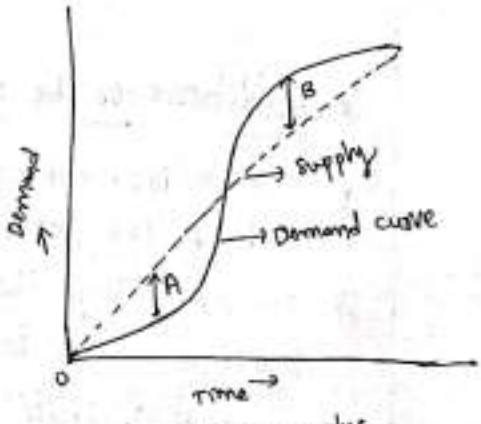


Fig. Hydrograph for determining storage required for distribution Reservoir

(b) Mass curve Method



A → surplus
B → deficit

Total Storage = A+B

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(iii) Breakdown storage: It is the storage required to be provided in a distribution reservoir to care of emergencies which may arise due to failure of pumps, failure of electric supply etc.

→ For this storage a lump sum provision of about 25% of the total storage capacity of distribution reservoir is provided

(iv) Fire storage: A provision of fire storage in a distribution reservoir is required to be made to provide water for fire fighting purposes

→ 1 to 4 lit/day/capita for normal Indian conditions for fire reserve

⇒ the total quantity of water required for fire demand can be calculated from formulas given in unit 1? (We already seen)

* Design of Distribution System:

→ For head loss calculation, Hazen – Williams formula is more commonly used.

⇒ Head loss by Hazen-Williams formula

$$h_f = \frac{10.68\, L\, Q^{1.852}}{C_H^{1.852}\, D^{4.87}}$$

where
C_H ⇒ roughness coefficient
Q = discharge
L = Length of pipe
D = Diameter of pipe

* conditions to be Satisfied in Design:

1. The inflow into each junction must be equal to the flow out of the junction, as per principle of continuity.
2. In each loop, the loss of head due to flow in clockwise direction must be equal to the loss of head due to flow in anticlockwise direction [i.e algebraic sum of head loss in each closed loop must be zero]

* Methods for Analysis of pipe Networks:

⇒ The following methods are used for analysis of pressure in distribution system

1. Hardy-cross Method
2. Equivalent pipe method
3. Electrical Analogy method
4. Method of sections & circle Method
5. Graphical Method

1 Hard-cross Method:

→ It is a method of successive approximations which involves a trial & error process.

→ Hardy cross method may be carried out in the following two ways

(a) Balaring heads by correcting assumed flows &

(b) Balancing flows by correcting assumed heads

⇒ The head loss in each pipe is determined by pipe flow formula

⇒ The successive corrections are made in the flows in each pipe until the heads are balanced & the principle of continuity is satisfied at each junction.

⇒ In this method following three laws are applicable

(i) In each separate pipe or element comprising the system, there will be a relation between the head loss in the element & the quantity of water flowing through it.

(ii) At each junction, the algebraic sum of the quantities of water entering & leaving the junction is zero

$$\text{ie } \Sigma Q = 0$$

(iii) In any closed path (or) circuit, the algebraic sum of the head loss in the individual elements is zero

$$\boxed{\text{i.e } \Sigma H = 0}$$

⇒ Now if Q_a be the assumed flow in a pipe & Q be the actual flow in that pipe, then correction will be given by the relation

$$\boxed{\Delta = Q - Q_a}$$

$$\boxed{Q = Q_a + \Delta} \longrightarrow \text{equation (1)}$$

⇒ If the head loss in the pipe under reference is H_L, it can be determined by the formula

$$\boxed{H_L \propto Q^x}$$

In order to remove proportionality we use constant 'k'

$$\boxed{H_L = k Q^x} \longrightarrow \text{equation (2)}$$

Where 'k' is a constant depending upon the size of the pipe & its internal condition

from equation (1) we know that

$$\boxed{Q = Q_a + \Delta}$$

substitute equation (1) in equation (2)

i.e $H_L = k Q^x$

$$\boxed{H_L = k (Q_a + \Delta)^x}$$

it is similar to $(a+b)^n$ form after expanding equation we get

$$H_L = K\left(Q_a^n + x Q_a^{n-1}\Delta\right)$$

⇒ Δ is very small for all pipes of network, so neglecting terms containing higher power of Δ. Finally we get

$$H_L = K Q_a^n + x Q_a^{n-1}\Delta$$

⇒ In the closed network of a pipe line, the total loss of head must be zero i.e $\Sigma H_L = 0$

$$\therefore \Sigma K\left(Q_a^n + x Q_a^{n-1}\cdot\Delta\right) = 0$$

or $$\Sigma\left(K Q_a^n\right) = -\Sigma\left(K Q_a^{n-1}\cdot x\cdot\Delta\right)$$

But the value of Δ is very small for all the pipes of the network under consideration, it can be taken out of summation, therefore

$$\Sigma\left(K Q_a^n\right) = -\Delta\Sigma\left(K Q_a^{n-1}\cdot x\right)$$

$$\Delta = -\frac{\Sigma\left(K Q_a^n\right)}{x\,\Sigma\left(K Q_a^{n-1}\cdot x\right)}$$

$$\Delta = -\frac{\Sigma\left(K\cdot Q_a^n\right)}{x\,\Sigma\left(K Q_a^2\cdot Q_a^{-1}\right)} = -\frac{\Sigma\left(K Q_a^n\right)}{x\,\Sigma\left[K\frac{Q_a^n}{Q_a}\right]} \rightarrow \text{equation (3)}$$

From equation (2) $H_L = K Q_a^n$, we get that $h_L = K Q_a^n$

$$\Delta = -\frac{\Sigma H_L}{x\,\Sigma\left(h_L/Q_a\right)} \rightarrow \text{equation (4)}$$

⇒ In the equation (4) the numerator is obtained by the algebraic sum of the head losses in the various pipes of the closed loop.

Note:

1. Clock wise flows & their corresponding head losses are taken as positive (+ve).
2. Anti clock wise flows & their corresponding head losses are taken as negative (-ve).

⇒ The value of 'x' is taken 1.85 [as per Hazen Williams formula] in this method known as "Hardy cross method".

⇒ The minor losses are usually neglected, although they can be calculated by substituting an equivalent length pipe.

⇒ In case of network of pipes having many loops, the system must be divided into two (or) more loops, such that each pipe in the network included in the circuit of one loop

2. Equivalent pipe Method:

⇒ This method is sometimes used as an aid in solving large networks of pipes, in which it becomes convenient to, first all, replace the different small loops by single equivalent pipes having the same head loss.

⇒ In this method, a complex system of pipes is replaced by a single hydraulically equivalent pipe.

⇒ The equivalent pipe is one which will replace a given system of pipes with equal head loss for a given flow.

⇒ In this method, pipe circuit can be reduced into a single equivalent pipe of using the following two principles of hydraulics

(i) The loss of head caused by a given flow of water through the pipes connected in series, is additive

(ii) The quantity of discharge flowing through the different pipes connected in parallel will be such as to cause equal head loss through each pipe

(or) simply we can write

⇒ the entire network of pipe is considered to be split up into two portions viz.

(i) Pipes in series &
(ii) pipes in parallel

* Appurtenances in Distribution system:

1. Valves
2. Manholes
3. Fire hydrants
4. Water Meters

1. Valves:

⇒ Valves are provided in the pipelines to control the flow of water, to isolate & drain sections for test, inspection, cleaning & repairs, to regulate pressures & to release (or) admit air.

⇒ The types of valves commonly used are

(i) Sluice valve (or) Gate valves

(ii) Butterfly valves

(iii) Globe valve

(iv) Check valve (or) Reflux valve (or) Non-return valve

(v) Air valve (or) Air-relief valve

(vi) Scour valves (or) Blow-off valves (or) Drain valve

(vii) Pressure Relief valves

(i) Sluice valve (or) Gate valve:

⇒ These valves are used to regulate the flow of water through the pipelines.

⇒ These are most commonly used valves in water works

⇒ These valves are cheaper, offer less resistance to the flow of water than other valves, used for same purpose

⇒ This is connected to a nut (or) wheel above by means of a thread spindle passing through a gland & stuffing box arrangement.

⇒ When wheel is rotated the spindle rises up, raising the disc along with it.

⇒ The opening in the valve thus get uncovered & water from one section of the pipe line passes into another

⇒ The valve is can be closed by rotating the spindle in another direction

(ii) Butterfly valves: These are used to regulate & stop the flow especially in large size conduits

(iii) Globe Valve: These are used to regulate flow through pipe lines. These valves are normally used in pipes of small diameter [less than 100 mm] & as water taps

(iv) Check valve or Reflux valve or Non-returning valve:

⇒ check valve also known as Reflex valve or non-returning valve.

⇒ A check valve allows water to flow in one direction only and the flow in reverse direction is automatically stopped by it.

⇒ this valve consist of a metallic disc hinged from the crown which fits tightly against the annular valve seat

⇒ when, water flows disc rotates round the hinge & remains in horizontal plane. thus water flows.

⇒ Now if the flow reverse, the disc automatically falls down by rotating round & remain tightly pressed against the valve seat by pressure of water it self

⇒ The reflux valve is invariably placed in a pumping main so that if the pump fails or stops, water is prevented from flowing back to the pump & thus pumping equipment is saved from possible damage

(v) Air valve (or) Air-relief valves:

→ When water enters in pipe lines, it also carries some air with it which tends to accumulate at high points of the pipe.

⇒ When the quantity of air increases, it causes serious blockage to the flow of water. Therefore it is most essential to remove the accumulated air from the pipe line.

→ The air valve helps to admit air into the pipe when the pipe being emptied or when negative or vaccum pressure is created in the pipe. Air valve operates automatically while allowing air to escape from or to enter a pipe.

⇒ the air valves are usually located at summits & also at changes in grade to steeper slopes

(vi) Scour valve (or) Blow-off valves or Drain valves:

→ In the summits of mains, it is possible that some suspended impurities may settle down & cause obstruction to the flow of water.

⇒ If water not taken out it will stagnate & bacteria will be born it.

⇒ Scour valves are provided for completely emptying or draining of the pipe for removing sand or silt deposited in the pipe & for inspection, repair etc located at dead ends & depressions or low points in the pipe line.

(vii) Pressure-Relief valve:

⇒ These valves relieve high pressure in pipe lines.

⇒ These are provided to keep the pressure in a pipeline below a predetermined value & thus protect it against the possible danger of bursting due to excessive pressure.

⇒ these valves are often placed at low points where the pressure is high

⇒ Further a pressure relief valve is usually provided on the upstream side of a sluic valve so that the pipe lying on the upstream side of the valve is relieved of water hammer pressure resulting from the sudden closure of the sluice valve

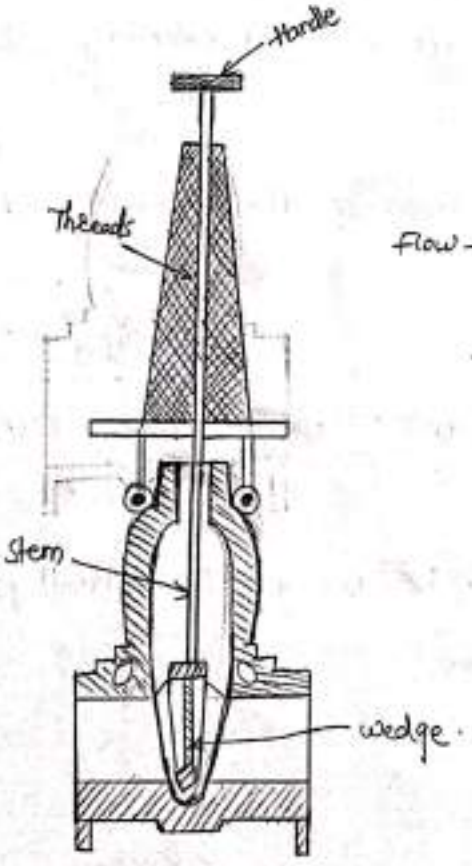

fig: Sluice valve

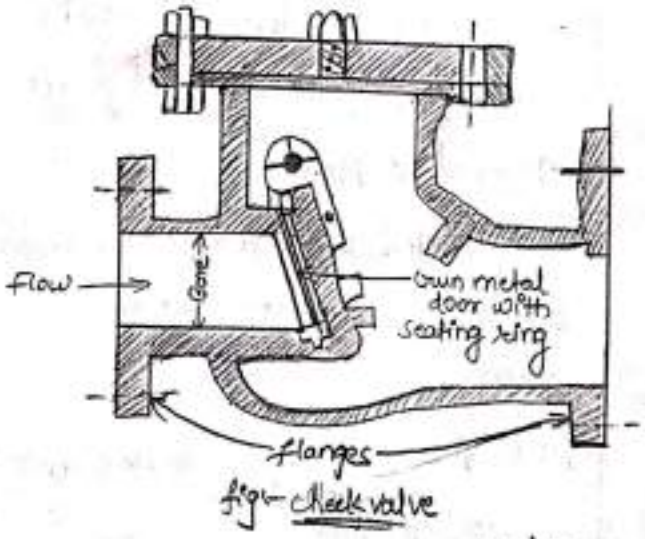

fig- Check valve

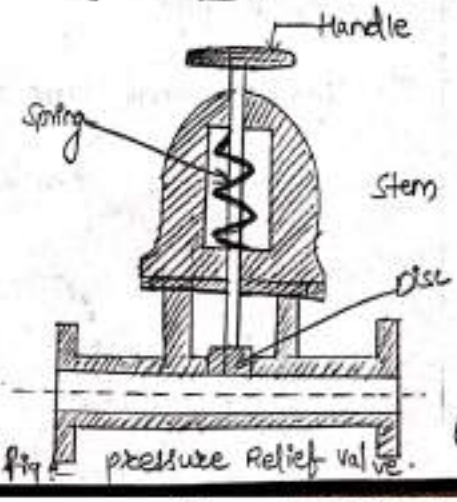

fig: pressure Relief valve.

2. Manholes:

→ Manholes provided at suitable intervals along the pipeline for inspection & repairs

⇒ Usually spaced 300 to 600m apart on large pipelines

⇒ Their most useful positions are at summits & down stream of main valves

3. Fire hydrants:

→ Hydrant is an outlet provided in a pipeline for tapping water mainly for the purpose of fire fighting.

→ Also used for withdrawing water for certain other purposes such as a sprinkling on roads, Flushing streets etc

→ Generally fire hydrants are placed at all important road junctions & at intervals not exceeding 300m.

④ Water Meters:

→ Installed in pipelines to measure the quantity of water flowing through them

Types:

(i) Inferential type meters (or) velocity meters: used for large pipes

(ii) Displacement type meters: used for small pipe & domestic connections

* Advantages of Water meters:

→ The wastage of water is reduced, giving financial saving to all

→ The consumers have to pay only for the quantity of water they use actually

→ Waste water survey can be done easily

→ Careless consumers are penalized & careful one gets benefit

→ The loads on treatment plants are reduced.

* Dis-advantages of Water Meters:

→ The installation & maintenance of meters is costly.

→ consumers use less quantity of water, which causes insanitary conditions

→ If meters become defective, the consumers (or corporation may be in loss for the time, the defects are not removed

→ When meters does not show any consumption, the stand-by charges will be some what injustice.

→ Meters cause loss of head, thuse decrease the available head & increase the cost of pumping

→ consumers stop gardening, which affects economy & appearance of the community.

* Laying of pipe lines:

→ Pipes are generally laid below the ground level, but sometimes when they pass in open areas, they may be laid over the ground

→ First of all detailed map showing all roads, streets, lanes etc. is prepared. Pipe length & sizes are marked. The position of existing pipe lines, sewer lines etc will also be marked on it

⇒ In addition to this position of valves & other pipe specials, stand spots etc. will also be made so that at the time of laying there should be no difficulty in this connection.

⇒ centre line of pipe line will be transferred on the ground from the detailed plan

⇒ When centre line has been marked on the ground the excavation of the trenches will be started. The width of the trench will be 30 cm to 45 cm more than the external diameter of pipe.

⇒ Pipe line should be laid more than 90 cm below the ground so that pipe may not break due to impact of loads.

⇒ pipe laying should be done ▶ Lower level to higher level

⇒ After laying pipes in position, they are tested for water leakage & pressure.

⇒ When the pipe line is tested, the back filling of the excavated material will be done.

* Testing of pipe lines:

⇒ After laying the new pipe line, jointing & back filling, it is subjected to the following tests.

(i) Pressure Test

(ii) Leakage Test

(i) Pressure Test:

→ Pressure test at a pressure of at least double the maximum working pressure, pipe & joints shall be absolutely water-tight under the test

(ii) Leakage Test:

→ this test to be conducted after the satisfactory completion of the pressure test

⇒ Leakage is defined as the quantity of water to be supplied into the newly laid pipe or any valved section there of necessary to maintain the specified leakage test pressure after the pipe has been filled with water & the air expelled

⇒ No pipe line is found to be satisfactory, until the leakage is less than the 'Q' value determined by following formula

$$Q = ND\frac{\sqrt{P}}{3.3}$$

Where Q = allowable leakage in cm^3/hr.

N = No of joints in the length of pipe line

D = Diameter of pipe line in mm

P = avg test pressure during leakage test in kg/cm²

* Location of leaks:

⇒ For locating leaks in water supply pipes following method may be used

(i) By direct observation
(ii) By using sounding rods
(iii) By Hydraulic gradient line
(iv) By using Wast-detecting meters [Deacon's meter]

ii) Sounding rods: This rod detects leaky pipe by emitting sound of leak.

⇒ A metal rod is inserted into the ground at the suspected portion, if there is a leak in the pipe the sound of the water escaping through the leak can be heared by placing the ear against the rod or by means of amplifying device such as aqua-phone or sono scope

(iii) By Hydraulic Gradient line:

→ This method is used in locating the correct position of leak. First hydraulic lines are drawn & these lines intersect at the place of leak.

(iv) By Waste water meters:

→ Generally Deacons waste water meter used for this purpose
→ It consists of a disc held in balance by a counter weight and when water passes, it is forced down
→ The movement of disc are directly transferred by a system of levers to a pencil point, which moves on a graph paper mounted on drum.
→ The drum rotates continuously clockwise direction.
→ Thus rate of flow of water is automatically recorded on graph paper.

* Pipe-Joints:

→ For the facilities in handling transportation & placing in position, pipes are manufactured in small lengths of 2 to 6m. these are small pieces of pipes are then joined together after placing in position, to make one continuous length of pipe line.

⇒ The design of these joints mainly depends on the condition of the pipe, internal water pressure & the condition of the support.

⇒ Various types of joints which are mostly used are, as follows

(i) Spigot & Socket joint
(ii) Expansion joint
(iii) Flanged joint
(iv) Mechanical joint
(v) Flexible joint
(vi) Screwed & Soket joint
(vii) Butt end joint
(viii) simplex joint
(ix) Collar joint

* Types of pipes:

⇒ Water is conveyed from source to treatment plant & treatment plant to consumer employing pressure conduits.

- These pressure conduits are circular pipes, which transport water under pressure.

⇒ pipes may be made of

1. Cast iron
2. Wrought iron
3. steel
4. Galvanised iron
5. cement concrete

Type of pipe	Type of joint
1. Cast Iron pipes (CI pipes)	1. Socket & spigot joint 2. Flanged joint 3. Expansion joint 4. Pressed coupling
2. Galvanised Iron (GI) pipe & Wrought Iron (WI) pipe	1. Screwed & socket joint
3. Steel pipes	1. Pressed couplings
4. Cement concrete pipes	1. Socket & spigot joint 2. Butt-end joint
5. Asbestos cement pipes	1. Simplex joint [using sleeve of Asbestos cement]
6. Hume steel pipes [Steel pipes coated inside & outside with cement mortar]	1. Collars joint