

₹ 500.00 BU

WATER SUPPLY SANITARY ENGINEERING

[INCLUDING ENVIRONMENTAL ENGINEERING]



Rangwala

Edition : 30th Edition 2022 ISBN : 9789385039546 **Binding** : Paperback

: 784 + 16 = 800 **Pages** : 235 × 33 × 170 Size (mm)

Weight : 960 g





ABOUT THE BOOK

The entire subject of Water Supply and Sanitary Engineering including Environmental Engineering also known as Public Health Engineering is divided in to three parts:

- (1) Water Supply Engineering
- (2) Sanitary Engineering
- (3) Environmental Engineering.

The *first part* deals with the fundamentals of Water Supply Engineering. It discusses the whole science of water supply engineering relating to the quantity and quality of water, sources of water supply, pumps for water supply projects, treatment of water, coagulation of water, filtration of water, disinfection of water, water softening, collection and conveyance of water, distribution system of water, pipe appurtenances, water pollution control, water management, radioactivity and water supplies, etc.

The **second part** of the book deals with the fundamentals of Sanitary Engineering. It discusses the topics such as collection and conveyance of refuse, waste water, quantity and quality of sewage, construction and design of sewers, sewer appurtenances, sewage pumps, house drainage, natural methods of sewage disposal, primary treatment of sewage, filtration of sewage (secondary treatment), activated sludge process, sludge treatment and disposal, miscellaneous methods of sewage treatment, miscellaneous topics of sanitary engineering, etc.

The third part deals with the fundamentals of Environmental Engineering. It discusses the topics such as environment, ecology and ecosystem, air pollution, noise pollution, natural resources and population, miscellaneous topics of environmental engineering and environmental legislation.

The Appendix A demonstrates the Typical Design of a Sewage Treatment Plant and Appendix B describes some of the Terminology of the subject.

The book in its 40 chapters and two appendices includes:

- * 278 Self explanatory and neat diagrams
- * 152 Illustrative problems
- * 68 Useful tables
- * 690 Questions at the end of chapters.

The book should prove to be extremely useful to the Civil Engineering and also Environmental Engineering students preparing for the Degree Examinations of all the Indian Universities, Diploma Examinations conducted by various Boards of Technical Education, Certificate Courses as well as for the A.M.I.E., U.P.S.C., G.A.T.E., I.E.S. and other similar competitive and professional examinations. It should also prove of interest to the practising professionals.

CONTENT

PART I: WATER SUPPLY ENGINEERING

- 1: INTRODUCTION
- 2: QUANTITY OF WATER
- 3: SOURCES OF WATER SUPPLY
- 4: PUMPS FOR WATER SUPPLY PROJECT
- 5: QUALITY OF WATER
- 6: TREATMENT OF WATER (SCREENS. PRE-SEDIMENTATION AND SEDIMENTATION TANKS)
- **COAGULATION OF WATER**
- 8: FILTRATION OF WATER
- 9: DISINFECTION OF WATER
- 10: WATER SOFTENING
- 11: MISCELLANEOUS METHODS OF WATER TREATMENT
- COLLECTION AND CONVEYANCE OF WATER
- 13: DISTRIBUTION SYSTEM OF WATER
- 14: PIPE APPURTENANCES
- 15: WATER POLLUTION CONTROL AND WATER MANAGEMENT
- 16: RADIOACTIVITY AND WATER SUPPLIES

PART II: SANITARY ENGINEERING

- 17: SANITARY ENGINEERING AN INTRODUCTION
- 18: COLLECTION AND CONVEYANCE OF REFUSE (WASTE WATER)
- WASTE WATER
- 20: QUANTITY OF SEWAGE
- 21: CONSTRUCTION OF SEWERS
- 22: DESIGN OF SEWERS
- 23: SEWER APPURTENANCES
- 24: SEWAGE PUMPS
- 25: HOUSE DRAINAGE
- 26: QUALITY OF SEWAGE
- 27: NATURAL METHODS OF SEWAGE DISPOSAL
- 28: PRIMARY TREATMENT OF SEWAGE
- 29: FILTRATION OF SEWAGE (SECONDARY TREATMENT)
- 30: ACTIVATED SLUDGE PRÒCESS
- 31: SLUDGE TREATMENT AND DISPOSAL
- 32: MISCELLANEOUS METHODS OF SEWAGE TREATMENT
- 33: MISCELLANEOUS TOPICS OF SANITARY ENGINEERING

PART III: ENVIRONMENTAL ENGINEERING

- 34: ENVIRONMENTAL
- 35: ECOLOGY AND ECOSYSTEM
- 36: AIR POLLUTION
- 37: NOISE POLLUTION
- 38: NATURAL RESOURCES AND POPULATION
- 39: MISCELLANEOUS TOPICS OF ENVIRONMENTAL **ENGINEERING**
- 40: ENVIRONMENTAL LEGISLATION

APPENDIX A: TYPICAL DESIGN OF SEWAGE

TREATMENT PLANT

APPENDIX B: TERMINOLOGY **BIBLIOGRAPHY**

Catalogue Checklist

Follow us:





INDEX



WATER SUPPLY AND SANITARY ENGINEERING **DETAILED CONTENTS**

PART I: WATER SUPPLY ENGINEERING

Chapter 1 INTRODUCTION

- General 1-1.
- 1-2. Need to protect water supplies
- 1-3 Water supply schemes
- 1-4 Project drawings
- 1-5 Report of water supply scheme/project
- 1-6. Importance of water supply project
- 1-7. Layout of water supply project **QUESTIONS 1**

Chapter 2 QUANTITY OF WATER

- 2-1. Data to be collected
- 2-2. Rate of demand
- 2-3. Factors affecting rate of demand
- 2-4. Measurement of water
- 2-5. Variations in rate of demand
- 2-6. Effects of variations on design
- 2-7. Water requirements for buildings other than residences
- 2-8. Design period
- 2-9. Summary **QUESTIONS 2**

Chapter 3 SOURCES OF WATER SUPPLY

- 3-1. General.
- Surface runoff 3-2.
- 3_3 Precipitation
- 3-4. Measurement of rainfall
- 3-5 Rainfall
- 3-6. Choice of source of water supply scheme
- 3-7 Types of sources for water supply schemes
- Surface sources for water supply schemes 3-8.
- 3-9. Salient features of reservoir design
- 3-10. Underground sources for water supply schemes
- 3-11. Forms of underground sources
- 3-12. Classification of wells
- 3-13. Types of well construction
- 3-14. Yield of a well
- 3-15. Specific capacity of a well
- 3-16. Tests for yield of a well
- 3-17. Spacing of wells
- 3-18. Sanitary protection of wells
- 3-19. Summary
- 3-20. Typical problems **QUESTIONS 3**

Chapter 4 PUMPS FOR WATER SUPPLY PROJECT

- Necessity of pumps 4-1.
- 4-2. Choice of type of pumps
- 4-3. Types of pumps
- 4-4. Power for pumps
- 4-5. Design of pumps
- 4-6. Rising main
- 4-7. Typical Problems **QUESTIONS 4**

Chapter 5 QUALITY OF WATER

- 5-1. Meaning of pure water
- 5-2. Reasons for the analysis of water
- 5-3. Impurities in water
- Analysis of water 5-4.
- 5-5. Physical tests
- 5-6. Chemical tests
- 5-7 Bacteriological tests
- Maintenance of purity of waters 5-8.
- 5-9. Water-borne diseases
- 5-10. Suitability of water for trade purposes:
- 5-11. Water for swimming pools
- 5-12. Drinking water standards **QUESTIONS 5**

Chapter 6 TREATMENT OF WATER (SCREENS, PRE-SEDIMENTATION AND SEDIMENTATION TANKS)

- 6-1. General
- 6-2. Screens
- 6-3. Pre-sedimentation
- Sedimentation tanks
- 6-4-1. Purpose and location
- 6-4-2. Theory of sedimentation
- 6-4-3. Types of sedimentation tanks
- 6-4-4. Design aspects of continuous **QUESTIONS 6**

Chapter 7 COAGULATION OF WATER

- 7-1. Purpose
- 7-2. Principle of coagulation
- 7-3. Flocculation
- 7-4. Usual coagulants
- 7-5. Feeding the coagulants
- 7-6. Mixing devices
- 7-7. Jar test
 - **QUESTIONS 7**

Chapter 8 FILTRATION OF WATER

- 8-1. General
- 8-2. Theory of filtration
- Filter sand 8-3.
- 8-4. Classification of filters
- 8-4-1. Slow sand filters
- 8-4-2. Gravity type rapid sand filters
- 8-4-3. Pressure type rapid sand filters
- Comparison between slow sand filters and gravity type rapid sand filters
- Double filtration **QUESTIONS 8**

Chapter 9 DISINFECTION OF WATER

- 9-1. Necessity for disinfection of water
- 9-2. Theory of disinfection
- 9-3. Minor methods of disinfection
- 9-4. Uses of ULTRA VIOLET-UV system
- 9-5. Chlorination
- 9-6. Properties of chlorine
- 9-7. Action of chlorine
- 9-8. Application of chlorine
- Forms of chlorination 9_9
- 9-10. Tests for chlorine 9-11. Chlorine dioxide
- **Questions 9**

Chapter 10 WATER SOFTENING

- 10-1. Purpose of water softening
- 10-2. Types of hardness
- 10-3. Removal of temporary hardness
- 10-4. Removal of permanent hardness
- 10-5. Lime-soda process
- 10-6. Zeolite process
- 10-7. Demineralisation process
- 10-8. Reverse osmosis **QUESTIONS 10**

Chapter 11 MISCELLANEOUS METHODS OF WATER TREATMENT

- 11-1. General
- 11-2. Colour, odour and taste removal
- 11-3. Iron and manganese removal
- 11-4. Fluoridation **QUESTIONS 11**

Chapter 12 COLLECTION AND CONVEYANCE OF WATER

- 12-1. Meaning
 - COLLECTION OF WATER
- 12-2. Intakes







Follow us:



WATER SUPPLY AND SANITARY ENGINEERING **DETAILED CONTENTS** 12-3. Design of intakes 17-5. Sanitary project drawings 12-4. Design procedure for intakes 17-6. Report for sanitary project 12-5. Types of intakes 17-7. Site for sewage treatment works 12-6. Intake towers 17-8.Design aspects for sewage treatment plant 298 CONVEYANCE OF WATER 17-9. Some definitions **OUESTIONS 17** 12-7. Conveyance of water 12-8. Pipes Chapter 18 COLLECTION AND CONVEYANCE OF REFUSE 12-9. Types of Pipes according to material used (WASTE WATER) 12-10. Pipe corrosion 18-1. General 12-11. Effects of pipe corrosion 18-2. Methods of carrying refuse 12-12. Theories of pipe corrosion 18-3. Systems of sewerage 12-13. Prevention of pipe corrosion 18-4. Favourable Conditions for sewerage 12-14. Laying of water supply pipes 18-5. Patterns of refuse collection 12-15. Hydrostatic testing of pipes **QUESTIONS 18 QUESTIONS 12 Chapter 19 WASTE WATER** Chapter 13 DISTRIBUTION SYSTEM OF WATER 19-1. General 13-1. General considerations 19-2. Standards for disposal of waste water 13-2. Methods of distribution of water 19-3. Waste water treatment 13-3. Service reservoirs 19-4. Primary waste water treatment 19-5. 13-4. Systems of supply of water Secondary waste water treatment 19-5-1. Biological treatment units 13-5. Methods of layout of distribution pipes 19-5-2. Secondary clarifier 13-6. Wastage of water 19-5-3. Sludge digester 13-7. Water waste surveys 19-5-4. Sludge drying beds 13-8. Permissible wastage of water 19-6. Oxidation ponds 13-9. Preventive measures 19-7. Tertiary waste water treatment 13-10. Water waste tests 19-8. Disposal of waste water 13-11. Maintenance of distribution system 19-9. Reuses of waste water **QUESTIONS 13 QUESTIONS** 19 **Chapter 14 PIPE APPURTENANCES Chapter 20 QUANTITY OF SEWAGE** 14-1. Necessity 20-1. General 14-2. Air valves 20-2. Dry weather flow 14-3. Bib cocks 20-3. Storm water 14-4. Fire hydrants **QUESTIONS 20** 14-5. Reflux valves **Chapter 21 CONSTRUCTION OF SEWERS** 14-6. Relief valves 21-1. General 14-7. Sluice valves 21-2. Materials for sewers 14-8. Scour valves 21-3. Materials used for sewers 14-9. Stop cocks Shapes of sewers 21-4. 14-10. Water meters 21-5. Joints in sewers QUESTIONS 14 21-6. Laying and testing of sewers Chapter 15 WATER POLLUTION CONTROL AND WATER 21-7. Ventilation of sewers MANAGEMENT 21-8. Methods of ventilation of sewers 15-1. Meaning of the term 21-9. Cleaning and maintenance of sewers 15-2. Sources of water pollution 21-10. Surface drains 15-3. Types of water pollution **QUESTIONS 21** 15-4. Preventive measures **Chapter 22 DESIGN OF SEWERS** 15-5. Conclusion 22-1. General approach 15-6. Water management 22-2. Minimum and maximum velocities (Self-cleansing and non-15-7. Measures for re-shaping local water balance scouring velocities) 15-8. Use and conservation of water resources 22-3. Hydraulic formulas for design of sewers **QUESTIONS 15** 22-4. Sizes of sewers 22-5. Chapter 16 RADIOACTIVITY AND WATER SUPPLIES Time of concentration 22-6. Design procedure 16-1. Radioactivity 22-7. Variation in flow and velocities 16-2. Effects of radiation Typical Problems of design of sewers 22-8. 16-3. Radioactive sources 16-4. Disposal of radioactive wastes **QUESTIONS 22 Chapter 23 SEWER APPURTENANCES** 16-5. Radioactivity of water 23-1. Meaning of the term 16-6. Measurement of radioactivity 23-2. 16-7. Effect of treatments on water Catch basins or catch pits 23-3. Clean-outs 16-8. Recommended methods 23-4. Drop manholes 16-9. Conclusion 23-5. Flushing tanks **QUESTIONS** 16 23-6. Grease and oil traps

PART II: SANITARY ENGINEERING

Chapter 17 SANITARY ENGINEERING - AN INTRODUCTION

- 17-1. General
- 17-2. Purpose of sanitation
- 17-3. Principles of sanitation
- 17-4. Sanitary projects



Inverted siphons

23-11. Storm water regulators

QUESTIONS 23

Lampholes

Inlets

23-10. Manholes

23-7.

23-8.

23-9.







WATER SUPPLY AND SANITARY ENGINEERING **DETAILED CONTENTS**

Chapter 24 SEWAGE PUMPS Chapter 30 ACTIVATED SLUDGE PROCESS Necessity of pumps 24-1. 30-1. Meaning of the term 24-2. Pumping of sewage 30-2. Action of activated sludge 24-3. Pumping stations 30-3. Flow diagram 24-4. Requirements of a pumping station 30-4. Methods of aeration 24-5. Types of sewage pumps 30-5. Diffused air aeration 24-6. Power for pumps 30-6. Mechanical aeration 24-7 Horse-power of pumps 30-7. Combination of diffused air aeration and mechanical aeration **QUESTIONS 24** 30-8. Sludge bulking **Chapter 25 HOUSE DRAINAGE** Accumulation of volatile suspended solids 30-9. 25-1. Meaning of the term 25-2. Principles of house drainage 30-10. Sludge volume index 25-3. Traps 30-11. Sludge density index Some definitions 25-4. 30-12. Step aeration 25-5. Sanitary fittings 30-13. Tapered aeration 25-6. Systems of plumbing 30-14. Extended aeration Drainage plans of buildings 25-7. 30-15. Contact stabilization 25-8. Testing of drains and pipes 30-16. Complete mix process 25-9. Maintenance of house drainage system 30-17. Oxidation ditch **QUESTIONS 25** 30-18. Advantages of activated sludge process **Chapter 26 QUALITY OF SEWAGE** 30-19. Disadvantages of activated sludge process General 26-1. Activated sludge process versus trickling filters 26-2. Properties of sewage **QUESTIONS 30** 26-2-1. Physical properties 26-2-2. Chemical properties Chapter 31 SLUDGE TREATMENT AND DISPOSAL 26-2-3. Biological properties 31-1. Necessity 26-3. Cycles of decomposition 31-2. Quantity of sludge 26-4. Analysis of sewage 31-3. Sludge treatment 26-5. Physical tests 31-3-1. Sludge thickening 26-6. Chemical tests 31-3-2. Sludge digestion 26-6-1. Chlorine 31-3-3. Sludge conditioning 26-6-2. Fats, greases and oils 26-6-3. Nitrogen 31-3-4. Sludge dewatering 26-6-4. Oxygen 31-3-5. Sludge disposal 26-6-5. pH value 31-4. Sludge gas 26-6-6. Total solids 31-5. Sludge digestion tanks 26-7. Bacteriological tests 31-6. Capacity of sludge digestion tank 26-8 Relative stability 31-7. Standard rate digestion 26-9. Population equivalent 31-8. High rate digestion **QUESTIONS 26** 31-9. Two-stage digestion Chapter 27 NATURAL METHODS OF SEWAGE DISPOSAL **QUESTIONS 31** 27-1. General 27-2. Disposal by dilution Chapter 32 MISCELLANEOUS METHODS OF SEWAGE 27-3. Self-purification of natural waters **TREATMENT** 27-4. Disposal by land treatment 32-1. General 27-5. Sewage sickness 32-2. Cesspools **QUESTIONS 27** 32-3. Chlorination of sewage **Chapter 28 PRIMARY TREATMENT OF SEWAGE** 32-4. Imhoff tanks General. 28-1. 32-5. Oxidation ponds 28-2. Screens 32-6. Septic tanks 28-3. Grit chambers 32-7. Treatment of industrial wastes 28-4.Detritus tanks 32-8. Wastes from fertiliser factories Skimming tanks 28-5. **QUESTIONS 32** 28-6. Plain sedimentation tanks 28-7. Primary clarifiers Chapter 33 MISCELLANEOUS TOPICS OF SANITARY 28 - 8.Secondary clarifiers **ENGINEERING** 28-9.Coagulation of sewage 33-1. General **QUESTIONS 28** 33-2. Bio-gas Chapter 29 FILTRATION OF SEWAGE (SECONDARY 33-3. Elutriation TREATMENT) 33-4. Garbage collection and removal 29-1. Secondary treatment 33-5. Garbage disposal 29-2. Filters 33-6. Micro-organisms 29-3. Contact beds 33-7. Types of metabolism 29-4. Intermittent sand filters 33-8. Divisions of micro-organisms 29-5. Trickling filters 33-9. Night soil disposal without water carriage 29-5-1. Standard rate trickling filters 33-10. Rural sanitation 29-5-2. High rate or high capacity trickling filters 33-11. Rotating biocontactor (RBC) 29-6. Miscellaneous filters **QUESTIONS 33 QUESTIONS 29**









WATER SUPPLY AND SANITARY ENGINEERING **DETAILED CONTENTS**

PART III: ENVIRONMENTAL ENGINEERING

Chapter 34 ENVIRONMENT

- 34-1. Definition
- 34-2. Components of environment
- 34-3. Man-environment relationship
- Impact of technology on the environment 34-4.
- Environmental degradation 34-5.
- 34-6. Principle of payment by polluter
- 34-7. Biological amplification
- 34-8. Environmental health hazard
- 34-9. Incipient lethal level
- 34-10. Monitoring programme
- World environment day (WED) 34-11.
- 34-12 environmental impact assessment (EIA)
- Sustainable development 34-13.
- 34-14. Environmental ethics
- 34-15. Code of ethics
- 34-16. Some terms **QUESTIONS 34**

Chapter 35 ECOLOGY AND ECOSYSTEM

- 35-1. Introduction
- 35-2. Ecosystem
- 35-3. Classification of ecosystem
- 35-3-1. Artificial ecosystems
- 35-3-2. Natural ecosystems
- 35-4.
- Aspects of ecosystem Components of ecosystem 35-5.
- Energy flow in ecosystem 35-6.
- 35-7. Food chains and food webs
- 35-8. Ecological or eltonian pyramid
- 35-9. Endangered species
- 35-10. Biogeochemical cycles
- 35-11. Acclimatization **QUESTIONS 35**

Chapter 36 AIR POLLUTION

- General 36-1.
- 36-2. Air pollution
- 36-3. Importance of air pollution
- 36-4. Composition of air
- 36-5 Necessity of ventilation
- 36-6. Quantity of air required
- 36-7. Aerosols
- 36-8. Smoke and fog
- 36-9 Dust, gas and vapour
- 36-10. Coning and fanning
- 36-11. Acid soot
- 36-12. Downwash
- 36-13. Green-house effect
- 36-14. Ozone layer
- 36-15. Consequences of green-house effect and ozone layer
- 36-16. Sources of air pollution
- 36-17. Air pollutants
- Urban air pollution 36-18.
- 36-19. Self-cleansing of atmosphere
- 36-20. Effects of air pollution
- 36-21. Acid rains
- Control of air pollution 36-22.
- 36-23. Some tragic incidences **QUESTIONS 36**

Chapter 37 NOISE POLLUTION

- 37-1. General
- 37-2. Effects of noise
- 37-3. Threshold of hearing
- 37-4. Measurement of sound
- 37-5. Acoustic reflex
- 37-6. Acceptable noise levels
- 37-7. Types of noises
- 37-8. Control of noise pollution
- 37-9. Air pollution and noise pollution
 - **QUESTIONS 36**

Chapter 38 NATURAL RESOURCES AND POPULATION

- Natural resources
- 38-2. Exploitation of natural resources
- 38-3. Major natural resources
- 38-3-1. Agricultural resources
- 38-3-2. Animal resources
- 38-3-3. Food resources
- 38-3-4. Forest resources
- 38-3-5. Land resources
- 38-3-6. Marine resources
- 38-3-7. Mineral resources
- 38-3-8. Soil resources
- 38-3-9. Wild life resources
- 38-3-10. Water resources
- 38-3-11. Energy resources
- 38-4. Renewable or non-conventional energy resources
- 38-4-1. Sun energy
- 38-4-2. Wind energy
- 38-4-3. Bio-energy
- 38-4-4. Geothermal energy
- 38-4-5. Oceanic energy
- 38-4-6. Tidal energy
- 38-4-7. Chemical energy
- 38-4-8. Hydrogen energy
- 38-4-9. Hydro energy
- 38-5. Conservation of natural resources
- 38-6. **Population**
- Theories of population 38-7.
- 38-8. Methods of population forecasts
- 38-9. Factors affecting estimated population
- 38-10. Population explosion
- 38-11. Population growth rate **QUESTIONS 38**

Chapter 39 MISCELLANEOUS TOPICS OF ENVIRONMENTAL **ENGINEERING**

- 39-1. General
- 39-2. Bioremediation
- 39-3. Biodiversity
- 39-4. Gross domestic product and quality of life
- 39-5. Cadium poisoning
- 39-6. Mercury poisoning
- 39-7. Trace metal poisoning
- 39-8. Eutrophication (water pollution)
- 39-9. Land pollution
- 39-10. Oil pollution
- 39-11. Thermal pollution and cooling tower
- 39-12. Half-life (radioactive pollution)
- 39-13. Fertilizers
- 39-14. Pesticides
- 39-15. Tragedy of commons **QUESTIONS 39**

Chapter 40 ENVIRONMENTAL LEGISLATION

- 40-1. General
- 40-2. Prevalent environmental acts
- 40-3. Pollution Control Policy
- Forests and Environment Department
- 40-5. Gujarat Pollution Control Board (GPCB)
- 40-6. Gujarat Environmental Management Institute (GEMI) 40-7. Gujarat Ecology Commission (GEC)
- 40-8. Gujarat Institute of Desert Ecology (GUIDE) **QUESTIONS 40**

Appendix A TYPICAL DESIGN OF A SEWAGE TREATMENT **PLANT**

Appendix B TERMINOLOGY

BIBLIOGRAPHY

Index







