The entire subject of Water Supply and Sanitary Engineering including Environmental Engineering is divided into three parts:

1. Water Supply Engineering
2. Sanitary 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
* 88 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.
PART I: WATER SUPPLY ENGINEERING

Chapter 1 INTRODUCTION

1-1. General
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
3-2. Surface runoff
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
3-8. Surface sources for water supply schemes
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

4-1. Necessity of pumps
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
5-4. Analysis of water
5-5. Physical tests
5-6. Chemical tests
5-7. Bacteriological tests
5-8. Maintenance of purity of waters
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
6-4. 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
8-3. Filter sand
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
8-5. Comparison between slow sand filters and gravity type rapid sand filters
8-6. 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
9-9. Forms of chlorination
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
12-2. Intakes
Chapter 18 COLLECTION AND CONVEYANCE OF REFUSE (WASTE WATER)

18-1. General
18-2. Methods of carrying refuse
18-3. Systems of sewerage
18-4. Favourable Conditions for sewerage
18-5. Patterns of refuse collection

Chapter 19 WASTE WATER

19-1. General
19-2. Standards for disposal of waste water
19-3. Waste water treatment
19-4. Primary waste water treatment
19-5. Secondary waste water treatment
19-5-1. Biological treatment units
19-5-2. Secondary clarifier
19-5-3. Sludge digester
19-5-4. Sludge drying beds
19-6. Oxidation ponds
19-7. Tertiary waste water treatment
19-8. Disposal of waste water
19-9. Reuses of waste water

Chapter 20 QUANTITY OF SEWAGE

20-1. General
20-2. Dry weather flow
20-3. Storm water

Chapter 21 CONSTRUCTION OF SEWERS

21-1. General
21-2. Materials for sewers
21-3. Materials used for sewers
21-4. Shapes of sewers
21-5. Joints in sewers
21-6. Laying and testing of sewers
21-7. Ventilation of sewers
21-8. Methods of ventilation of sewers
21-9. Cleaning and maintenance of sewers
21-10. Surface drains

Chapter 22 DESIGN OF SEWERS

22-1. General approach
22-2. Minimum and maximum velocities (Self-cleansing and non-scouring velocities)
22-3. Hydraulic formulas for design of sewers
22-4. Sizes of sewers
22-5. Time of concentration
22-6. Design procedure
22-7. Variation in flow and velocities
22-8. Typical Problems of design of sewers

Chapter 23 SEWER APPURTEANCES

23-1. Meaning of the term
23-2. Catch basins or catch pits
23-3. Clean-outs
23-4. Drop manholes
23-5. Flushing tanks
23-6. Grease and oil traps
23-7. Inlets
23-8. Inverted siphons
23-9. Lampholes
23-10. Manholes
23-11. Storm water regulators

Chapter 17 SANITARY ENGINEERING – AN INTRODUCTION

17-1. General
17-2. Purpose of sanitation
17-3. Principles of sanitation
17-4. Sanitary projects
17-5. Sanitary project drawings
17-6. Report for sanitary project
17-7. Site for sewage treatment works
17-8. Design aspects for sewage treatment plant 298
17-9. Some definitions

Chapter 16 RADIOACTIVITY AND WATER SUPPLIES

16-1. Radioactivity
16-2. Effects of radiation
16-3. Radioactive sources
16-4. Disposal of radioactive wastes
16-5. Radioactivity of water
16-6. Measurement of radioactivity
16-7. Effect of treatments on water
16-8. Recommended methods
16-9. Conclusion

Chapter 15 WATER POLLUTION CONTROL AND WATER MANAGEMENT

15-1. Meaning of the term
15-2. Sources of water pollution
15-3. Types of water pollution
15-4. Preventive measures
15-5. Conclusion
15-6. Water management
15-7. Measures for re-shaping local water balance
15-8. Use and conservation of water resources

Chapter 14 PIPE APPURTEANCES

14-1. Necessity
14-2. Air valves
14-3. Bib cocks
14-4. Fire hydrants
14-5. Reflex valves
14-6. Relief valves
14-7. Sluice valves
14-8. Scour valves
14-9. Stop cocks
14-10. Water meters

Chapter 13 DISTRIBUTION SYSTEM OF WATER

13-1. General considerations
13-2. Methods of distribution of water
13-3. Service reservoirs
13-4. Systems of supply of water
13-5. Methods of layout of distribution pipes
13-6. Wastage of water
13-7. Water waste surveys
13-8. Permissible wastage of water
13-9. Preventive measures
13-10. Water waste tests
13-11. Maintenance of distribution system

Chapter 12 CONVEYANCE OF WATER

12-3. Design of intakes
12-4. Design procedure for intakes
12-5. Types of intakes
12-6. Intake towers
12-7. Conveyance of water
12-8. Pipes
12-9. Types of Pipes according to material used
12-10. Pipe corrosion
12-11. Effects of pipe corrosion
12-12. Theories of pipe corrosion
12-13. Prevention of pipe corrosion
12-14. Laying of water supply pipes
12-15. Hydrostatic testing of pipes
Chapter 24 SEWAGE PUMPS
24-1. Necessity of pumps
24-2. Pumping of sewage
24-3. Pumping stations
24-4. Requirements of a pumping station
24-5. Types of sewage pumps
24-6. Power for pumps
24-7 Horse-power of pumps

QUESTIONS 24

Chapter 25 HOUSE DRAINAGE
25-1. Meaning of the term
25-2. Principles of house drainage
25-3. Traps
25-4. Some definitions
25-5. Sanitary fittings
25-6. Systems of plumbing
25-7. Drainage plans of buildings
25-8. Testing of drains and pipes
25-9. Maintenance of house drainage system

QUESTIONS 25

Chapter 26 QUALITY OF SEWAGE
26-1. General
26-2. Properties of sewage
26-2-1. Physical properties
26-2-2. Chemical properties
26-2-3. Biological properties
26-3. Cycles of decomposition
26-4. Analysis of sewage
26-5. Physical tests
26-6. Chemical tests
26-6-1. Chlorine
26-6-2. Fats, greases and oils
26-6-3. Nitrogen
26-6-4. Oxygen
26-6-5. pH value
26-6-6. Total solids
26-7. Bacteriological tests
26-8 Relative stability
26-9. Population equivalent

QUESTIONS 26

Chapter 27 NATURAL METHODS OF SEWAGE DISPOSAL
27-1. General
27-2. Disposal by dilution
27-3. Self-purification of natural waters
27-4. Disposal by land treatment
27-5. Sewage sickness

QUESTIONS 27

Chapter 28 PRIMARY TREATMENT OF SEWAGE
28-1. General
28-2. Screens
28-3. Grit chambers
28-4. Detritus tanks
28-5. Skimming tanks
28-6. Plain sedimentation tanks
28-7. Primary clarifiers
28-8. Secondary clarifiers
28-9. Coagulation of sewage

QUESTIONS 28

Chapter 29 FILTRATION OF SEWAGE (SECONDARY TREATMENT)
29-1. Secondary treatment
29-2. Filters
29-3. Contact beds
29-4. Intermittent sand filters
29-5. Trickling filters
29-5-1. Standard rate trickling filters
29-5-2. High rate or high capacity trickling filters
29-6. Miscellaneous filters

QUESTIONS 29

Chapter 30 ACTIVATED SLUDGE PROCESS
30-1. Meaning of the term
30-2. Action of activated sludge
30-3. Flow diagram
30-4. Methods of aeration
30-5. Diffused air aeration
30-6. Mechanical aeration
30-7. Combination of diffused air aeration and mechanical aeration
30-8. Sludge bulking
30-9. Accumulation of volatile suspended solids
30-10. Sludge volume index
30-11. Sludge density index
30-12. Step aeration
30-13. Tapered aeration
30-14. Extended aeration
30-15. Contact stabilization
30-16. Complete mix process
30-17. Oxidation ditch
30-18. Advantages of activated sludge process
30-19. Disadvantages of activated sludge process
30-20. Activated sludge process versus trickling filters

QUESTIONS 30

Chapter 31 SLUDGE TREATMENT AND DISPOSAL
31-1. Necessity
31-2. Quantity of sludge
31-3. Sludge treatment
31-3-1. Sludge thickening
31-3-2. Sludge digestion
31-3-3. Sludge thickening
31-3-4. Sludge conditioning
31-3-5. Sludge dewatering
31-3-6. Sludge disposal
31-4. Sludge gas
31-5. Sludge digestion tanks
31-6. Capacity of sludge digestion tank
31-7. Standard rate digestion
31-8. High rate digestion
31-9. Two-stage digestion

QUESTIONS 31

Chapter 32 MISCELLANEOUS METHODS OF SEWAGE TREATMENT
32-1. General
32-2. Cesspools
32-3. Chlorination of sewage
32-4. Imhoff tanks
32-5. Oxidation ponds
32-6. Septic tanks
32-7. Treatment of industrial wastes
32-8. Wastes from fertiliser factories

QUESTIONS 32

Chapter 33 MISCELLANEOUS TOPICS OF SANITARY ENGINEERING
33-1. General
33-2. Bio-gas
33-3. Elutriation
33-4. Garbage collection and removal
33-5. Garbage disposal
33-6. Micro-organisms
33-7. Types of metabolism
33-8. Divisions of micro-organisms
33-9. Night soil disposal without water carriage
33-10. Rural sanitation
33-11. Rotating biocontactor (RBC)

QUESTIONS 33
PART III : ENVIRONMENTAL ENGINEERING

Chapter 34 ENVIRONMENT
34-1. Definition
34-2. Components of environment
34-3. Man-environment relationship
34-4. Impact of technology on the environment
34-5. Environmental degradation
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
34-11. World environment day (WED)
34-12. Environmental impact assessment (EIA)
34-13. Sustainable development
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
35-3-1. Artificial ecosystems
35-3-2. Natural ecosystems
35-4. Aspects of ecosystem
35-5. Components of ecosystem
35-6. Energy flow in ecosystem
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
36-1. General
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
36-18. Urban air pollution
36-19. Self-cleansing of atmosphere
36-20. Effects of air pollution
36-21. Acid rains
36-22. Control of air pollution
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
38-1. 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
38-7. Theories of population
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. Cadmium 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
40-4. 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