

**INSTRUCTIONS TO PAPER SETTERS:****MAXIMUM MARKS: 75**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 25 marks.
2. Apart from question no. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only one question from each unit.

**UNIT – I**

Unit operations and their applications in treatment of water, Sewage, Industrial effluent and emissions.

Mixing and Flocculation: Gravitational, Mechanical and Pneumatic devices, Types of impellers.

Sedimentation: Discrete settling, Flocculent settling, Hindered or Zone settling, Compression settling. Long tube settling tests, sedimentation equipment, Batch flow and continuous flow operations. Principles, Design concepts & suitability of gravity settlers and sludge thickeners.

Flotation and aerosol separation: Methods of flotation, chemical agents promoting flotation, gas particle contact. Aerosol characteristics & their separation, Particle characteristics.

**[No. of Hours: 12]****UNIT – II**

Flow through beds of solids : Slow sand filters, Rapid sand filters, Pressure filters, Ion exchange units, Adsorption towers, Flow through expanded beds, Flow through porous plates and membranes.

Gas transfer: Mechanism of transfer, Film coefficients and equilibrium relationships, Gas dispersion. Principles, Design concepts & suitability of packed columns, Tray columns, Spray units etc.

**[No. of Hours 10]****UNIT – III**

Principles, Design concepts & suitability of Adsorption (fixed bed and moving bed), absorption and desorption.

Membrane System: Reverse Osmosis, Electrodialysis, Ultrafiltration, Nanofiltration.

**[No. of Hours 10]****UNIT – IV**

Principles, Design concepts & suitability of centrifugal separators, Impingement separators, Electrostatic precipitators and scrubbers.

Principles, Design concepts & suitability of disinfection, Chemical precipitation, Vacuum filtration and hydraulic press.

**[No. of Hours: 10]****Text and Reference Books:**

1. R. Parker. N. Morris. F.N. Fair. S.C. Bhatia, "Wastewater Engineering", CBS Publishers.
2. Mark J. Hammer, Mark J. Hammer, Jr., "Water & Wastewater Technology", Prentice Hall of India.
3. Metcalf & Eddy, "Wastewater engineering Treatment disposal reuse", Tata McGraw Hill.
4. Metcalf & Eddy, "Wastewater engineering Treatment & reuse," Tata McGraw Hill.
5. Soli J Arceivala, "Wastewater Treatment for Pollution Control", Tata McGraw Hill.
6. CPHEEO Manual.
7. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, "Environmental Engineering", TMH.
8. Mackenzie L. Davis, David A. Cornwell, "Introduction to Environmental Engineering", TMH.