ENVIRONMENTAL HYDRAULICS

Paper Code: ETEN-206	**L**	**T/P**	**C**
Paper: Environmental Hydraulics	**3**	**1**	**4**

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 1 question from each unit. Each question should be 12.5 marks.

Objective: The course refers primarily to Laminar and Turbulent flow concepts, pipe flow and open channel flow concepts. Further, the course covers concepts of movement and transformation of pollutants released in the atmospheric environment.

UNIT I

Navier's-Stokes equation of motion for laminar Flow; Laminar flow between two parallel plates, laminar flow through pipes, Dimensional Analysis and Modal Studies, Velocity distribution in turbulent flow; shear stress due to turbulence, turbulent flow in circular pipes, resistance of smooth and artificially roughened pipes, General resistance diagram.

[T1,T2] [No. of Hours: 11]

UNIT II

Pipe Flow Problems: Losses in pipe flow, pipes in series, pipes in parallel, branching pipes, siphons, multi-reservoir problems, pipe net work analysis using Hardy Cross Method, unsteady flow in pipes, water hammer analysis.

[T1,T2] [No. of Hours: 11]

UNIT III

Open Channel Flow: Derivation of the general one-dimensional equations of continuity, momentum and energy used in open channel flow analysis, Steady non-uniform flows, channel transitions and controls, hydraulic jumps surges, Unsteady flow in open channels, Method of characteristics, surge formation, Kinematics of waves, flood routing and overhead flow Turbines.

[T1,T2][No. of Hours: 11]

UNIT IV

Atmospheric Boundary Layer and Diffusion : Solar Radiation, Air stability, Logarithmic profile, Turbulence, Statistical Measures, Boundary Layer Scaling, Turbulent Gradient Transport, Statistical Theories of Turbulent Diffusion, Eddy diffusion model, Gaussian dispersion model, Evaluation of standard deviation, Estimation of maximum ground level concentration, Models based on K – Theory, Removal Mechanisms, Box Models.
Elements of Meteorology, Wind velocity profiles, Maximum mixing depth, Wind rose, General characteristics of stack plumes, Heat island effect.

[T1,T2] [No. of Hours: 12]

Text Books:

[T1] Subramanya K., "Flow in Open Channels", Tata McGraw Hill Education (P) Ltd., New Delhi.
[T2] Garde R.J., Mirajgaoker A.G., "Engineering Fluid Mechanics", Scitech Publications (P) Ltd., Chennai.

Reference Books :

[R1] Lyons T. and Scott B., "Principles of Air Pollution Meteorology", CBS Publishers and Distributers (P) Ltd., New Delhi. (for Unit-IV)
[R2] Jacobson M.Z., "Fundamentals of Atmospheric Modelling", Cambridge University Press, New York.
[R3] Shaughnessy E.J., Katz I.M. and Schaffer J.P., "Introduction to Fluid Mechanics", Oxford University Press, New Delhi.
[R4] Bansal R.K., "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications (P) Ltd., New Delhi.
[R5] Jain A.K., "Fluid Mechanics", Khanna Publishers, New Delhi.
[R6] Munson B.R., Young D.F. and Okiishi T.H., "Fundamentals of Fluid Mechanics", Wiley India (P) Ltd., New Delhi.