Department of Civil Engineering

I. Course Title : Dimensional Analysis and Similitude
II. Course Code : CE 501
III. Credit Hours : 2+0

IV. Aim of the course

To acquaint the students with importance of analysis of dimensions and similitude principles in structuring mathematical/simulation models of various processes under different constraint variables.

V. Theory

Unit I

Introduction, Dimensions, Dimensional homogeneity, Non-dimensional parameter, Methods of dimensional analysis: Rayleigh's method, Buckingham-Pi theorem, Choice of variables, Model analysis, Examples on various applications, Dimensional analysis and Intermediate Asymptotic.

Unit II

Model studies, Model classification, Dimensionless numbers: Reynolds model, Froude's model, Euler's Model, Webber's model, Mach model, Scale effects, Distorted models, Model laws.

Unit III

Similitude: Types of similarities (geometric-kinematic and dynamic similarity), force ratios, similarity laws. Model analysis: Physical models. Similarity methods for nonlinear problem types of models, Scale effect. Numerical problems on Reynolds's and Froude's Model.

Unit IV

Use and scope of mathematical modeling, Principles of model formulation, Role and importance of steady-state and dynamic simulation, Classification of models, Model building, Modeling difficulties, Degree-of-freedom analysis, Selection of design variables.

VI. Learning outcome

The students will be able to analyze complex problems using dimensional analysis and to develop rules for experiments with scale models and provide basis for analyses and calculations, including simplifications and assumptions made, when formulating mathematical models.

VII. Lecture Schedule

S.No.	Topic	No. of Lectures
1.	Introduction, Dimensions, Dimensional homogeneity, Non-dimensional parameter	2

S.No.	Topic	No. of Lectures
2.	Methods of dimensional analysis: Rayleigh's method, Buckingham-Pi theorem, Choice of variables	3
3.	Model analysis, Examples on various applications, Dimensional analysis and Intermediate Asymptotic	2
4.	Model studies, Model classification, Dimensionless numbers: Reynolds model	3
5.	Froude's model, Euler's Model, Webber's model, Mach model, Scale effects	3
6.	Distorted models, Model laws.	2
7.	Similitude: Types of similarities (geometric-kinematic and dynamic similarity), force ratios, similarity laws	3
8.	Model analysis: Physical models. Similarity methods for nonlinear problem types of models, Scale effect	3
9.	Numerical problems on Reynolds's and Froude's Model	3
10.	Use and scope of mathematical modeling, Principles of model formulation	2
11.	Role and importance of steady-state and dynamic simulation	2
12.	Classification of models, Model building, Modeling difficulties	2
13.	Degree-of-freedom analysis, Selection of design variables	2
	Total	**32**

VIII. Suggested Reading

- Barenblatt GI. 1987. *Dimensional Analysis*. Gordon and Breach Science, New York.
- Langhar HL. 1951. *Dimensional Analysis and the Theory of Models*. Wiley, New York.
- Murphy G. 1950. *Similitude in Engineering*. The Ronald Press Company, New York.
- Zohuri Bahman. *Dimensional Analysis and Self-Similarity Methods for Engineers and Scientists*. Springer Publications, New York.

I. Course Title : Water Quality and Pollution Control

II. Course Code : CE 502

III. Credit Hours : 2+1

IV. Aim of the course

To acquire in-depth knowledge of water quality parameters, water quality standards, source of water pollution and multiple use of water.

V. Theory

Unit I

Physical and chemical properties of water, suspended and dissolved solids, EC and pH, major ions. Water quality (Physical, Chemical and Bacteriological) investigation, Sampling design, Samplers and automatic samplers. Data collection platforms, Field kits, Water quality data storage, analysis and inference, Software packages. Water quality indices. Water quality for irrigation. Salinity and permeability problem, saline water irrigation root zone salinity, interaction of irrigation and drainage.

Unit II

Sources and types of pollution, organic and inorganic pollutants. BOD–DO relationships, impacts on water resources. NPS pollution and its control, Eutrophication control. Water treatment technologies, Constructed wetlands.