MATH-822 Mathematical Modelling-I

Credit Hours: 3-0
Prerequisite: None

Course Objectives: The course focuses on the application of "dimensional methods" tofacilitate the design and testing of engineering problems. It aims to develop a practical approach to modeling and dimensional analysis. This course will be well received and will prove to be an invaluable reference to researchers and students with an interest dimensional analysis and modeling and those who are engaged in design, testing and performancesevaluation of engineering and physical system.

Core Contents: The course includes the theory of matrix algebra and linear algebra, thetheory of dimension, transformation of dimensions and structure of physical variables, dimensional similarities and models law. This course will cover the nature of dimensional analysis use in mathematical modeling.

Detailed Course Contents: Mathematical Preliminaries, Matrices and Determinants, Operation with Matrices, The rank of matrices and Systems of linear equations, Formats and Classification, Numerical, Symbolic and Mixed format, Classification of Physical Quantities, dimensional system, General Statement, The SI system, Structure, Fundamental dimension, Derived dimensional units with and without specific names, Rules of etiquettes in Writing dimensions.
Other than SI dimensional systems, A note on the classification of dimensional systems, Transformation of Dimensions, Numerical equivalences, Techniques, Examples, Problems, Arithmetic of Dimensions, Dimensional Homogeneity. Equations, graphs, Problems, Structure of Physical Relations, the dimensional matrix, Number of independent sets of products of given dimension 1,11, Special case, Buckingham's theorem, Selectable and non selectable dimensions, Minimum number of independent product of variables of given dimension, Constancy of the sole dimensionless product, Number of dimension equals or exceeds the number of variables, Systematic determination of Complete Set of Products of Variable Transformations, Theorems related to some specific transformations, Transformations between systems of different d matrices, Number of Sets of Dimensionless Products of Variables, Distinct and equivalent sets, Changes in dimensional set not affecting the dimensional variables, Prohibited changes in dimensional set. Relevancy of Variables, Dimensional irrelevancy, Condition, Adding a dimensionally irrelevant variables to a set of relevant variables, Physical irrelevancy, Problems, Economy of Graphical Presentation, Number of curves and charts, Problems, Forms of Dimensionless Relations, General classification, Monomial is Mandatory, Monomial is impossible, Reconstructions, Sequence of Variables in the Dimensional Set, Dimensionless physical variable is present, Physical variables of identical dimensions are present, Independent and dependent variables.

Learning Outcomes: Students are expected to understand Fundamentals dimension of dimensionalanalysis.

Text Books:

1. Thomas Szitres, Applied Dimensional Analysis and Modeling, Elsevier Inc., 2007. (Referredas TS).
2. S.H. Friedberg, A.J. Insel, L.E.Spence, Linear Algebra, Prentice-Hall, Inc., Englewood Cliffs, N.J. USA,979 (referred as FIS)

ASSESSMENT SYSTEM

Nature of assessment	Frequency	Weightage (%age)
Quizzes	Minimum 3	10-15
Assignments	-	5-10
Midterm	1	25-35
End Semester Examination	1	40-50
Project(s)	-	10-20

Weekly Breakdown		
Week	***Section***	***Topics***
1	TS, Ch. 1, FIS, Ch. 3	Mathematical Preliminaries, Matrices and Determinants, Operation withMatrices, The rank of matrices and Systems of linear equations
2	TS Chs. 2, 3	Formats and Classification, Numerical, Symbolic and Mixed format Classification of Physical Quantities, dimensional system, General Statement, The SIsystem
3	Ch 3	Structure, Fundamental dimension, Derived dimensional units with and withoutspecific names, Rules of etiquettes in Writing dimensionsOther than SI dimensional systems
4	Chs 3,4	A note on the classification of dimensional systems, Transformation ofDimensions,Numerical equivalences, Techniques, Examples, Problems
5	Chs 5, 6	Arithmetic of Dimensions, Dimensional Homogeneity
6	Chs 6,, 7	Equations, graphs, Problems, Structure of Physical Relations, the dimensionalmatrix, Number of independent sets of products of given dimension 1,11, Special case
7	Ch 7	Buckingham's theorem, Selectable and non selectable dimensions, Minimum number of independent product of variables of given dimension,Constancyof the sole dimensionless product
8	Chs 7,8	Number of dimension equals or exceeds the number of variables Systematic determination of Complete Set of Products of Variable

9	**Mid Semester Exam**	
10	Ch 9	Transformations, Theorems related to some specific transformations,Transformations between systems of different d matrices
11	Ch 10	Number of Sets of Dimensionless Products of Variables Distinct and equivalent sets, Changes in dimensional set not affecting thedimensionalvariables, Prohibited changes in dimensional set
12	Ch 11	Relevancy of Variables, Dimensional irrelevancy, Condition, Adding adimensionally irrelevant variables to a set of relevant variables,
13	Chs 11, 12	Physical irrelevancy, Problems, Economy of Graphical PresentationNumber of curves and charts, Problems
14	Ch 13	Forms of Dimensionless Relations, General classification, Monomial isMandatory,Monomial is impossible, Reconstructions
15	Ch 14	Sequence of Variables in the Dimensional Set, Dimensionless physicalvariable is present,
16	Ch 14	Physical variables of identical dimensions are present, Independent anddependent variables
17		Review of Material
18	**End Semester Exam**	