Subject Description Form

Subject Code	EE3006 / EE3006A
Subject Title	Analysis Methods for Engineers
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: AMA2111
Objectives	1. To familiarize students with the essential numerical techniques and operations research methods which are applicable in most engineering problems. 2. To enable students to analyze the advantages and limitations of the commonly adopted numerical techniques and operations research methods. 3. To prepare students for tackling practical engineering problems, with a combination of strong theoretical background and sound analysis methods.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. Match the numerical methods and operations research techniques with the corresponding mathematical theories and compare their advantages and limitations. b. Given an engineering problem, justify the application of an appropriate technique, formulate the solution process and evaluate the results. c. Analyze essential features of different engineering problems in engineering. d. Apply computer software to implement iterative numerical algorithms. e. Write technical reports and present the findings in logical and organised manner.
Subject Synopsis/ Indicative Syllabus	1. ***Basics*****:** Error propagation, numerical stability, solutions by iterations, Newton's method, finite difference and interpolation, Lagrange interpolation; solution of non-linear simultaneous equation; numerical differentiation and integration. 2. ***Differential equations*****:** Numerical solutions of ordinary differential equations, Euler and Runge-Kutta methods, convergence and stability; finite difference methods for partial differential equations, boundary value problems. 3. ***Operations research*****:** Linear programming, simple Simplex algorithms, sensitivity analysis, shortest path and maximum flow problems, integer programming, combinatorial optimisation problems, applications in power systems and transportation. 4. ***Optimisation***: Direct search and simple gradient methods; optimisation with constraints. 5. ***Probability and statistics:*** Random variables, probability distributions, sample distributions and means, Central Limit Theorem, significance and hypothesis testing, stochastic processes. **Laboratory Experiments:** • Numerical analysis and algorithm implementation using Matlab • Numerical evaluation of partial differential equations of voltage or heat distribution in electrical systems

Teaching/Learning Methodology

Basic concepts and theories are taught in lectures and tutorials. When conducting the experiments, the students are expected to solve practical problems with critical and analytical thinking. Interactive assignments and on-the-spot discussions are conducted in both lectures and laboratory sessions. Experiments are designed so that the students should use the references in the instruction sheets to look for supplementary information.

Teaching/Learning Methodology	Outcomes				
	a	b	c	d	e
Lectures	✓	✓	✓	✓	
Tutorials	✓	✓	✓	✓	
Experiments				✓	✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed				
		a	b	c	d	e
1. Examination	60%	✓	✓	✓		
2. Tests	18%	✓	✓	✓		
3. Assignments	10%	✓	✓	✓	✓	
4. Laboratory performance & reports	12%				✓	✓
Total	100%					

The outcomes on concepts, design and applications are assessed by the usual means of examination and tests. The outcomes on analytical skills, problem-solving techniques, technical reporting and teamwork, are evaluated by experiments and the reports.

Student Study Effort Expected

Class contact:	
▪ Lecture/Tutorial	33 Hrs.
▪ Laboratory	6 Hrs.
Other student study effort:	
▪ Laboratory preparation/report	12 Hrs.
▪ Self-study and assignments	54 Hrs.
Total student study effort	105 Hrs.

Reading List and References

Reference books:

1. J.H. Mathews, Numerical methods using MATLAB, Pearson Prentice Hall, 2004
2. S.C. Chapra, Applied numerical methods with MATLAB for engineers and scientists, McGraw Hill, 2008
3. F.S. Hillier, Introduction to operations research, McGraw Hill, 2005
4. A.V. Balakrishnan, Introduction to random processes in engineering, John Wiley & Sons, 2005
5. R.E. Walpole, R.H. Myers, S.L. Myers and K.Y. Ye, Probabilities and Statistics for Engineers and Scientists, Prentice Hall, 2002