Subject Description Form

Subject Code	AMA3231
Subject Title	Numerical Methods and Computing
Credit Value	3
Level	3
Pre-requisite	AMA2380 Engineering Mathematics
Exclusion	Numerical Methods and Computing (AMA3301)
Objectives	The objectives of this subjects are to (1) Provide students with an understanding of simple analytic and numerical methods of various topics such as linear systems, ordinary and partial differential equations, numerical methods; (2) Enable students to apply the basic techniques to model and solve the mathematical problems in building services engineering using numerical method; (3) Introduce Matlab to students and enable them to apply Matlab to create computational code for solving problems in building services engineering; (4) Provide students with background computing knowledge to support their study in later stage, e.g., project works and elective subjects in the final year.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) apply mathematical reasoning to analyze essential features of different problems in building services engineering; b) extend their knowledge of mathematical and numerical techniques and adapt known solutions to different situations in building services engineering; c) analyze and model application problems using numerical method and fundamental knowledge in building services engineering; d) write computational code using Matlab for solving problems in application and explain the computation results based on fundamental knowledge in building services engineering.

<table>
<tr><td>Subject Synopsis/ Indicative Syllabus</td><td>
Ordinary differential equations
Basic concept of ordinary differential equations; Numerical methods for solving ordinary differential equations; First and second order solutions; Applications.
Partial differential equations
Basic concept of partial differential equations; Heat conduction equations; Fluid dynamic equations; Wave equations; Boundary- and initial- value problems, Separation variables method; Finite difference method; Applications.
Numerical methods
Numerical methods for linear systems; LU decomposition; Guass-Seidel method; Solutions of non-linear equations; Newton-Raphson methods; Numerical integration using trapezoidal and Simpson’s rules; Solutions to ordinary differential equations; Euler’s and Runge-Kutta methods; Finite difference method for solution of Laplace equation; curve fitting by least squares methods; Applications.
Matlab programming
Introduction to Matlab; Realization of numerical method using Matlab; Visualization of computation results in Matlab; Computational code creation using Matlab; Applications.
</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>
Lectures – 14 sessions of 2-hour lecture are provided. Lectures are to introduce the basic concepts and associated theories.

Tutorials – 14 sessions of 1-hour tutorial help students solve difficult exercises in which the students cannot solve by themselves. Students are encouraged to prepare and complete the tutorial exercises at home. It helps enhance their learning outcomes.

Assignment – Provide opportunities to test students’ understanding (formative & judgmental).
</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="4">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td></tr>
<tr><td>1. Test</td><td>30</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>2. Assignment</td><td>10</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>3. Examination</td><td>60</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100 %</td><td colspan="4"></td></tr>
</table>
</td></tr>
</table>

	Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes: Test (week 7-9) – Facilitator can have a better understanding of individual student / students' weaknesses or strength so that remedial actions can be taken timely. It also serves as a judgmental exercise. Assignment – Some exercises require in-depth discussion and critical analysis. They are not suitable in use at test or examination. Students can gain an experience in analyzing difficult problems. Examination – Held at the end of the unit with questions aligned with the intended subject learning outcomes.	
Student Study Effort Expected	Class contact:	
	▪ Lecture	26 Hrs.
	▪ Tutorials	13 Hrs.
	Other student study effort:	
	▪ Tutorial exercises	28 Hrs.
	▪ Self-studying & revision	50 Hrs.
	Total student study effort	117 Hrs.

Reading List and References

References:

Kreyszig, E.	Advanced Mathematics Engineering	John Wiley 2011
Gerald, C.F. & Wheatley, P.O.	Applied Numerical Analysis 7th edition	Addison-Wesley, 2004
Chapra, S.C. & Canale, P.R.	Numerical methods for Engineers: with Programming and Software Applications, 5th edition	McGraw Hill, 2006
Palm, W.J.	Introduction to MATLAB for engineers, 3rd edition	McGraw Hill, 2011