Subject Description Form

Subject Code	CSE20302
Subject Title	Engineering Analysis and Computation
Credit Value	3
Level	2
Pre-requisite	AMA2131: Mathematics for Engineers COMP1012: Programming Fundamentals and Applications
Objectives	To acquire knowledge of engineering mathematics up to degree level for the formulation and solution of practical problems in civil engineering.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. apply mathematical reasoning to analyse essential features of different problems; b. apply the fundamentals of mathematics and science to formulate problems in civil engineering; c. apply such fundamentals to obtain solutions to problems formulated; d. apply numerical methods and programming languages to solve engineering problems; e. critically analyze and interpret the models formulated and solutions obtained to support the synthesis of logical and cost-effective solutions; f. communicate solutions logically and lucidly through calculation, sketch, drawing and in writing.
Subject Synopsis/ Indicative Syllabus	1. Application of calculus to 2-dimensional and 3-dimensional problems in civil engineering such as state of stresses in solid mechanics, fluid pressure and velocities in fluid flow problems. Function of several variables such as fluid pressure, velocities and stresses. Material derivatives, partial derivatives, chain rule, Taylor's formula. Constrained and unconstrained optimization problems for transportation planning. Existence and uniqueness of solution. Other applications in civil engineering such as geometric properties of structural cross-sections, hydrostatic thrusts on submerged surfaces, strain energy and external work. Double and triple integrals, change of variables, Gauss divergence theorem, Green's theorem. 2. Elementary differential formulation of civil engineering problems and applications in fluid flow problems, structural and geotechnical problems. First order, second order and higher order ordinary differential equations, separate equations, initial value problem and boundary value problems.

Other applications such as vibration of lumped mass systems, beam on elastic foundation, beam-column problems and hydraulic surge tank in unsteady flow. Second order and higher order equations, general solutions, non-homogeneous equations, particular solutions by undetermined coefficients and variation of parameters.

3. Introduction to commonly-used numerical methods and software for engineering computations. Finite difference method and its application in civil engineering problems such as soil consolidation. Runge-Kutta method and its applications. Approximate approaches for numerical integration, such as the Trapezoidal rule, Simpson's rule and Gauss quadrature. Application of numerical methods and programming languages to solve engineering problems.

Teaching/Learning Methodology

Emphasis is placed on a pro-active learning approach. Fundamental knowledge will be introduced in the lectures, with interspersed questions, exercises and quizzes for class discussion and after class self-study. Students will be expected to read up, do exercises and reflect critically on the material covered in class. Students will apply numerical methods and programming languages to analyse engineering problems (e.g., slope deformation). Tutorials will provide opportunities for discussion of lecture materials and will also be conducted in the form of example class and problem-solving session to supplement understanding from lectures. Additional face-to-face discussion sessions can be arranged on request.

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)					
		a	b	c	d	e	f
1. Assignments	15	✓	✓	✓	✓	✓	✓
2. Mid-term test	15	✓	✓	✓		✓	✓
3. Final Examination	70	✓	✓	✓	✓	✓	✓
Total	100 %						

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Students must attain at least grade D in both coursework and final examination (whenever applicable) in order to attain a passing grade in the overall result.

Student Study Effort Expected	Class contact:	Average hours per week
	▪ Lectures / Tutorials	3 Hrs.
	Other student study effort:	
	▪ Reading and studying	4 Hrs.
	▪ Completion of Assignments	2 Hrs.
	Total student study effort	9 Hrs.
Reading List and References	Boyce, W.E., DiPrima, R.C. and Meade D.B. (2018). Elementary Differential Equations and Boundary Value Problems, 10th edition. Wiley. Chau K.T. (2018). Theory of Differential Equations for Engineering and Mechanics. CRC Press. Chau K.T. (2019). Applications of Differential Equations for Engineering and Mechanics. CRC Press. Kreyszig, E. (2011). Advanced Engineering Mathematics, 10th edition. Wiley. Marsden, J.E. (2002). Basic Multivariable Calculus, 3rd edition. Springer Verlag.	