

SUBJECT DESCRIPTION FORM

Subject Title: Numerical Methods
for Product Analysis

Subject Code: ME4906

Number of Credits: 3

Hours Assigned: Lecture 28 hours
Tutorial/Laboratory 14 hours

Pre-requisite: ME3903 Quantitative and Computational Methods

Co-requisite: Nil

Exclusion: Nil

Objectives:

1. To introduce students advanced numerical methods and theories relating to engineering.
2. To introduce students computational techniques relating to product analysis.
3. To develop students' ability and skills in solving industrial problems using quantitative and computational methods.

Student Learning Outcomes:

The subject is designed to fulfil the following categories of learning outcomes:

(a) Professional/Academic knowledge and skills

(b) Attributes for all-roundedness

1. To understand the concepts, theories and techniques of a variety of numerical methods.
 2. To apply numerical methods for analysing data to solve engineering problems.
 3. To use computational methods in analysing experimental data.
 4. To understand various computational techniques in modelling and solving engineering problems.
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Syllabus:

Computer Solution of Non-linear Equations and Simultaneous Linear Equations: Newton-Raphson method for pipe friction factor. Solving of simultaneous linear equations by matrix inversion using modern software. Gaussian elimination. Gaussian-Seidal method. Modelling, curve fitting and interpolation using modern software.

Numerical Differentiation, Integration and Ordinary Differential Equations: Difference equation. Simpson's rule. Ordinary Differential Equations with initial conditions. Euler's method and Runge-Kutta method in solving engineering problems such as motion of particles.

Finite Difference Method: Finite differences for parabolic systems and initial-boundary-value problems. Discretization of differential equations. Solving of steady-state and transient conduction problems.

Finite Element Method: Finite elements for elliptic systems and boundary-value problems: basic theory, discretization, interpolation function. Formulation of element characteristic matrices. Incorporation of boundary conditions. Solving final matrix equation through problems in structure design.

Method of Assessment:

Overall Assessment: $0.50 \times$ End of Subject Examination + $0.50 \times$ Continuous Assessment

1. Assignments and case-studies on analysis of physical and mechanical systems and products.
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Reference books:

1. Charpra, S.C., Numerical Methods for Engineers, 5th edition, McGraw Hill, 2006.
 2. Chandrupatla, T.R., Introduction to Finite Elements in Engineering, 3rd edition, Pearson, 2002.
 3. Kays, W.M., Convective Heat and Mass Transfer, 4th edition, McGraw Hill, 2005.
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Teaching/Learning Approaches:

Formal Contact (Hours)		
Lecture	Other Activities	
	Tutorial	Case Studies
28	8	6

Major Teaching/Learning Activities:

Concepts and techniques of various numerical and computational methods will be introduced through lectures. Tutorials are conducted in groups to help students consolidating the materials covered in the lectures. Students are required to apply the knowledge and skills to solve various practical problems in the form of exercises and case studies.

Justification on The Appropriateness of The Teaching and Learning Methods for Aligning with Intended Outcomes:

1. The teaching and learning methods include lectures, tutorials, and case studies.
 2. The lectures are aimed at delivering fundamental concepts and theories of the numerical and computational methods.
 3. The case studies are aimed at providing students with hand-on skills in applying the theories and methods learnt to solve real life problems. In conducting the case studies, students will grab the problem solving technique and hence develop their self-learning skills. Through feedback evaluation, deep understanding of the theories taught can be assured.
 4. The tutorial classes are conducted based on an active classroom setting in such a way that two-way communication will be encouraged. They serve to assist students not only to clarify their concepts about the subject, but also to monitor their progress.
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Justification on The Appropriateness of The Assessment Methods to Enable Valid Assessment of The Intended Learning Outcome:

1. The assessment composes of 50% continuous assessment and 50% examination.
2. The continuous assessment component includes: one closed-book short test (20%), two assignments (10%), and two case studies (20%). The closed-book test is aimed at assessing the interim knowledge gained by the student. In completing the assignments, students can practice the theories and self-assess their own progress of study. The case studies assess the students' self-learning skills and their ability in applying the computational and quantitative methods to solve real life problems. In addition, their presentation and communication skills can also be assessed on the basis of the case study presentation and report.
3. The examination gives critical and individual assessment to the students by testing the knowledge and skills they have acquired.