Module Syllabus

Module Title
ADVANCED CIVIL ENGINEERING MATHEMATICS

Module Code
CBE2026

Class Contact Hours
45 hours

Module Value
3.0

Course Code/Level

Full-time Mode
51301F Higher Diploma in Civil Engineering/Level 4

Part-time Mode
53301F/55901F Higher Diploma in Civil Engineering /Level 4

Learning Outcomes

To achieve this module a student shall be able to:

• Understand and apply knowledge of matrix algebra by deriving and solving algebraic equations pertaining to engineering problem in construction industry;
• Understand and apply techniques of finding eigenvalues and eigenvetors in solving algebraic equations;
• Define engineering problems with multiple variables using partial derivative and apply the technique to find total differentials and maximum/minimum;
• Demonstrate knowledge and understanding of double integrals by applying techniques of evaluate double integrals over simple regions to calculate areas, volumes, masses and mean values;
• Define engineering problems using differential equations and apply techniques for solving ordinary differential equations;
• Understand and apply knowledge of probability and statistics to analyze problems
• Demonstrate and apply knowledge of numerical method in solving equations, integrations and curve fitting

Pre-requisite(s):

CBE5021 – MATHEMATICS FOR CONSTRUCTION
Teaching & Learning Strategies

Full-time & Part-time Modes
The module consists of 30 hours of formal lecture and 15 hours of tutorial hours.

Formal lectures will focus on basic theories and relevant mathematical techniques such as matrix algebra and advanced calculus.

In tutorials, students will work on exercises based on basic principles learned in lectures. Students will be encouraged to participate in open discussions. An informal approach will be adopted and mathematical processes will be explained using simple language. Mathematical ideas will be illustrated by examples and rigorous derivations are kept to the minimum. Emphasis is placed on basic concepts, techniques and applications, rather than abstract treatments. Ample practical exercises will be given in tutorial classes.

Software packages such as Derive or Matlab may be used to enhance teaching and learning at appropriate occasions. Students are also encouraged to access internet web sites on relevant mathematics topics to supplement their learning.

Assessment Scheme

| Coursework | 40% |
| Exam | 60% |
# Content

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<tr>
<th>Learning Outcome</th>
<th>Indicative Contents</th>
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| 1. Understand and apply knowledge of matrix algebra by deriving and solving algebraic equations pertaining to engineering problem in construction industry. | ● Basic operations of matrices (up to 3x3)  
● Properties of determinants  
● Cramer’s rule  
● Gaussian elimination  
● Eigenvalues and Eigenvectors  
Applications: Stiffness Matrix for beams; Structural member forces |
| (15 hours)                                                                        |                                                                                     |
| 2. Define engineering problems with multiple variables using partial derivative and apply the technique to find total differentials and maximum/minimum. | ● Functions of several variables  
● Partial differentiation  
● Chain rule  
● Total differentials  
● Maximum/Minimum  
Applications: Fluid Flow, Consolidation of soil |
| (12 hours)                                                                        |                                                                                     |
| 3. Demonstrate knowledge and understanding of double integrals by applying techniques of evaluate double integrals over simple regions to calculate areas, volumes, masses and mean values. | ● Iterated integrals  
● Evaluation of double integrals  
| (6 hours)                                                                         |                                                                                     |
(6 hours)  
- Variable separable  
- Integrating factors  
- 2nd order homogeneous O.D.E.  
Applications: Cable of a Suspension Bridge, Buckling of Columns, Simple Harmonic Motion, Free Oscillation and Forced Vibration, Damping and Resonance.

5. Demonstrate and apply knowledge of numerical method in solving equations, integrations.  
(6 hours)  
- Numerical solution to roots of equations  
- Numerical integration: Trapezoidal and Simpson's rules  
Applications: Area and Volume Calculation for Earthwork, Material Test and Experimental Data Plot
Key Skills
The following key skills are expected to be demonstrated by the students in their coursework activities under this module. The skills intended shall align with the requirements as described under the “Section 6.7 - Key Skills” in the Volume 1 of the Course Validation Document for 51301F/55901/53201/55201/53501/55501 C/D/HD in Civil Engineering Courses.

Fundamental Skills
Communication, IT and Numeracy ✓
Information Management □
Use of Numbers ✓
Creative Thinking ✓
Analytical & Problem Solving ✓

Personal Management Skills
Attitudes & behaviour □
Responsibility & Autonomy ✓
Adaptation ✓
Continuous Learning ✓
Work Safety □

Teamwork Skills
Working with others □
Participation in Projects & Tasks □

Reference