Semester:	4			
Course Code:	EM2050			
Course Name:	Computational Methods			
Credit Value:	3 (Notional hours:150)			
Prerequisites:	None			
Core/Optional	Core			
Hourly Breakdown	Lecture hrs.	Tutorial hrs.	Assignment hrs.	Independent Learning & Assessment hrs.
	36	5	8	101

Course Aim: The aim of the course is to introduce computational methods with emphasis on numerical methods and Fourier methods, providing students with necessary background on its theoretical, implementation and application aspects.

Intended Learning Outcomes:

On successful completion of the course, the students should be able to;

- **Solve** nonlinear equations, linear systems, interpolate, initial-value problems and boundary value problems numerically; perform interpolation and integration
- **Describe** the principles of Fourier analysis; apply Fourier methods to solve boundary value problems
- **Analyze** convergence and computational cost of computational methods
- **Implement** computational methods on a programming language
- **Apply** computational methods to solve some practical engineering problems

Course Content:

- **Preliminaries:** Floating point arithmetic, Big O notation, matrix norms, Review of programming
- **Error Analysis:**
- **Numerical solutions to nonlinear equations:** Fixed point iteration, Bisection method, Newton-Raphson method
- **Numerical solutions to systems of linear equations:** Gaussian elimination, Jacobi method, Gauss-Seidel method
- **Interpolation:** Lagrange interpolating polynomial, Newton’s interpolating polynomials, Spline interpolation

- **Numerical integration:** Trapezoidal rule, Simpson rule, Gaussian quadrature
- **Numerical solutions to ordinary differential equations: Initial value problems**: Euler method, Runge - Kutta methods;
  Boundary value problem: Finite difference method, Adaptive step size mechanisms
- **Numerical solutions to partial differential equations:** Explicit and implicit finite difference methods, Basics of finite element methods
- **Fourier Methods**: Fourier series, Fourier transform, Discrete Fourier Transform, Fourier methods to solve BVP, applications
- **Assignments**: covering selected topics & appropriate problems from the respective fields

Teaching /Learning Methods:
Classroom lectures, tutorial discussions and in-class assignments

Assessment Strategy:

Continuous Assessment 40%	Final Assessment 60%		
Details: Lab assignments, tutorials 40%	Theory (%) 60%	Practical (%)	Other (%)

Recommended Reading:

- Ackleh et al. Classical and Modern Numerical Analysis,1st Edition(2009) Chapman and Hall/CRC.
- Quarteroni et al. Scientific Computing with MATLAB and Octave,2nd Edition(2014) Springer.
- Strang. Computational Science and Engineering,1st Edition(2007), Wellesley-Cambridge Press
- Gockenbach. Partial Differential Equations: Analytical and Numerical Methods,2nd Edition (2002)SIAM,