Course Code	EM 317
Course Title	Computational Methods
No. of Credits	3
Pre-requisites	EM 216, EM 217
Compulsory/Optional	Compulsory for Mechanical Engineering Spcialization

Aim(s) : 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

Time Allocation (Hours) : Lectures 36 , Tutorials 05 , Practicals 08

(**Notional hours 150**)

Course content / Course description :

- **Preliminaries:** Floating point arithmetic, Big O notation, matrix norms, review of programming (e.g. MATLAB / GNU Octave / Python)
- **Nonlinear Equations:** Bisection method, Newton's methods, convergence
- **Systems of linear equations:** LU factorization, iterative methods (Jacobi, Gauss-Seidel), convergence, computational cost
- **Interpolation**: Lagrange, trigonometric interpolation
- **Integration:** mid-point rule, trapezoidal rule
- **Initial Value Problems:** Euler methods, stability, consistency, convergence, applications
- **Boundary Value Problems** (BVP): Finite Difference Methods, Finite Element Methods, convergence, applications
- **Fourier Methods**: Fourier series, Fourier transform, Discrete Fourier Transform, Fourier methods to solve BVP, applications

Recommended Texts (if any) :

- 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,

Assessment	**Percentage Mark**
In-course Lab assignments, tutorials	40
End-semester	60