# Partial Differential Equations and Numerical Methods (MAL251)

| **Course no: MAL251** | **Open course (YES/NO) :** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **NO** | **N** | **N** | **N** |
| **Type of course** | Regular | | | |
| **Course Title** | **Partial Differential Equations and Numerical Methods** | | | |
| **Course Coordinator** | Dr. Prashant Kumar | | | |
| **Course objectives:** | This course provides an introduction to topics involving partial differential equations and numerical methods. Firstly, emphasis is placed on the development of abstract concepts and applications of linear and nonlinear first order partial differential equations, solution of wave, heat and Laplace's equations. Secondly, this course focuses on computational methods since mathematical models describing physical phenomena are rarely analytically solvable. | | | |
| **POs** | | | | |

| **Semester: 4th** | **Autumn:** | | **Spring: Yes** | | |
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| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Load** |
| **Contact Hours** | 3 | 1 | 0 | 4 | 48 |
| **Prerequisite course code as per proposed course numbers** | Nil | Nil | | | |
| **Prerequisite credits** | Nil | Nil | | | |
| **Equivalent course codes as per proposed course and old course** | Nil | Nil | | | |
| **Overlap course codes as per proposed course numbers** | Nil | Nil | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | *Numerical Analysis: Mathematics of Scientific computing* |
| | Author | D. Kincaid and W Cheney, |
| | Publisher | AMS |
| | Edition | 3rd edition 2002 |
| 2. | Title | Advanced Engineering Mathematics |
| | Author | E. Kreyszig, |
| | Publisher | John Wiley and Sons |
| | Edition | 8th Edition, 2008. |
| **Reference Book:** | | |
| 1. | Title | *An Introduction to Numerical Analysis* |
| | Author | K. E. Atkinson |
| | Publisher | John Wiley and Sons |
| | Edition | 2nd Edition 1989 |

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| **Content** | **Course Contents**<br>**Unit I: Partial Differential Equations:** Formation and solutions of partial differential equations, Lagrange's linear equation of the first order, Non-linear equations, Charpit's method, Homogeneous linear equations with constant co-efficient, Non-homogeneous linear equations.<br>Solutions of Wave equation, Heat equation and Laplace's equation by the method of separation of variables. (20 hours)<br><br>**Unit II: Numerical Analysis:** Principles of floating point computations and rounding errors. Solutions of nonlinear equations: Bisection method, Newton's method and its variants, fixed point iterations, convergence analysis; Newton's method for non-linear systems. Interpolation: Polynomial interpolation, Hermite interpolation, spline interpolation, error estimates. Numerical differentiation: Based on interpolation, the method of undetermined coefficients, Richardson extrapolation, Error estimates. Numerical integration: Based on interpolation, quadrature methods, Gaussian quadrature, Error estimates. Initial value problems: Taylor series method, Euler and modified Euler methods, Runge-Kutta methods, multistep methods, stability and convergence analysis. (28 hours) |
| **Curse Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |