

## NIRMA UNIVERSITY

|                              |                                        |
|------------------------------|----------------------------------------|
| <b>Institute:</b>            | <b>Institute of Technology</b>         |
| <b>Name of Programme:</b>    | <b>B Tech Civil Engineering</b>        |
| <b>Course Code:</b>          | <b>2CL801CC25</b>                      |
| <b>Course Title:</b>         | <b>Mathematics for Civil Engineers</b> |
| <b>Course Type:</b>          | <b>Core</b>                            |
| <b>Year of introduction:</b> | <b>2025-2026</b>                       |

| L | T | Practical component |    |   |   | C |
|---|---|---------------------|----|---|---|---|
|   |   | LPW                 | PW | W | S |   |
| 2 | 0 | 2                   | -  | - | - | 3 |

### Course Learning Outcomes (CLOs):

At the end of the course, the student will be able to –

- 1 apply Fourier series for representing periodic functions (BL3)
- 2 appraise real-life applications of differential equations (BL5)
- 3 analyse civil engineering problems using numerical methods (BL4)
- 4 develop computer applications for civil engineering problems. (BL3)

| Unit     | Contents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Teaching hours<br>(Total 30) |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| Unit-I   | <b>Fourier Series</b><br>Periodic functions, Euler's formula, Fourier expansion of periodic functions with period $2\pi$ , Dirichlet's conditions, Fourier series of even and odd functions, Fourier series of periodic functions with arbitrary periods, Fast Fourier transformation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 05                           |
| Unit-II  | <b>Differential Equations</b><br>Higher order ordinary differential equations with constant coefficients, complementary function and particular integral, boundary value problem, initial value problem, solution of partial differential equations, method of separation of variable, wave and Laplace equation, applications of differential equations in civil engineering.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 08                           |
| Unit-III | <b>Numerical Methods</b><br>Iterative method: motivation, errors, truncation error, rounded off error, absolute error, relative error and percentage error, propagation of error, solution of algebraic and transcendental equation by false position, Newton-Raphson iteration, rate of convergence of the iteration methods, comparisons of iterative methods, system of linear algebraic equations: Gauss-Seidel iteration method, Gauss elimination method, Gauss quadrature method, finite differences and interpolation: Newton's forward and backward interpolation and Lagrange's interpolation, numerical differentiation and integration: numerical differentiation, numerical integration: trapezoidal rule, Simpson's 1/3rd rule, Simpson's 3/8th rule, numerical solution of differential equation: Euler's method, Runge-Kutta method of 4th order, finite difference method, eigen value, eigen vector, curve fitting: least-square regression, interpolation. | 17                           |

Self-Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Suggested Readings/ References: Veerarajan, T. *Engineering Mathematics*, McGraw-Hill.  
Grewal B. S., *Higher Engineering Mathematics*, Khanna Publishers.  
Kreyszig, E. *Advanced Engineering Mathematics*, John Wiley & Sons.  
Boyce, W. E. & DiPrima R. C., *Elementary Differential Equations and Boundary Value Problems*, Wiley India.  
Simmons G. F. & Krantz S. G., *Differential Equations*, McGraw Hill.  
Chapra S. C. & Canale R. P. *Numerical Methods for Engineers*, McGraw-Hill.

Suggested List of Experiments Laboratory work will be based on above syllabus incorporating the exercise using C programming and other programming languages.

| Sr. No | Name of Exercises                                                           | Hours |
|--------|-----------------------------------------------------------------------------|-------|
| 1      | Numerical iteration methods-Newton Raphson                                  | 04    |
| 2      | Solution of a system of linear algebraic equation using Gauss-Seidel method | 04    |
| 3      | Newton's forward interpolation                                              | 04    |
| 4      | Newton's backward interpolation                                             | 02    |
| 5      | Numerical differentiation                                                   | 06    |
| 6      | Numerical integration                                                       | 04    |
| 7      | Numerical solution of ODE using 4 <sup>th</sup> order Runge-Kutta method    | 04    |
| 8      | Numerical solution of PDE using the finite difference method                | 02    |