

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**B.E. SEMESTER : 3**  
**ENVIRONMENTAL SCIENCE & TECHNOLOGY**

**Subject Name: MATHEMATICS - 3**

Sr. No.	Course contents
01.	First order ODE: Methods for solving them, homogeneous equations, exactness, methods for finding integrating factors, Linear & Bernoulli's equation.
02.	Higher order ODE: Linear ODEs (generalities) complimentary function as & particular integrals, linear dependence & independence of functions, Wronskians, Abel-Liouville formula, use of a known solution (for reduction of order) method of variation of parameter.
03.	Linear ODEs with constant coefficient & the Cauchy Euler equation. The characteristic polynomial & indicial polynomial, discussion of the case of complex roots & repeated roots, extracting the real form of the solution via Euler's formula  $e^{i\theta} = \cos\theta + i\sin\theta$ method of undetermined coefficient for finding the particular integral for special right h& sides. (forcing functions) both for constant coefficient ODEs as well as Cauchy Euler ODEs.
04.	Beta Gamma functions & their basic properties, statement of Euler's reflection formula, duplication formula via beta gamma.
05.	Laplace transforms: Definition of functions of exponential type with examples. Definition of the Laplace transform & its basic properties as well as examples of Laplace transforms of exponential function, polynomials & trigonometric functions. Statement of the Riemann Lebesgue lemma. Finding the inverse transform. Laplace transform of $d^n y$ & $t^n y(t) dt^n$ Heaviside unit step function & shifting theorems. Convolution & the convolutions theorem. Beta gamma identity. Use of Laplace transform for solving IVP for ODEs & systems of ODEs. Computing certain important integrals via Laplace transforms.
06.	Series solution of ODEs, Illustrative examples as the equations of Legendre, Tchebychev etc., Legendre polynomials, their Orthogonality & completeness.
07.	Ordinary differential equations with regular singular points & the method of Frobenius. Detailed discussion of Bessel's equations & Bessels' functions of first kind only. Basic properties of $J_p(x)$ , the recurrence relation between $J_{p-1}(x)$ , $J_p(x)$ & $J_{p+1}(x)$ . Integral representation of $J_n(x)$ (where n is a non negative integer).

<b>08.</b>	Fourier series & Fourier transforms Basic formulae in Fourier series. Statement of the theorem on point wise convergence of Fourier series. Parsevals formula (statement only) & Bessel's inequality with examples .Mean convergence of Fourier series. Fourier transforms & its basic properties. Fourier transform of the Gaussian & the Fourier inversion theorem (statement only). Riemann Lebesgue lemma for Fourier series & Fourier transforms (statement only).
<b>09.</b>	Basic partial differential equations of mathematical physics & their origins (vibrating strings, vibrating membranes heat conduction in solids etc.,). Solving PDEs via the method of separation of variables. The Laplace operator in cylindrical & spherical polar coordinates. Brief discussion of Fourier Bessel series. Solution via Fourier series/ Fourier-Bessel series for rectangular & circular domains in $R^2$ & spherical & cylindrical domains in $R^3$ .

### Reference Books:

1. Advanced engineering mathematics, E.Kreyszig, John Wiley ,8<sup>th</sup> Ed, 1999.
2. Elementary Differential Equations ,W. E. Boyce & R. DiPrima, John Wiley, 8<sup>th</sup> Ed.,2005.
3. Fourier series & boundary value problems, R. V. Churchill & J. W. Brown, McGraw-Hill 7<sup>th</sup> Ed., 2006.
4. Calculus , T.M.Apostol, Wiley Eastern , 2<sup>nd</sup> Ed., 1980