Proficiency in Mathematics

Nischal Chandur

1) UE18MA101: Engineering Mathematics – I:

1. Differential Calculus	• Cauchy's Mean value theorem • Taylors and Maclaurin's series expansion for one variable. • Introduction to polar coordinates. • Polar curves • Angle between radius vector and tangent • angle between two curves • Pedal equations • Radius of curvature and its different forms.
2. Partial Differentiation	• Introduction to partial differentiation • geometrical interpretation • total derivative • chain rule • partial differentiation of composite and implicit functions • Homogeneous functions and Euler's theorem (no proof). • Taylor's and Maclaurin's series for two variables Maxima and Minima for function of two variables. Errors and approximations.
3. Integral Calculus	• Tracing of Cartesian and polar curves. • Double Integrals • change of order of integration • change of variables (polar, spherical and cylindrical coordinates) • Triple integrals • Application of multiple integrals- Center of mass and Moment of inertia.
4. Ordinary Differential Equations	• Introduction to Differential equations • Linear and Reducible to Linear (Bernoulli as a particular case) • Exact differential equations • Reducible to exact differential equations • Orthogonal trajectories (Cartesian and polar forms). • Solution of first order non-linear differential equations- equations solvable for p, y, x • Application problems on differential equations.
5. Higher order differential equations	• Introduction to higher order differential equations • Complementary function and particular integrals of standard functions.

- Cauchy's and Legendre's differential equations, variation of parameters.
- Application problems on differential equations.

2) UE18MA151: Engineering Mathematics – II

1. Vector Calculus
   - Introduction to vectors and vector differentiation.
   - Gradient of a scalar function
   - Directional derivative, angle between the surfaces.
   - Divergence, Curl, related properties.
   - Vector Integration -Line, Surface and Volume Integrals.
   - Green's theorem, Stokes' theorem and Gauss divergence theorem (without proof).
2. Special Functions
   - Beta-Gamma functions – Definition, properties and graphs.
   - Relation between Beta - Gamma functions and Duplication formula.
   - Bessel's differential equation and its general solution.
   - Recurrence relations for Jn(x), Generating function for Jn(x), Jacobi series and Bessel's Integral formula.
   - Orthogonality of Bessel functions.
3. Laplace Transform
   - Introduction to integral transforms
   - Definition, Laplace transforms of standard functions.
   - Properties of Laplace Transform-Linearity, First Shifting, change of scale property, Multiplication by t^n and division by t.
   - Laplace transforms of derivatives and integrals.
   - Laplace transforms of periodic functions.
   - Unit- step function, unit-impulse function and related properties.
4. Inverse Laplace Transform
   - Inverse Laplace transforms of standard functions
   - Various methods of finding inverse Laplace transforms, Convolution theorem. Applications of Laplace transforms - To solve differential equations.
5. Fourier Series
   - Introduction to Fourier series
   - Dirichlet’s conditions
   - Euler’s formulae.
   - Fourier Series of Even and odd functions, half –range Fourier series.
   - Complex form of Fourier series. Parseval’s identity, Practical Harmonic Analysis. Application Problems.

3) UE18MA202: Engineering Mathematics – III

1. Complex Function Theory	• Introduction to Complex Functions • Continuity and Derivative of complex functions • Cauchy-Riemann equations, Analytic Functions, Milne-Thompson Method • Conformal Transformation and Mapping
2. Complex Integration	• Line integral of a complex function • Cauchy's theorem and Cauchy's Integral Formula • Taylor's and Laurent's series of complex functions
3. Probability and Discrete Random Variable	• Independent events, combined events, axioms of probability, compound law of probability, Bernoulli trials • Baye's Theorem and Formula • Random variable, discrete random variable, discrete probability distribution. • Binomial distribution, Poisson distribution, Uniform distribution
4. Continuous Random Variables	• Continuous and cumulative distribution function • Gaussian Random Variable and distribution • Expectation, expectation value of a random variable • Transformation of random variable, conditional density, and distribution function • Rayleigh's Random Variable
5. Partial Differential Equations	• Formation of PDEs by separation of variables • Linear PDE of first order • Solution of homogeneous linear PDE • Non-homogeneous linear PDE

4) UE18MA251: Linear Algebra and its Applications

1. Matrices and Gaussian Elimination	• The Geometry of Linear Equations • Gaussian Elimination • Singular cases • Elimination Matrices • Triangular factors and Row Exchanges • Inverses and Transposes • Inverse by Gauss -Jordan method.
2. Vector Spaces	• Vector Spaces and Subspaces • Linear Independence • Basis and Dimensions • The Four Fundamental Subspaces.
3. Linear Transformations	• Linear Transformations • Orthogonal Vectors and Subspaces • Cosines and Projections onto Lines, • Projections and Least Squares.
4. Orthogonalization, Eigen Values and Eigen Vectors	• Orthogonal Bases • The Gram- Schmidt Orthogonalization • Introduction to Eigen values and Eigen vectors • Properties of Eigen values and Eigen vectors • Power Method to find the Largest Eigen Value • Diagonalization of a Matrix.
5. Singular Value Decomposition	• Tests for positive definiteness • Positive Definite Matrices and Least Squares • Semidefinite Matrices • Singular Value Decomposition • Applications of the SVD.

5) UE18EC400L: Matrix Theory

1. Matrix as a Linear Transformation	• Vector spaces • linear transformation, matrix multiplication • linear independence basis • fundamental theorem of linear algebra • rank-nullity theorem, Gaussian elimination • LU decomposition, inner products • Cauchy-Schwarz inequality • orthogonality, Gram-Schmidt and QR decomposition • determinants and properties.
2. Matrix Norms	• Norms and inner products • equivalence of matrix norms • dual norm, matrix norms, induced norms, spectral norm and spectral radius, • properties, equivalence of matrix norms • error analysis.
3. Similar Matrices	• Eigenvalues and eigenvectors • similarity, diagonalizability, eigenspace, algebraic and geometric multiplicities • unitary equivalence, related problems.
4. Matrix Decomposition	• Schur's triangularization • Cayley-Hamilton theorem • quadratic form • nilpotent matrices, index of a matrix • normal matrices, unitary diagonalizability • Jordan canonical form, SVD
5. Use Cases and Theorems	• Least-squares • Cholesky decomposition • PCA • Hermitian matrices • PD matrices • Rayleigh-Ritz theorem • Courant-Fisher theorem