SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

ENGINEERING MATHEMATICS-I

(Common to all branches)

Course Code: 18UMAC100	**CIE Marks: 50**
Contact Hours/Week: 04(3L+1T)	**SEE Marks: 50**
Total Hours: 50 (8L+2T per Unit)	**Exam Hours: 03**
Semester: I	**Credits: 04**

Course Learning Objectives: This course will enable students to master the basic tools of differential & integral calculus, differential equations and elementary linear algebra and become skilled to formulate, solve and analyze science and engineering problems.

UNIT-I

Differential Calculus-1:-

Review of elementary calculus, Polar curves-angle between the radius vector and tangent, angle between two curves, pedal equation. Curvature and radius of curvature- Cartesian and polar forms (without proof). Centre and circle of curvature (formulae only)–Applications to evolutes.

Self Study: Applications to involutes. **8L + 2T**

UNIT-II

Differential Calculus-2:-

Taylor's and Maclaurin's series expansions for one variable (statements only), indeterminate forms -L'Hospital's rule. Partial differentiation; Euler's theorem Total derivatives-differentiation of composite functions. Maxima and minima for a function of two variables; Method of Lagrange multipliers with one subsidiary condition. Applications of maxima and minima with illustrative examples. Jacobians - Simple problems.

Self Study: Errors and Approximations. **8L + 2T**

UNIT-III

Integral Calculus:-

Multiple integrals: Evaluation of double and triple integrals. Evaluation of double integrals-change of order of integration and changing into polar co-ordinates. Applications to find area, volume.

Beta and Gamma functions: definitions, Relation between beta and gamma functions and simple problems.

Self Study: Applications of multiple integral to find centre of gravity. **8L + 2T**

UNIT-IV

Ordinary differential equations(ODE's)of first order:-

Leibnitz's linear equation, Bernoulli's equation, Exact and reducible to exact differential equations. Applications of ODE's-orthogonal trajectories, Newton's law of cooling and L-R circuits.

Nonlinear differential equations: Introduction to general and singular solutions; Solvable for p only; Clairaut's and reducible to Clairaut's equation only.

Self Study: Applications of ODE's to R-C circuit. **8L + 2T**

UNIT-V

Elementary Linear Algebra: Rank of a matrix-echelon form. Solution of system of linear equations – consistency. Gauss-elimination method & Gauss-Seidel iterative method. Eigen values and eigen vectors- Rayleigh's power method. Diagonalization of a square matrix of order two.

Self Study: Solution of system of linear equations by Gauss –Jordan method. **8L + 2T**

Course Outcomes: On completion of this course, students are able to:

COs	Description of the course outcomes	Mastering 3	Moderate 2	Introductory 1
CO.1	Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the bentness of a curve.			1
CO.2	Learn partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions and Jacobians.		1,2	
CO.3	Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes		1,2	
CO.4	Solve first order linear/nonlinear differential equations analytically using standard methods.		1,2	
CO.5	Solve first order nonlinear differential equations analytically using standard methods.			1
CO.6	Apply matrix theory for solving system of equations and compute eigen values and eigen vectors required for matrix diagonalization process.		1	

Text Books:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.
2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed. (Reprint), 2016.

Reference books:

1. C.Ray Wylie, Louis C.Barrett : "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill Book Co., New York, 1995.
2. N.P.Bali and Manish Goyal: A Text Book of Engineering Mathematics, Laxmi Publishers, 7th Ed., 2010.
3. B.V.Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
4. Veerarajan T.," Engineering Mathematics for First year", Tata McGraw-Hill, 2008.
5. Thomas G.B. and Finney R.L."Calculus and Analytical Geometry"9th Edition, Pearson, 2012.

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
Mapping Level												

1 -> Introductory (Slight); 2 -> Reinforce (Moderate); 3 -> Mastering (Substantial)

Jenifer.K

HoD Mathematics

SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

ENGINEERING MATHEMATICS-II

(Common to all branches)

Course Code: 18UMAC200	**CIE Marks: 50**
Contact Hours/Week: 04(3L+1T)	**SEE Marks: 50**
Total Hours: 50 (8L+2T per Unit)	**Exam Hours: 03**
Semester: II	**Credits: 04**

Course Learning Objectives: The purpose of the course **is** to facilitate the students with concrete foundation of vector calculus, ordinary and partial differential equations, infinite series and numerical methods enabling them to acquire the knowledge of these mathematical tools.

UNIT-I

Differential Equations of higher order: -

Second order linear ODE's with constant coefficients-Inverse differential operators, method of variation of parameters; Legendre's homogeneous equations. Applications to oscillations of a spring and L-C-R circuits.

Self Study: Cauchy's homogeneous equations. **3L+ 1T**

UNIT-II

Partial Differential Equations (PDE's):

Formation of PDE's by elimination of arbitrary constants / functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE. Solution of PDE by variable separable method. Derivation of one-dimensional heat and wave equations and solution of wave equation by the method of separation of variables.

Self Study: Solution of heat equation by the method of separation of variables. **3L+ 1T**

UNIT-III

Infinite Series: Convergence and divergence of infinite series- Cauchy's root test and D'Alembert's ratio test (without proof)- Illustrative examples.

Power series solutions-Series solution of Bessel's differential equation leading to $J_n(x)$- Bessel's function of first kind, Recurrence relations, generating function, orthogonality.

Self Study: Convergence of alternating series. **3L+ 1T**

UNIT-IV

Vector Calculus: -

Vector Differentiation: Scalar and vector fields**.** Gradient, directional derivative; curl and divergence-physical interpretation; Illustrative problems. **Vector Integration:** Line integrals, Surface integrals and volume integrals. Theorems of Green, Gauss and Stokes (without proof). Applications to work done by a force and flux.

Self Study: Solenoidal and irrotational vector fields. **3L+ 1T**

UNIT V

Elementary Numerical Methods:

Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof). Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods (only formulae) - Illustrative examples.

Numerical integration: Simpson's $(1/3)^{th}$ rule, Weddle's rule (without proof).Problems.

Self Study: Numerical integration by Simpson's $(3/8)^{th}$ rule. **3L+ 1T**

Course Outcomes: On completion of this course, students are able to:

COs	Description of the course outcomes	Mastering 3	Moderate 2	Introductory 1
CO.1	Explain various physical models through higher order differential equations and solve such linear ordinary differential equations.			1,2
CO.2	Understand a variety of partial differential equations and solution by exact methods / method of separation of variables.		1,2	
CO.3	Describe the applications of infinite series and obtain series solution of ordinary differential equations.			1
CO.4	Illustrate the applications of multivariate calculus to understand the solenoidal and irrotational vectors			1,2
CO.5	Exhibit the interdependence of line, surface and volume integrals.			1,2
CO.6	Apply the knowledge of numerical methods in the models of various physical and engineering phenomena.			1,2

Text Books:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 43rd Ed., 2015.
2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed. (Reprint), 2016.

Reference books:

1. C.Ray Wylie, Louis C.Barrett : "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill Book Co., New York, 1995.
2. N.P. Bali and Manish Goyal: A Textbook of Engineering Mathematics, Laxmi Publishers, 7th Ed., 2010.
3. B.V. Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
4. Veerarajan T.," Engineering Mathematics for First year", Tata McGraw-Hill, 2008.
5. Thomas G.B. and Finney R.L. "Calculus and Analytical Geometry"9th Edition, Pearson, 2012.

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
Mapping Level												

1 -> Introductory (Slight); 2 -> Reinforce (Moderate); 3 -> Mastering (Substantial)

HoD Mathematics

SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

Detailed Syllabus

III Semester

15UMAC300	**Engineering Mathematics-III**	**(4 - 0 - 0) 4 : 52 Hrs.**

Course Learning Objectives:

Learn to represent a periodic function in terms of sine and cosine. Learn the concepts of a continuous and discrete integral transform in the form of Fourier and Z-transforms. Learn the concepts of calculus of functions of complex variables. Learn the concept of consistency, method of solution for linear system of equations and Eigen value problems. Understand the concepts of PDE and its applications to engineering.

Course outcomes:

COs	**Description of the course outcomes:** At the end of course, the students will be able to	**Mapping to POs (1-12)**		
		Mastering 3	**Moderate 2**	**Introductory 1**
CO-1	Express periodic function as a Fourier series.		1	
CO-2	Describe Fourier transform and its properties.		1	
CO-3	Define and describe Z transforms and properties and solve difference equations using Z transform.		1	
CO-4	Explore analytical functions and properties and describe Bilinear transformations.		1	
CO-5	Solve set of linear equations. Estimate rank, eigen value and eigen vectors as applied to engineering problems.		1,2	

CO-6	Construct and solve partial differential equation resulting from one dimensional heat equation and wave equation.		1,2	

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PO-13	PO-14	PO-15
Mapping Level	2	2													

1 -> Introductory (Slight); 2 -> Reinforce (Moderate); 3 -> Mastering (Substantial)

Contents:

1) Fourier Series and Fourier Transform

Fourier series, Fourier series of Even and Odd functions, exponential form of the Fourier series, half range Fourier series, practical harmonic analysis.

Infinite Fourier transform, Infinite Fourier sine and cosine transforms, properties of Inverse transform, Convolution theorem, Parseval's identity for Fourier transform, Fourier Sine and Cosine transform. **14 Hrs.**

2)Z–Transform

Basic definitions of z-transform, transform of standard forms, linearity property, damping rule, shifting rule, initial and final value theorems, Inverse z-transforms (Partial Fraction method), convolution theorem, applications of z-transforms to solve difference equations. **6 Hrs.**

3)Complex variables

Functions of complex variables, Analytic function, Cauchy-Riemann equation in cartesian and polar coordinates, Consequences of Cauchy-Riemann equations, Construction of analytic functions. Conformal Transformations: Standard transformation $w = z^2$, $w = e^z$, $w = z + \frac{a^2}{z}$ (only theoretical discussions). Bilinear Transformation. **10 Hrs.**

4) Linear Algebra

Rank of a matrix by elementary transformations, solution of system of linear equations-Gauss-Elimination method, Gauss-Seidel method and L-U

decomposition method. Eigen values and Eigen vectors. Rayleigh's power method to find the largest Eigen value and the corresponding Eigen vector. Application to Electric circuits, spring mass system, parachutist problem. **12Hrs.**

5)Partial Differential equations

Formulation of PDE by elimination of arbitrary constants/functions, Solution of Lagrange's equations. Solution of non-homogeneous PDE by direct integration, solution of homogeneous PDE involving derivative with respect to one independent variable only. Solution of First and Second order PDE by method of separation of variables. Derivation of one dimensional heat and wave equations, solutions by variable separable method, as applied to engineering problems.

10Hrs.

Reference Books:

1. Kreyszig E., Advanced Engineering Mathematics, 8th Edn, John Wiley & sons, 2003.
2. B. S. Grewal – Higher Engineering Mathematics – Khanna Publishers – 40th edition – 2007.
3. Lathi B. P, Modern Digital and Analog Communication System, 2nd edition, pp. 29-63.
4. Chapra S C and Canale R P, Numerical methods for Engineers, 5th edition, TATA McGraw- Hill, 2007.

Jenifer K

HoD Mathematics

SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

Detailed Syllabus

IV Semester

15UMAC400	**Engineering Mathematics-IV**	**(4 - 0 - 0) 4 : 52 Hrs.**

Course Learning Objectives:

Learn to solve algebraic and transcendental equations numerically. Learn the concepts of finite differences and its applications. Learn the concept of special functions. Learn fitting of a curve, correlation, regression for a statistical data. Learn the basic concepts of probability, random variables and probability distributions. Learn the concepts of stochastic process and Markov chain.

Course outcomes:

COs	**Description of the course outcomes:** At the end of course, the students will be able to	**Mapping to POs (1-12)**		
		Mastering 3	**Moderate 2**	**Introductory 1**
CO-1	Solve the problems of algebraic and transcendental equations using numerical methods.		1	
CO-2	Use numerical methods to solve first order differential equations.		1	
CO-3	Derive the solution of Bessel's differential equation, Legendre's differential equation.			1
CO-4	Analysis the bivariate statistical data and calculate correlation and regression. Apply concepts of probability to solve engineering problems.		13,14,15,16	1
CO-5	Recite Markov chains and describe stochastic process.		13,14,15,16	1,2

Pos	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PO-13	PO-14	PO-15	PO-16
Mapping Level	.4	1											2	2	2	2

1 -> Introductory (Slight); 2 -> Reinforce (Moderate); 3 -> Mastering (Substantial)

Contents:

1. **Numerical Methods**

   Roots of equations: Regula Falsi method, Newton- Raphson Method, Finite differences: Forward, Backward and central differences. Newton Gregory forward and backward interpolation formulae. Striling's and Bessel's interpolation formulae. Lagrange's interpolation formulae. Numerical integration: Simpson's $1/3^{rd}$ rule and Weddle's rule, Solutions to Engineering problems. **10 Hrs.**

2. **Numerical solution of O.D.E**

   Numerical solution of ordinary differential equations of first order and first degree, Picards method. Taylor's series method, modified Euler's method, Runge-Kutta method of fourth order. Milne's predictor and corrector methods (no derivations of formulae).

   Numerical solution of simultaneous first order ordinary differential equations: Picards method, Runge-Kutta method of fourth- order. **10 Hrs.**

3. **Special functions**

   Introduction to series solution, Series solution of Bessel's differential equation leading to Bessel function of first kind, orthogonal property of Bessel function, Series solution of Legendre's leading to Legendre's polynomial, Rodrigues formula. **8 Hrs.**

4. **Statistics and probability**

   Curve fitting by the method of least squares: $y = a+bx$, $y = a+bx+cx^2$, $y = ab^x$, Correlation and regression.

   Random Variables: Discrete and continuous random variables-PDF-CDF-Binomial, Poisson, exponential and Normal distribution. Joint probability distribution of two discrete random variables.

   Sampling: Sampling distribution, standard error, test of hypothesis for means and population, confidence limits for means. *t*-Students distribution as a test of goodness of fit. **14 Hrs.**

5. **Markov Chains**

   Markov chains –Introduction, probability vectors, Stochastic Matrices, Fixed points and Regular stochastic matrices, Markov chains, higher transition probabilities stationary distribution of regular Markov chains and absorbing states. **10 Hrs.**

Reference Books:

1. Jain, Iyengar and Jain, Numerical Methods for Engg. & Scientist, PHI, 3rd edition, 2005.
2. Gupta S C and Kapoor V K, Fundamentals of Mathematical Statistics, 9th edition, Sultan Chand & Sons, New Delhi, 2002.
3. B. S. Grewal, Higher Engineering Mathematics-Khanna Publishers –40th edition– 2007.
4. Kreyszig E., Advanced Engineering Mathematics,8th edition, John Wiley & sons,2007.

HoD Mathematics

SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

III Semester

15UDIP300	**Engineering Mathematics (Diploma)**	**(4 - 0 - 0) 4 : 52 Hrs.**

CIE Marks: 50

1) Differential Calculus:

Differentiation of n^{th} order of standard functions, Leibnitz theorem, (Statement only) with examples, polar curves, Taylor's series, Maclauri's series of simple functions for single variable.

Partial Differentiation: Definition, Euler theorem, total differentiation, Differentiation of composite and implicit functions, Jacobians illustrative examples and problems. **12hrs.**

2) Integral Calculus:

Reduction formula for functions Sin^nx, cos^nx, sin^nx, cos^mx. Double integral, simple problems, Triple integral simple problem (with standard limits), β, γ functions, properties, relation between β & γ functions simple problems. **10hrs.**

3) Differential Equations:

Solution of first order, first degree differential equations – variable separable methods homogenous equation, Bernoulli's and exact differential equations (without IF) Differential equations of second and higher orders with constant co-efficient. **10 hrs.**

4) Vectors:

Vector differentiation, Velocity, Acceleration of a vector point function, gradient, and divergence, solenoidal and irrotational fields, simple and direct problems. **6hrs.**

5) Laplace transforms:

Definitions, Laplace transforms of elementary functions, derivatives and integrals, inverse, transforms, Applications of Laplace transforms to differential equation. **12hrs.**

TEXTBOOKS:

01. Higher Engineering Mathematics - B.S Grewal
02. Higher Engineering Mathematics - H.K Das

Note: 1. Grades i) PP
ii)NP
2. No End Semester Examination
3. No Credits (Bridge Couse)

HoD Mathematics

SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

VIII Semester

15UMAE875	Applied Numerical Methods	(4 - 0 - 0) 4 : 52 Hrs.

Course Learning Objectives:

Study the numerical methods to solve algebraic, transcendental equations, partial differential equations and boundary value differential equations.

Course outcome:

COs	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to Pos (1-12)		
		Mastering 3	Moderate 2	Introductory 1
CO-1	Apply the techniques of QR and singular value decomposition, least square approximation in solving inconsistent linear systems.		1	
CO-2	Employ interpolation and extrapolation to analyze the experimental data and predict.		1	
CO-3	Apply Numerical method to solve boundary valued differential equation.	1		
CO-4	Apply Numerical Integration to compute Area.	2		
CO-5	Apply the concept of Rank to solve Engineering Application Problems.	1		
CO-6	Apply suitable Numerical method to solve partial differential equation.		1	

Contents:

Chapter I

Linear Algebra -I:

Condition number of a matrix L-U factorization method (Crout's method), Partition method. Bounds for Eigen values, Jacobi's method. Given's method. **10 Hrs.**

Chapter II

Linear Algebra-II: Gram-Schmidt orthogonalization process. QR decomposition, singular value decomposition, least square approximations**.** Applications of SVD-PCA (Principal component analysis. Multi-regression analysis. **10 Hrs.**

Chapter III

Interpolation and extrapolation

Central differences, central difference interpolation formulae. Gauss's forward interpolation formula. Gauss's backward interpolation formula, Stirling's interpolation formula, Everett's interpolation formula, Bessel's interpolation formula. Cubic Spline interpolation.

Numerical Differentiation

Derivatives using Stirling's formula, Bessel's formula.

Numerical Integration

Romberg integration, Gaussian quadrature, double integration by Trapezoidal and Simpson's l/3rd rules. **12Hrs**.

Chapter IV

Numerical solution of ODE:

Picard's method, Taylor's series method for simultaneous first order ordinary differential equations and second order Ordinary differential equations. Runge-Kutta method for simultaneous first order O.D.E and second order O.D.E, Linear Shooting method. Finite difference method. **10 Hrs.**

Chapter V

Numerical solution of PDE:

Numerical solution of one-dimensional heat equation. Bendre-Schmidt's method. Crank-Nicolsen method. Numerical solution of one-dimensional wave equation; explicit method problems. Numerical solution of two-dimensional Laplace equation. **10 Hrs.**

References

1. Richard. L. Burden, J. Douglas Faires, Numerical Analysis, Thompson Publishing Company edition - 2001.
2. M.K. Jain, S.R.K. lyengar and R.K. Jain - Numerical methods for scientific and Engineering computation New Age International Publisher - 5lh edition - 2007.
3. Anthony Ralston, Philip Rabinowitz - A first course in Numerical Analysis - McGraw Hill Publication - 2"J edition – 2001
4. B.S. Grewal Numerical methods in engineering and science Khanna Publishers 9th edition- 2010.

Pos-	PO-1	PO-2
Mapping Level	**2**	**3**

HoD Mathematics