SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

18UMAC100	**Engineering Mathematics-I**	**(3-2-0) 4**

Contact Hours: 52

Course Learning Objectives (CLOs):

This coursewillenable students tomaster thebasic tools of differential&integralcalculus, differential equations andelementary Linear algebraand become skilled in formulating, solve and analyzescienceand engineering problems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	**Apply** the knowledge of calculus to solve problems related to polar curves, curvature and its applications in determining the bentness of a curve.			1,2
CO2	**Learn** partial differentiation to calculate rate of change of multivariate functions, solve problems related to composite functions, Jacobians and application such as maxima and minima.			1,2
CO3	**Apply** the concept of multiple integration and their usage in computing the area and volumes.		1,2	
CO4	**Compute** the solution of system of equations, Eigen values and Eigen vectors and their applications.		1,2	
CO5	**Solve** first order linear differential equations analytically using standard methods and analyze engineering applications.		1,2	

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	1.6	1.6	-	-	-	-	-	-		-	-	-

Pre-requisites: A basic course on: 1. Differentiationof functions.
2. Integration of functions.
3. Matrices and Determinants.

Contents:

Unit-I

Differential Calculus-1:

Review ofelementarycalculus, Polar curves-angle between the radius vector and tangent, angle between twocurves, Pedal equation. Curvatureandradius of curvature-Cartesian and polar forms (without proof). Centre andcircle of curvature (formulae only).

Self Study: Applications to Evolute. **10L + 2T**

Unit-II

Differential Calculus-2:

Taylor's and Maclaurin'sseries expansions for one variable(statements only). Indeterminate forms $(\frac{0}{0}, \frac{\infty}{\infty}, 0\times\infty, \infty-\infty, 0^0, \infty^0, 1^\infty)$.

Partial differentiation: Euler's theorem, Total derivatives, Differentiation of composite functions. Maxima and Minima for a function of two variables, Method of Lagrange's multipliers with one subsidiary condition. Jacobians and properties (without proof).

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

Unit-III

IntegralCalculus:

Multiple Integrals: Evaluation of double integrals (direct examples and with region given. Evaluation of double integrals by change of order of integration and changing into polar co-ordinates. Evaluation of Triple integrals.

Beta and Gamma functions: Definitions, Relation between Beta and Gamma functions.

Self Study: Applications to find Area and Volume. . **8L + 2T**

Unit-IV

Elementary Linear Algebra:

Rank of a matrix- Row Echelon form. Solution of system of linear equations – consistency. Gauss-elimination method, Gauss-Seidel iterative method and LU-decomposition method. Eigen values and Eigen vectors- Rayleigh's power method. Diagonalization of a square matrix of order two.

Self Study: Elementary operations of matrices using MATLAB. **8L + 2T**

Unit-V

Ordinary Differential Equations of First Order:

Leibnitz's linear equation, Bernoulli's equation, Exact and reducible to exact differential equations. Orthogonal trajectories. Applications of ODE's to R-C circuit and L-R circuits.

Self Study: Applications of ODE's to Newton's law of cooling. **8L + 2T**

Reference Books:

1. **B.S. Grewal**: Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
2. **E. Kreyszig**: Advanced Engineering Mathematics, John Wiley & Sons, 10th edition (Reprint),2016.
3. **B.V.Ramana:** Higher Engineering Mathematics, 11th edition, Tata McGraw-Hill, 2010.

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HoD Mathematics

SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

18UMAC200	**Engineering Mathematics-II**	**(3-2-0) 4**

Contact Hours: 52

Course Learning Objectives (CLOs):

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.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO 1	**Explain** various physical models through higher order differential equations and solve such linear ordinary differential equations.		1,2	
CO 2	**Solve** problems on partial differential equations by 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	**Apply** the knowledge of numerical methods to fit an interpolating curve to the experimental data and obtain solution of transcendental equation and use numerical methods for engineering application.		1,2	
CO 5	Compute Gradient, Divergence, Curl vector valued functions and illustrate the Engineering applications through vector calculus.			1,2

Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	1.6	1.4	-	-	-	-	-	-		-	-	-

Pre-requisites: A basic course on: 1. Differentiation of functions.
2. Integration of functions.

Contents:

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. **8L+ 2T**

Unit-II

Partial Differential Equations (PDE's):

Formation of PDE's by elimination of arbitrary constants /functions. 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. Numerical solution of Laplace equation by Five-point formula and Diagonal formula.

Self Study: Solution of heat equation by the method of separation of variables. **10L+ 2T**

Unit-III

Infinite Series:

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

Special functions:

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

Self Study: Generating function of Bessel's functions. **8L+ 2T**

Unit-IV

Elementary Numerical Methods:

Solution of polynomial and transcendental equations: Newton-Raphson's and Regular-Falsi methods (only formulae) - Illustrative examples.

Finite difference: Interpolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof).

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

Self Study: Numerical integration by Simpson's $(3/8)^{th}$ rule. **8L+ 2T**

Unit-V

Vector Calculus:

Vector Differentiation: Scalar point function and vector point functions. Gradient, Directional Derivative; Curl and Divergence-physical interpretation. Solenoidal and irrotational vectors. Illustrative problems.

Vector Integration: Line integrals, Surface integrals and volume integrals. Green's theorem, Gauss divergence theorem and Stoke's theorem (only statements). Illustrative examples.

Self Study: Applications to work done by a force. **8L+ 2T**

Reference Books:

1. **B.S. Grewal**: Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
2. **E. Kreyszig**: Advanced Engineering Mathematics, John Wiley &Sons, 10th edition, (Reprint), 2016.
3. **Srimanta Pal and Subodh Chandra Bhunia:** Engineering Mathematics, Oxford University Press, 2015.
4. **B.V. Ramana**: Higher Engineering Mathematics, 11th edition, Tata McGraw- Hill, 2010.

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SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

18UMAC300	**Engineering Mathematics-III**	**(3 - 0 - 0) 3**

Contact Hours: 39

Course Learning Objectives (CLOs):

To have an insight into Laplace transforms, Fourier series, Fourier transforms, Difference equations and Z-transforms. To develop the proficiency in variational calculus and solving ODE's arising in engineering applications, using numerical methods.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Transform the given function using Laplace/Fourier transforms depending on the nature of engineering applications.			1
CO-2	Express periodic function as a Fourier series and obtain the various harmonics of the Fourier series expansion for the given numerical data.			1,2
CO-3	Solve difference equations using Z-transform.			1
CO-4	Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.		1,2	
CO-5	Determine the extremals of functional using calculus of variations and solve problems arising in engineering.			1,2

Pos	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	1.2	1.3	-	-	-	-	-	-		-	-	-

Pre-requisites: A basic course on differentiation and integration of function.

Contents:

Unit-I

Laplace Transforms: Definition and Properties. Laplace transform of elementary functions. Laplace transforms of Periodic functions and unit-step function problems.

Inverse Laplace Transforms: Inverse Laplace transform - problems, Convolution theorem (without proof) to find the inverse Laplace transform and problems, solution of linear differential equations using Laplace transform. **8 Hrs.**

Unit-II

Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions of period 2π and arbitrary period. Half- range Fourier series. Practical harmonic analysis, examples from engineering field. **8 Hrs.**

Unit-III

Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Simple problems.

Z-Transforms and Difference Equations: Z-transform- definition, Standard Z-transforms, Damping and shifting rules, Initial value and Final value theorems (without proof) with problems. Inverse Z-transform. Simple problems. Difference equations-basic definition. Application of Z-transform to solve Difference equation. **8 Hrs.**

Unit-IV

Numerical Solutions of Ordinary Differential Equations (ODE's): Numerical solution of ODE's of first order and first degree-Taylor's series method, Modified Euler's method. Runge –Kutta method of fourth order, Milne's predictor and corrector method (No derivations of formulae). Problems. **7 Hrs.**

Unit-V

Numerical Solution of Second Order ODE's: Runge-Kutta method and Milne's predictor and Corrector method. (No derivations of formulae). **Calculus of Variations**: Variation of function and functional, variational problems, Euler's equation (without proof), Geodesics (plane), hanging chain problems.**8 Hrs.**

Reference Books:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
2. E. Kreyszig: Advanced Engineering Mathematics, John Wiley& Sons, 10th edition (Reprint), 2016.
3. Srimanta Pal et al: Engineering Mathematics, Oxford University Press, 3rd edition, 2016.

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SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

18UMAC400	**Engineering Mathematics-IV**	**(3 - 0 - 0) 3**

Contact Hours: 39

Course Learning Objectives (CLOs):

To provide an insight into applications of conformal mapping, integration of complex functions and application of probability distributions in Engineering.

Course Outcomes (COs):

Description of the Course Outcomes: At the end of the course the student will be able to:		**Mapping to POs(1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Construct and use the concepts of analytic function to solve the problems arising in Engineering field.			1
CO-2	Utilize conformal transformation and complex integral to transform irregular domain onto a relatively simple domain.		1	
CO-3	Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.		1	
CO-4	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.		1,2	
CO-5	Estimate the correlation and covariance using joint probability distributions. Also use student's t-distribution, Chi-square distribution as a test of goodness of it.		1,2	

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	1.8	2	-	-	-	-	-	-		-	-	-

Pre-requisites: 1. A basic course on Differentiation and integration of function.

2. A basic course on probability and statistical averages.

Contents:

Unit-I

Calculus of complex functions: Review of function of a complex variable, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms. Construction of analytic functions: Milne-Thomson method-Problems. **7 Hrs.**

Unit-II

Conformal transformations: Introduction. Discussion of transformations $(w = e^z; w = z^2, w = z + \frac{1}{z}, z \neq 0)$. Bilinear transformations- Problems.

Complex integration: Line integral of a complex function, Cauchy's theorem and Cauchy's Integral theorem. **8 Hrs.**

Unit-III

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions-problems (No derivation for mean and standard deviation)-Illustrative examples. **8 Hrs.**

Unit-IV

Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression–problems.

Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form $= ax + b; y = ax^2 + bx + c; y = ax^b$ **.** **8 Hrs.**

Unit-V

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation and covariance.

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit. **8 Hrs.**

Reference Books:

1. E. Kreyszig:Advanced Engineering Mathematics, John Wiley & Sons 10th edition. (Reprint) 2016.
2. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.
3. Srimanta Pal et al: Engineering Mathematics, Oxford University Press, 3rd edition, 2016.

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HoD Mathematics

SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

VI Semester

18UMAO675	Applied Mathematics	(3 - 0 - 0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The students are expected to learn about mathematical modelling, use of numerical techniques to deal with engineering systems. Further, they need to learn LPP and statistical tools for interpretation. They are also expected to carry out sampling distribution analysis and use of graph theory for engineering problems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Obtain Mathematical model of Engineering Systems using different domains.		1,2	
CO-2	Formulate LPP and obtain optimal solutions using different tools.		1,2	
CO-3	Apply statistical tools to Interpret the data using different tools.		1,2	
CO-4	Determine Type errors and test for goodness of fit using different methods.		1,2	
CO-5	Use graph theory to obtain solution for engineering problems.		1,2	

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

Pre-requisites:

A basic course on the concepts of algebra, geometry, calculus, trigonometry and laws of physics, statistical averages and probability theory.

Contents:

Unit I

Introduction to Mathematical Modelling and Numerical Techniques:

Introduction, Modelling technique, classification and characteristics. Mathematical modelling through algebra, geometry, calculus, trigonometry. Mathematical model of engineering system. **8 Hrs.**

Unit II

Linear and Non-Linear programming:

Introduction, Mathematical formulation of a L.P.P, basic solution. Geometric (or graphical) method, Simplex method. Assignment problem. Non-Linear Programming –Constrained extremal problems-Lagrange's multiplier method- Kuhn- Tucker conditions and solutions. **8 Hrs.**

Unit III

Statistical Techniques:

Co-efficient of Variation, Skewness, Karl Pearson's co-efficient of Skewness, Moments, Pearson's Beta and Gamma co-efficients, Kurtosis. Time series and Forecasting. **7Hrs.**

Unit IV

Sampling distribution:

Introduction, population and samples. Type-I and Type- II errors. Test of hypothesis for means, student's t-distribution, Chi-square Distribution as a test of goodness of fit. **8 Hrs.**

Unit V

Graph Theory:

Definition of a graph theory, incidence and degree, walks, paths, circuits, Connectedness, Eulerian and Hamiltonian graphs, Trees, basic properties of trees, Binary trees, Preorder and post order traversals, Spanning and Minimal spanning trees, Connectivity and Separability, fundamental circuits and cut sets Isomorphism of graphs, Matrix representation of graphs, adjacency and incidence matrix Graph theoretical algorithms: Dijkstra, Prims and Kruskal. **8 Hrs.**

Reference Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers,44th edition,2017.
2. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons,10 edition.2016.
3. Srimanta Pal et al, Engineering Mathematics, Oxford UniversityPress,3rd edition, 2016.
4. Dougas B. West, Introduction to Graph Theory, second edition ,PH Learnig Private Limited,2009.

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SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

VIII Semester

15UMAE875	**Applied Numerical Methods**	**(4 - 0 - 0) 4**

Contact Hours: 52

Course Learning Objectives (CLOs):

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

Course Outcomes (COs):

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

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Mapping Level	**2.4**	**2.4**	-	-	-	-	-	-		-	-	-

Pre-requisites:

1. A basic course on Linear algebra.
2. A basic knowledge of ordinary and partial differential equations.

Contents:

Unit 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.**

Unit 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.**

Unit 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. **12 Hrs.**

Unit 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.**

Unit 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.**

Reference Books:

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 - 5^{lh} 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.

Jennifer K

HoD Mathematics

SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

III Semester (Bridge Course)

18UDIP300	Engineering Mathematics (Diploma)	(4 - 0 - 0) 4 : 52 Hrs.

Course Code: 18UDIP300 CTA: 50 Marks

Contact Hours/Week: 04

Unit I

Differential Calculus:

n^{th} order differentiation of standard functions. Leibnitz theorem (Statement only & illustrative examples), Taylor's series for single variable (Statement only & illustrative examples), Maclaurin's series for single variable (Statement only & illustrative examples). Indeterminate forms.

Polar curves-angle between the radius vector and tangent (Formula & illustrative examples), angle between two curves (Formula & illustrative examples). Definition of Curvature and radius of curvature. -Radius of curvature for Cartesian and polar curves (Formulas & illustrative examples). **(12 hrs.)**

Unit II

Partial Differentiation:

Definition of Partial derivative (illustrative examples), Euler's theorem (Statement only & illustrative examples), Total differentiation (illustrative examples), Differentiation of Composite functions (illustrative examples). Jacobians and its properties (No Proof) (illustrative examples). Maxima and minima for a function of two variables. **(10hrs.)**

Unit III

Integral Calculus:

Reduction formula for $\int_0^{\pi/2} \boldsymbol{sin^n x dx}$, $\int_0^{\pi/2} \boldsymbol{cos^n x dx}$ & $\int_0^{\pi/2} \boldsymbol{sin^n x cos^m x dx}$, (Formula & illustrative examples). Definition of Beta and Gamma functions (illustrative examples).Relation between Beta and Gamma functions (No Proof) (illustrative examples). Evaluation of Double integral (direct and region given), Change of order of integration, Change of variables. Evaluation of Triple integral (direct examples). **(12hrs.)**

Unit IV

Differential Equations of higher order

Solution of Second order Linear ordinary differential equation with constant coefficients. Method of variation of parameters. Legendre's homogeneous equations. **(10 hrs.)**

Unit V

Vector Calculus: -

Vector Differentiation: Scalar point function and vector point functions. Gradient, Directional Derivative; Curl and Divergence-physical interpretation. Solenoidal and irrotational vectors. Illustrative problems.

Vector Integration: Line integrals, Surface integrals and Volume integrals. Green's theorem, Gauss divergence theorem and Stoke's theorem (only statements). **(8 hrs.)**

TEXT BOOKS

Higher Engineering Mathematics - B.S GrewalHigher Engineering Mathematics - H.K Das

Note: 1. Grades (i) PP (ii) NP

2. No Semester End Examination 3. No Credits (Bridge Couse)

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