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: 100**
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.

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

CO.1	Apply the knowledge of calculus to solve problems related to polar curves, curvature and its applications in determining the bentness of a curve.
CO.2	Learn partial differentiation to calculate rates of change of multivariate functions, solve problems related to composite functions, Jacobians and application such as maxima and minima.
CO.3	Apply the concept of multiple integration and their usage in computing the area and volumes.
CO.4	Compute the solution of system of equations, Eigen values and Eigen vectors and their applications.
CO.5	Solve first order linear differential equations analytically using standard methods and analyze engineering applications.

CHAPTER-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).

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

CHAPTER- II

Differential Calculus-2: -

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

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

CHAPTER -III

Integral Calculus: -

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**

CHAPTER -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. 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**

CHAPTER -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- R-C circuit and L-R circuits.

Self Study: Applications of ODEs to Newton's law of cooling and Applications of orthogonal trajectories. **8L + 2T**

Textbooks:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
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/

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, curvature and its applications in determining the bentness of a curve.			1,2
CO.2	Learn partial differentiation to calculate rates of change of multivariate functions, solve problems related to composite functions, Jacobians and application such as maxima and minima.			1,2
CO.3	Apply the concept of multiple integration and their usage in computing the area and volumes.		1,2	
CO.4	Compute the solution of system of equations, Eigen values and Eigen vectors and their applications.			
CO.5	Solve first order linear differential equations analytically using standard methods and analyze engineering applications.		1	

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.

Description of the course outcomes: On completion of this course, students are able to:

CO.1	Explain various physical models through higher order differential equations and solve such linear ordinary differential equations.
CO.2	Solve problems on partial differential equations by method of separation of variables.
CO.3	Describe the applications of infinite series and obtain series solution of Bessel's differential equations.
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.
CO.5	Compute Gradiant , Divergence, Curl vector valued functions and Illustrate the Engineering applications through vector calculus.

CHAPTER-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**

CHAPTER -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. **8L+ 2T**

CHAPTER-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 Bessels function

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

CHAPTER –IV

Elementary Numerical Methods:

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

Finite differences. 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**

CHAPTER- 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 example.

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

Text Books:

1. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
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/

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	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 Gradiant, 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	1.2	1.2										

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

Jenifer.K

HoD Mathematics

SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

III Semester

18UMAC300 Engineering Mathematics-III (3 - 0 - 0) 4 : 39 Hrs.

Contact Hours: 39

Course Learning Objectives:

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.

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	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

Content

Chapter I

Laplace Transforms: Definition and Properties. Laplace transforms 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.**

Chapter 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.**

Chapter 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.**

Chapter 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.**

Chapter 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.**

Textbooks:

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

Reference books:

1. C. Ray Wylie, Louis C. Barrett : "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill Book Co., New York, 1995.
2. S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India, 4th Edition 2010.
3. B. V. Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
4. N. P. Bali and Manish Goyal : A Text Book of Engineering Mathematics, Laxmi Publishers, 7th Ed., 2014.
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.

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http://www.class-central.com/subject/math(MOOCs).
http://academicearth.org/.

VTU EDUSAT PROGRAMME – 20.

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	1.2	1.3													

1. Introductory (Slight) 2. Reinforce (Moderate) 3.Mastering (Substantial)

HoD Mathematics

SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

IV Semester

18UMAC400	**Engineering Mathematics-IV**	**(3 - 0 - 0) 3 : 39Hrs.**

Contact Hours:39

Course Learning Objectives: 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 course, the students will be able to	**Mapping to POs (1-12)**		
		Mastering 3	**Moderate 2**	**Introductory 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, covariance using joint probability distributions. Also use student's t-distribution, Chi-square distribution as a test of goodness of fit .		1,2	

Contents:

Chapter 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.**

Chapter II

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

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

Chapter 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.**

Chapter 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.**

Chapter 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.**

Textbooks:

1. E. Kreyszig:Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint) 2016.
2. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
3. Srimanta Pal et al: Engineering Mathematics, Oxford University Press, 3rd Edition, 2016. Reference books:
4. C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill Book Co., New York, 1995.
5. S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India, 4th Edition 2010.
6. B. V. Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.
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3. http://academicearth.org/.

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mapping Level	1.8	2														

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

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. **12 Hrs.**

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 Internationa! 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

SDM COLLEGE OF ENGINEERING & TECHNOLOGY, DHARWAD

Department of Mathematics

III Semester

Course Code: 18UDIP300 **CTA: 50 Marks**

Contact Hours/Week: 04

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

Chapter 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 only & illustrative examples), angle between two curves (Formula only & illustrative examples). Definition of Curvature and radius of curvature. -Radius of curvature for Cartesian and polar curves (Formula only & illustrative examples). **(12 hrs)**

Chapter 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)**

Chapter 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 only & 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)**

Chapter 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)**

Chapter 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)**

TEXTBOOKS:

Higher Engineering Mathematics - B.S Grewal

Higher Engineering Mathematics - H.K Das

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

2.No Semester End Examination

3.No Credits (Bridge Couse)

Jennifer K

HoD Mathematics