Detailed Syllabus
I Semester (2017-18)

15UMAC100 Engineering Mathematics-I (4 - 0 - 0) 4 : 52 Hrs.

Course Objectives:

To introduce the concept of differential calculus that finds the applications in various fields like Mechanics, Fluid flow, heat problem and potential theory and in many other areas. To learn the concept of polar coordinate system and its applications to engineering problems. To introduce the concept of differential equation and the application in various fields like electrical circuits, wave, heat conduction and other fields. Study the concept of vector calculus and it's properties. To prepare the students to formulate, solve and analyze engineering problems.

Course outcome: At the end of course the student should be able to :

CO-1	Derive n^{th} derivative of function. Examine the function by Cauchy's mean value theorem. Express the function as an infinite series.
CO-2	Evaluate limits with indeterminate forms using L'Hospital's rule. Derive angle between curves and radius of curvature.
CO-3	Discuss Partial derivatives and apply to study the behavior of function. Express function of two variable as an infinite series.
CO-4	Solve first order liner and exact differential equations.
CO-5	Define and discuss the concept of vector calculus.
CO-6	Apply to solve Physics and Engineering problems.

Contents:

1) **Differential Calculus (I)**
Hyperbolic functions:sinhx, coshx, tanhx, sechx, cosechx, cothx. Determination of n^{th} derivative of standard functions, illustrative examples. Leibnitz's theorem (without proof) and problems. Rolle's theorem (statement) and Cauchy's mean value theorems. Taylor's and Maclaurin's theorems for a function of a single variable (without proofs) and problems. **10 Hrs.**

2) **Differential Calculus (II)**
Indeterminate forms, L–Hospital's rule (without proof) and problems. Polar curves: Angle between the radius vector and tangent, angle between the Polar curves and Pedal equation for polar curves. Radius of curvature - Cartesian, parametric and polar forms. **10Hrs.**

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3) Differential Calculus (III)

Partial derivatives, Euler's Theorem, Total differentiation, Differentiation of composite and implicit functions, Jacobians, Error and approximation, Illustrative Engineering oriented problems. Taylor's and Maclaurin's expansions of a function of two variables and illustrative examples. Maxima and Minima for functions of two variables. Lagrange's method of undetermined multipliers. **12 Hrs.**

4) Differential equation (I)

Equations of First order and First degree:
Linear Differential equation, Equation Reducible to the Linear form (Bernoulli's differential equation). Exact differential equation, equation reducible to exact differential equation. Applications: Orthogonal Trajectories of Curves (Cartesian and Polar). Formulation of differential equation to L-R series circuit and R-C series circuit and their Physical interpretations. Newton's law of cooling. **10 Hrs.**

5) Vector Differentiation

Scalar and vector point function. Differentiation of vector function. Velocity and Acceleration and related problems. Gradiant of scalar point function, Divergence of vector point function, Solenoidal vectors. Curl of vector point function, Irrotational vectors. Vector identities: div(ØA),curl(ØA),curl(gradØ),div(curlØA). **10 Hrs.**

References:

1. Grewal B.S , Higher, Engineering Mathematics, 40th Edn, Khanna Publications, New Delhi- 2007
2. Kreyszig, E, Advanced Engineering Mathematics, 8th Edn, John Wiley & Sons, 2004
3. Bali and Iyengar, A text book of Engineering Mathematics, 6th Edn. Laxmi publications (P) Ltd. New-Delhi, 2003.
4. Early Transcendentals Calculus- James Stewart, Thomson Books, 5e 2007

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Dr K.S. Basavarajappa

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Detailed Syllabus

II Semester (2017-18)

15UMAC200 Engineering Mathematics-II (4 - 0 - 0) 4 : 52 Hrs.

Course Objectives:

Learn to solve 2nd and higher order linear differential equation with constant/ variable co-efficient. Learn to evaluate improper integrals using Beta & Gamma functions. Study Laplace Transforms and Inverse Laplace Transform that finds applications in various fields of engineering. Learn the concept of vector Integration. To prepare the students to formulate, solve and analyze engineering problems.

Course Outcome: At the end of course the student will be able to :

CO-1	Solve higher order linear differential equations.
CO-2	Evaluate definite integrals using reduction formulas, Beta function and Gamma function.
CO-3	Evaluate double and triple integrals.
CO-4	Define and Discuss Laplace transform and inverse Laplace transform of a given function and its properties. Apply to solve differential equations.
CO-5	Define and discuss the concept of vector Integration.
CO-6	Apply to solve Physics and Engineering problems.

Contents:

1) **Differential Equations (II)**

Linear differential equations of 2nd and higher order with constant coefficients. Cauchy Homogeneous Linear differential equation, Legendre's Homogenous linear differential equation. Method of variation of parameters. Applications: Formulation of differential equation to R-L-C series circuit and their Physical interpretations. Simple Harmonic motion and deflection of beams. **12 Hrs.**

2) **Integral Calculus (I)**

Reduction formula for $\int Sin^{n} x dx, \int Cos^{n} x dx, \int Sin^{m} x Cos^{n} x dx$ (no derivations) and problems. **Beta function:** Definitions, Properties and Problems. **Gamma Functions:** Definition, properties and problems. Relation between Beta and Gamma functions.

Definitions, Properties and Problems on Beta and Gamma functions. Relation between Beta and Gamma functions. Tracing of standard curves in Cartesian, parametric and polar forms. Application to find area, length, volume and surface area of solid of revolution. **12 Hrs.**

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3) Integral Calculus (II)

Multiple Integrals, Evaluation of double integrals and triple integrals. Evaluation of double integrals over a given region by change of order of integration, by change of variables and applications to area and Volume. **8 Hrs.**

4) Laplace Transforms

Introduction. Laplace Transform of Elementary Functions. Properties of Laplace Tansforms. Laplace Transform of $t^n f(t)$, Laplace Transform of $\frac{f(t)}{t}$. Laplace transform of derivative of f(t). Laplace Transform of periodic function. Heaviside shifting theorem .

Inverse Laplace Transforms

Definition of Inverse Laplace transform. Inverse Laplace transform of elementary functions and problems. Convolution theorem. Solutions of Ordinary Differential Equations by Laplace transform. Applications : Solution of LRC series circuits and vibration of strings . **14 Hrs.**

5) Vector Integration

Line Integrals, Surface Integrals and volume integrals. Greens theorems, Stokes theorems, Gauss- divergence theorem (Theorems statement only) and problems. **6 Hrs.**

References:

1. Grewal B.S., Higher Engineering Mathematics, 40th Edn, Khanna Publications, New Delhi-2007
2. Kreyszig, E., Advanced Engineering Mathematics, 8th Edn. John Wiley & Sons, 2004.
3. Early Transcendental Calculus- James Stewart, Thomson Books, 5e 2007
4. Bali and Iyengar, A text book of Engineering Mathematics, 6th Edn. Laxmi Publications (P) Ltd. New-Delhi, 2003

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Detailed Syllabus
III Semester (2017-18)

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

Course 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 outcome: At the end of course the students will be able to

CO-1	Express periodic function as a Fourier series analytically and numerically.
CO-2	Discuss Fourier transform and its properties.
CO-3	Define and discuss Z transforms and its properties. Solve difference equations using Z transforms.
CO-4	Define analytical functions. Discuss its properties and Bilinear transformations.
CO-5	Solve system of linear equations. Estimate rank, eigen value and eigen vector. Apply to solve engineering problems.
CO-6	Construct and solve partial differential equation. Apply to solve one dimensional heat equation and wave equation.

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 and practical harmonic analysis.

Fourier transform, Fourier sine transform and Fourier cosine transforms, properties of Fourier transform, Convolution theorem, Parseval's identity for Fourier transform, Fourier sine transform and Fourier 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.**

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3) Complex variables

Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates, Consequences of Cauchy-Riemann equations, Construction of analytic functions. Conformal Transformations: Standard transformation $w = z^2, w = e^z, w = z + \frac{a^2}{z}$ (no problems).Bilinear Transformation.

10Hrs.

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, Lagrange's solution of first order linear PDE. Solution of homogeneous PDE involving derivative with respect to one independent variable only. Solution of non-homogeneous PDE by direct integration, Solution of First and Second orders PDE by method of separation of variables. Formulation of one dimensional heat equation, Formulation of one dimensional wave equation and their solutions by variable separable method. Application to engineering problems. **10Hrs.**

References:

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. Srimanta Pal and Subodh C. Bhunia. Engineering Mathematics Oxford university press. 2015.
4. Bali and Iyengar, A text book of Engineering Mathematics, 6th Edn. Laxmi publications (P) Ltd. New-Delhi, 2003.

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Detailed Syllabus

IV Semester

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

Course 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 outcome: The students will be able to :

CO-1	Solve the algebraic and transcendental equations using numerical methods.
CO-2	Use numerical methods to solve first order differential equations
CO-3	Derive the solution of Bessel's differential equation, Legendre's differential equation from Laplace equation and discuss its properties.
CO-4	Analysis the bivariate statistical data and calculate correlation and regression. Employ concepts of probability to solve the problem related to engineering field.
CO-5	Define Markov chains and discuss the stochastic process.
CO-6	Apply to solve Physics and Engineering problems.

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. Applications to engineering problems. **10Hrs.**

2) **Numerical solution of O.D.E:**
Numerical solution of ordinary differential equations of first order and first degree. Picard's 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: Picard's method Runge-Kutta method of fourth- order. **10Hrs.**

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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 functions. Series solution of Legendre's differential equation leading to Legendre polynomials , Rodrigue's 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 properties, confidence limits for means. Student's *t*-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:

1. B. S. Grewal, Higher Engineering Mathematics – Khanna Publishers – 40th edition – 2007.
2. Kreyszig E., Advanced Engineering Mathematics, 8th Edn, John Wiley & sons, 2007.
3. Srimanta Pal and Subodh C. Bhunia. Engineering Mathematics Oxford university press. 2015.
4. Jain, Iyengar and Jain, Numerical Methods for Engg. & Scientist, PHI, 3rd Edn., 2005.

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Detailed Syllabus
VIII Semester (2017-18)
Open Elective for BE Students

11UMAE875	Applied Numerical Methods	(4 - 0 - 0) 4 : 52 Hrs.

Course Objectives:

With the advent of the modern high speed electronic digital computers, the numerical methods have been successfully applied to study problems in mathematics. Learn to solve numerically, algebraic, transcendental equation, boundary valued differential equations, double integration, boundary valued partial differential equations. Learn to evaluate an unknown function by finite differences. Study properties of matrices to solve linear algebraic system.

Course outcome: Upon the completion of the course, the student should be able to :

CO-1	Solve algebraic and transcendental equations.
CO-2	Employ interpolation to analyze a data satisfying a polynomial.
CO-3	Apply numerical method to solve boundary valued differential equation.
CO-4	Apply numerical methods to solve single and double definite integral.
CO-5	Employ matrix method to solve system of linear equation.
CO-6	Apply numerical method to solve partial differential equation.

Contents:

1. Numerical solution of Algebraic and Transcendental equations:
Fixed point iteration method, Aitken's process method, Horner's method, Grafee's root squaring method, Birge-Vietta method, Lin-Bairstow's method. Solution of system of non-linear equations Newton-Raphson's method. **10 Hrs**

2. Interpolation:
Central difference interpolation formulae; Gauss's forward interpolation formula, Gauss's backward interpolation formula. Stirling's formula, Bessel's formula, Everett's formula,. Hermite interpolation formula and interpolation with Cubic Spline. **10Hrs**

3. Numerical Differentiation and Integration
Derivatives using Stirling's formula, Bessel's formula. Single integration; Romberg's method, Gaussian integration. Double integration ; Trapezoidal and Simpson's $1/3^{rd}$ rules. **8 Hrs**

4. Numerical solution of ODE:
Numerical solution of first order simultaneous ordinary differential equation by Picard's method and Runge-Kutta method. Numerical solution of second order ODE by Picard's method and Runge-Kutta method. Solution of boundary value problem by Finite difference method, Shooting method and Rayleigh -Ritz method. **8 hrs**

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5. Numerical solution of PDE:
Finite diffence approximation to partial derivatives, Numerical solution of one dimensional heat equation by Bendre-Schmidt's method. Crank-Nicolsen's method and problems. Numerical solution of one dimensional wave equation by explicit method and problems.

8 Hrs

5. Linear Algebra:
Condition number of a matrix. Solution of linear simultaneous algebraic equation by Matrix inversion method. Triangularization method; Crouts method(Dolittle's method), Partition method, Relaxation method. Eigen values and Eigen vectors: Bounds for Eigen values, Jacobi's method and Given's method to find Eigen values and Eigen vectors.

8 Hrs

References

1. S.S.Sastry, Introductory methods of Numerical Analysis, 5th Edn, Thompson Publishing Company.
2. M.K. Jain, S.R.K. lyengar and R.K. Jain - Numerical methods for scientific and Engineering computation New Age Internationa! Publisher - 6lh edition - 2012.
3. Anthony Ralston, Philip Rabinowitz - A first course in Numerical Analysis - McGraw Hill Publication - 2nd edition – 2001
4. B.S.Grewal-Numerical methods in engineering and science- Khanna Publishers 9th edition- 2010.

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Dr K.S. Basavarajappa.

BIET, Davangere.