Siddaganga Institute of Technology, Tumkur – 572 103

(An Autonomous Institution affiliated to Visvesvaraya Technological University, Belgaum)

Engineering Mathematics-I (Common to all branches)

Contact Hours/ Week	3(L)+2(T)	Credits	4
Total Lecture Hours	40	CIE Marks	50
Total Tutorial Hours	20	SEE Marks	50
Sub Code	1RMAT1	Semester	I

Prerequisites: Basics in differential calculus, Integral calculus and Vectors.

Course Learning Objectives: This course will enable students to master the basic tools of differential and vector calculus, infinite series and differential equations and become skilled for solving problems in science and engineering.

Course objectives: This course will enable students to:

1. Know the behavior of the polar curve and its application.
2. Handle the indeterminate form; determine the extremities of functions of two variables.
3. Learn how the vectors govern the physical models.
4. Understand the behavior of the infinite series.
5. Know how the real word problems governed by the first order differential equations.

Course outcomes: After the completion of this course, students will be able to:

1. Apply the knowledge of calculus to solve problems related to polar curves and its applications in determining the bentness of the curve. (L1& L2)
2. Learn the notation of partial differentiation to calculate rates of change of multivariate functions and solve problems related to composite functions and applications. (L1& L2)
3. Illustrate the applications of multivariate calculus to understand the characteristics of vector field. (L1& L2)
4. Describe the convergence and divergence of infinite series and understand how a function of single variable can be expanded as a Taylor's series. (L1& L2)
5. Apply the analytical methods to solve first order and first-degree differential equations and solve some Engineering problems. (L1& L2)

UNIT-I: Differential Calculus-I
Polar curves: angle between the radius vector and tangent, angle of intersection of polar curves. Pedal equation for polar curves. Curvature and radius of curvature -Cartesian and pedal forms. (Without proof) (L1& L2)   (8+4) hrs

UNIT – II: Differential Calculus –II
Indeterminate forms L' Hospital Rule (without proof), Partial differentiation: Partial derivatives, Total derivatives-differentiation of composite functions. Maxima and minima for a function two variables; Method of Lagrange's Multipliers with one subsidiary condition. Applications of maxima and minima with illustrative examples. (L1& L2)   (8+4) hrs

UNIT – III: Vector Calculus
Vector Differentiation: scalar and vector fields, Gradient, directional derivative, divergence, curl-physical interpretation; solenoidal and   irrotational vector fields-illustrative problems. (L1& L2)   (8+4) hrs

UNIT-IV: Infinite Series
Convergence and divergence of infinite series-p-series test, comparison test, Cauchy's root test and D'Alembert's ratio test, Raabe's test (without proof)-Illustrative examples. Taylor's and Maclaurin's series expansions for one variable (statement only). (L1& L2)   (8+4) hrs

UNIT-V: Differential Equations-I
Solution of first order and first degree differential equations: Linear differential equations and Bernoulli's equation. Exact differential equations. Applications: Orthogonal trajectories (Cartesian form), Newton's law of cooling, flow of electricity, law of decay and growth. (L1& L2)   (8+4) hrs

Text Books:
1. Erwin Kreyzig, "Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2016.
2. B. S. Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.

Reference Books:
1. Maurice D. Weir, Joel R. Hass and George B. Thomas, "Thomas' calculus**:** Early Transcendentals", 12th edition, Pearson Education**,** 2016
2. Ramana .B.V, **"**Higher Engineering Mathematics"**,** 11th edition**,** Tata-McGraw Hill. 2010
3. C.Ray Wylie, Louis. C. Barrett "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.
5. Peter V.o 'Neil, "Advanced Engineering Mathematics", 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012.

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Engineering Mathematics-II (Common to all branches)

Contact Hours/ Week	3(L)+2(T)	Credits	4
Total Lecture Hours	40	CIE Marks	50
Total Tutorial Hours	20	SEE Marks	50
Sub Code	2RMAT1	Semester	II

Prerequisites: Basics in differential calculus, Integral calculus and vectors.

Course Learning Objectives: This course will facilitate the students with concrete foundation of ordinary differential equations, Laplace transforms, Integral calculus and numerical methods enabling them to acquire the knowledge of these mathematical tools.

Course outcomes: After the completion of this course, students will be able to:

1. Explain various physical models through higher order differential equations and solve such linear ordinary differential equations. (L1& L2)
2. Understand the concept of Laplace transform and obtain Laplace transform of periodic functions and unit step functions. (L1& L2)
3. Apply the concept of Laplace transform in solving Linear Differential equations. (L1& L2)
4. Apply the concept of change of order of integration and change of variables to evaluate multiple integrals and their usage in computing the area and volume. (L1& L2)
5. Apply the Numerical methods to solve Algebraic and transcendental equations and find the polynomials by finite difference method. (L1& L2)

UNIT-I: Linear Differential Equations
Solution of second and higher order equations with constant coefficients by inverse differential operator method, method of variation of parameters, solution of Cauchy's and Legendre's Linear differential equations. Engineering applications: oscillation of simple pendulum and spring, LCR circuits. (L1&L2)   (8+4) hrs

UNIT – II: Laplace Transform
Definition, Transforms of elementary functions, properties of Laplace Transform, Laplace Transform of $t^n f(t)$, $\frac{1}{t} f(t)$, derivatives and Integrals. Laplace Transform of Periodic functions, unit step function. (L1& L2)   (8+4) hrs

UNIT-III: Inverse Laplace Transform
Inverse Laplace Transform, Convolution theorem (without proof) and problems. Applications –Solution of Linear differential equations using Laplace Transform. (L1& L2)   (8+4) hrs

UNIT-IV: Integral Calculus
Reduction formulae for the integrals of $sin^n x, cos^n x, sin^m x cos^n x$, and evaluation of these integrals with standard limits-problems. **Beta and Gamma functions**: Definition, relation between Beta and Gamma functions and simple problems.
Multiple integrals –Evaluation of double and triple Integrals, evaluation of Double integrals- change of order of integration, Jacobians and change of variables. Applications to find area and volume. (L1& L2)   (8+4) hrs

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 method (only formula) – Illustrative examples. (L1& L2)   (8+4) hrs

Text Books:
1. Erwin Kreyzig, "Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2016.
2. B. S. Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.

Reference Books:
1. Maurice D. Weir, Joel R. Hass and George B. Thomas, "Thomas' calculus**:** Early Transcendentals", 12th edition, Pearson Education, 2016
2. Ramana .B.V, **"**Higher Engineering Mathematics"**,** 11th edition**,** Tata-McGraw Hill. 2010
3. C.Ray Wylie, Louis. C. Barrett "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.
5. Peter V.o 'Neil, "Advanced Engineering Mathematics", 7th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012.

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ENGINEERING MATHEMATICS – III (EC,TC,EE,IT)

Contact Hours/ Week	: 3 (L)+1(T)	Credits :	3.5
Total Lecture Hours	: 39 +13	CIE Marks :	50
Total Tutorial Hours	: 13	SEE Marks :	50
Sub. Code	: 3MAT3A		

Prerequisites: Engineering Mathematics-I and Engineering Mathematics-II.

Course objective:
1. To introduce the concept of analytic function, transformation for mapping.
2. The concept of complex variables to evaluate the integrals.
3. Introduce partial differential equations, use separation of variable method to solve wave, heat and Laplace equations.
4. Introduction of Finite difference approximation to derivatives to partial differential equations.
5. To represent a periodic signal as an infinite sum of sine wave components.

Course Outcomes: Upon completion of this course the student will be able to:
1. Apply basic mathematical operations on complex numbers in Cartesian and polar forms. Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation (L3,L1)
2. Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues(L3).
3. Formulate and solve partial differential equations. Use of separation of variable method to solve wave, heat and Laplace equations (L4).
4. Compute the numerical solution of partial differential equations (L4).
5. Represent a periodic function as a Fourier series. Compute the Fourier coefficients numerically (L3).

UNIT-I :Complex Variables   9 + 3 Hours

Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions (Statement only). Geometrical representation of $f(z)=w$, Conformal transformation: $w=e^z$, $w=z+\frac{1}{z}$, $w=z^2$, $w=c oshz$.

UNIT-II: Complex Integration   **6 + 3 Hours**
Bilinear transformation, Properties, Complex integration, Cauchy's theorem (statement only), Converse of Cauchy's theorem, Cauchy's integral formula (statement only), zeros & singularities of an analytic function, residues, residues theorem, calculation of residues.

UNIT – III : Partial differential equations (P.D.E.)   **8 + 3 Hours**
Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. **Applications of P.D.E.:** Classification of PDE, Solution of one dimensional heat, wave and two dimensional Laplace's equations by the method of separation of variables.

UNIT-IV :Numerical Solutions to the Partial differential equations   **8 + 2 Hours**
 Introduction, Finite difference approximation to derivatives, Elliptic equations, Solution of Laplace's equations, Parabolic equations, Solution of heat equation, Hyperbolic equations, Solution of wave equation.

UNIT – V:Fourier Series   **8 + 2 Hours**
Periodic functions, Fourier Expansions, Half Range Expansions, Complex form of Fourier series, Practical Harmonic Analysis.

Text Book:
1. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.

Reference Books:
1. Ramana .B.V, **"Higher Engineering Mathematics",** latest edition, Tata-McGraw Hill, 2016
2. Erwin Kreyszig, "Advanced Engineering Mathematics" , 10th edition, Wiley Publications, 2015.
3. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill,2014.

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ENGINEERING MATHEMATICS – III (Civil Engineering)

Contact Hours/ Week	: 3 (L)+1(T)	Credits :	3.5
Total Lecture Hours	: 39 +13	CIE Marks :	50
Total Tutorial Hours	: 13	SEE Marks :	50
Sub. Code	: 3MAT3B		

Prerequisites: Engineering Mathematics-I and Engineering Mathematics-II.

Course objectives:
1. To introduce the concept of analytic function, transformation for mapping.
2. To introduce the concept of complex variables to evaluate the integrals
3. To introduce the concept of partial differential equations, use separation of variable method to solve wave, heat and Laplace equations.
4. To represent a periodic signal as an infinite sum of sine wave components.
5. To find optimal solutions to engineering problems whose optimum may be a certain quantity, shape and function..

Course Outcomes:
Upon completion of this course the student will be able to:
1. Apply basic mathematical operations on complex numbers in Cartesian and polar forms. Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation (L3,L1)
2. Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues (L3).
3. Formulate and solve partial differential equations. Use of separation of variable method to solve wave, heat and Laplace equations(L4).

4. Represent a periodic function as a Fourier series. Determine the Fourier transform of a given function(L3).
5. Compute extreme values of a variational problems like geodesics, least time and shortest path(L3).

UNIT-I : Complex Variables   **9 + 3 Hours**

Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions(Statement only). Geometrical representation $f(z)=w$, Conformal transformation: $w=e^z$, $w=z+\frac{1}{z}$, $w=z^2$, $w=cosh\ z$.

UNIT-II: Complex Integration   **6 + 3 Hours**

Bilinear transformation, Properties, Complex integration, Cauchy's theorem (statement only), Converse of Cauchy's theorem, Cauchy's integral formula (statement only), zeros & singularities of an analytic function, residues, residues theorem, calculation of residues.

UNIT – III: Partial differential equations (P.D.E.)   **8 + 3 Hours**

Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. **Applications of P.D.E.:** Classification of PDE, solution of one dimensional heat wave and two dimensional Laplace's equation by the method of separation of variables.

UNIT – IV :Fourier Series & Fourier Transforms   **9 + 2 Hours**

Periodic functions, Fourier Expansions, Half Range Expansions, Complex form of Fourier series, Infinite Fourier Transforms, Properties (Statements only), Inverse Transforms.

UNIT-V :Calculus of Variation   **7 + 3 Hours**

Variation of a function and a functional, Extremal of a functional, Variational problems, Euler's equation, Standard Variational problems including geodesics, Minimal surface of revolution, hanging chain and Brachistrochrone problem.

Text Book:
1. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.

Reference Books:
1. Ramana .B.V, **"Higher Engineering Mathematics",** latest edition, Tata-McGraw Hill, 2016
2. Erwin Kreyszig, "Advanced Engineering Mathematics" , 10th edition, Wiley Publications, 2015.
3. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.

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MATHEMATICAL CONCEPTS FOR INFORMATION TECHNOLOGY (CSE, ISE)

Contact Hours/ Week	: 3 (L)+1(T)	Credits :	3.5
Total Lecture Hours	: 39 +13	CIE Marks :	50
Total Tutorial Hours	: 13	SEE Marks :	50
Sub. Code	: 3MAT3C		

Prerequisites: Engineering Mathematics-I and Engineering Mathematics-II.

Course objectives:
1. To introduce the concept of analytic function, transformation for mapping.
2. To introduce the concept of complex variables to evaluate the integrals
3. To introduce the concept of partial differential equations, use separation of variable method to solve wave, heat and Laplace equations.
4. To develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusion.
5. To introduce the basic concepts and applications of probability in engineering.

Course Outcomes:
Upon completion of this course the student will be able to:
1. Apply basic mathematical operations on complex numbers in Cartesian and polar forms. Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation (L3,L1)
2. Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues (L3).
3. Formulate and solve partial differential equations. Use of separation of variable method to solve wave, heat and Laplace equations (L3).
4. Apply least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data (L3)
5. Determine the nature of the events and hence calculate the appropriate probabilities of the events (L3).

UNIT-I : Complex Variables   **9 + 3 Hours**
Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions (Statement only). Geometrical representation $f(z)=w$, Conformal transformation: $w=e^z$, $w=z+\frac{1}{z}$, $w=z^2$, $w=cosh\ z$.

UNIT-II :Complex Integration   **6 + 3 Hours**
Bilinear transformation, Properties, Complex integration, Cauchy's theorem (statement only), Converse of Cauchy's theorem, Cauchy's integral formula (statement only), zeros & singularities of an analytic function, residues, residues theorem, calculation of residues.

UNIT – III : Partial differential equations (P.D.E.)   **8 + 3 Hours**
Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. **Applications of P.D.E.:** Classification of PDE, solution of one dimensional heat wave and two dimensional Laplace's equation by the method of separation of variables.

UNIT-IV : Statistics   **8 + 2 Hours**
Introduction, Definitions, Curve Fitting, equation of Straight line, parabola and exponential, correlation and regression, formula for correlation coefficient, regression lines and angle between the regression lines.

UNIT-V : Probability Theory   **7 + 2 Hours**
Basic terminology, Definition of probability, Probability and set notations, Addition law of probability, independent events, conditional probability, multiplication law of probability, Baye's theorem.

Text Book:
1. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.

Reference Books:
1. Ramana .B.V, **"Higher Engineering Mathematics",** latest edition, Tata-McGraw Hill, 2016
2. Erwin Kreyszig, "Advanced Engineering Mathematics" , 10th edition, Wiley Publications, 2015.
3. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill 2014.

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ENGINEERING MATHEMATICS – III (Chem, BT)

Contact Hours/ Week	: 3 (L)+1(T)	Credits :	3.5
Total Lecture Hours	: 39 +13	CIE Marks :	50
Total Tutorial Hours	: 13	SEE Marks :	50
Sub. Code	: 3MAT3D		

Prerequisites: Engineering Mathematics-I and Engineering Mathematics-II.

Course objectives:
1. To introduce the concept of analytic function, transformation for mapping.
2. To introduce the concept of complex variables to evaluate the integrals
3. To introduce the concept of partial differential equations, use separation of variable method to solve wave, heat and Laplace equations.
4. To make the student to apply the numerical methods to solve algebraic and transcendental equations.
5. To Solve the system of equation analytically and numerically.

Course Outcomes:

Upon completion of this course the student will be able to:
1. Apply basic mathematical operations on complex numbers in Cartesian and polar forms. Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation (L3,L1)
2. Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues(L3).
3. Formulate and solve partial differential equations. Use of separation of variable method to solve wave, heat and Laplace equations(L3).
4. Use numerical Methods to compute the roots of an algebraic or transcendental equations (L3).
5. Solve the system of equation analytically and numerically (L3).

UNIT-I :Complex Variables 9 + 3 Hours

Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions. Geometrical representation $f(z)=w$, Conformal transformation: $w=e^z$, $w=z+\frac{1}{z}$, $w=z^2$, $w=\cosh z$.

UNIT-II :Complex Integration 6 + 3 Hours

Bilinear transformation, Properties, Complex integration, Cauchy's theorem (statement only), Converse of Cauchy's theorem, Cauchy's integral formula (statement only), zeros & singularities of an analytic function, residues, residues theorem, calculation of residues.

UNIT – III :Partial differential equations (P.D.E.) 8 + 3 Hours

Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. **Applications of P.D.E.:** Classification of PDE, solution of one dimensional heat wave and two dimensional Laplace's equation by the method of separation of variables.

UNIT – IV :Roots of equation 8 + 2 Hours

Introduction, Bracketing methods – Bisection & Regula-falsi methods. Open methods – Secant method, Newton-Raphson method, multiple roots, Muller's method.

UNIT – V :System of linear algebraic equations 8 + 2 Hours

Rank of a matrix by echelon form, Consistency of a system of linear equations, Gauss elimination method, Gauss-Jordan method. Iterative methods - Jacobi, Gauss-Seidel iterative methods.

Text Books:
1. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.
2. B.S.Grewal, "Numerical Methods", 43rd edition, Khanna Publications, 2014.

Reference Books:
1. Erwin Kreyszig, "Advanced Engineering Mathematics" , 10th edition, Wiley Publications, 2015.

2. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
3. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.

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ENGINEERING MATHEMATICS – III (Mechanical Engineering)

Contact Hours/ Week	: 3 (L)+1(T)	Credits :	3.5
Total Lecture Hours	: 39 +13	CIE Marks :	50
Total Tutorial Hours	: 13	SEE Marks :	50
Sub. Code	: 3MAT3ME		

Prerequisites: Engineering Mathematics-I and Engineering Mathematics-II.

Course objective:
1. To introduce the concept of analytic function, transformation for mapping.
2. The concept of complex variables to evaluate the integrals.
3. Introduce partial differential equations, use separation of variable method to solve wave, heat and Laplace equations.
4. Introduction of Finite difference approximation to derivatives to partial differential equations.
5. To find optimal solutions to engineering problems whose optimum may be a certain quantity, shape and function..

Course Outcomes: Upon completion of this course the student will be able to:
1. Apply basic mathematical operations on complex numbers in Cartesian and polar forms. Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation (L3,L1)
2. Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues(L3).
3. Formulate and solve partial differential equations. Use of separation of variable method to solve wave, heat and Laplace equations (L4).
4. Compute the numerical solution of partial differential equations (L4).
5. Compute extreme values of a variational problems like geodesics, least time and shortest path(L3).

UNIT-I :Complex Variables   **9 + 3 Hours**
Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions(Statement only). Geometrical representation $f(z)=w$, Conformal transformation: $w=e^z$, $w=z+\frac{1}{z}$, $w=z^2$, $w=cosh\ z$.

UNIT-II: Complex Integration   **6 + 3 Hours**
 Bilinear transformation, Properties, Complex integration, Cauchy's theorem (statement only), Converse of Cauchy's theorem, Cauchy's integral formula (statement only), zeros & singularities of an analytic function, residues, residues theorem, calculation of residues.

UNIT – III: Partial differential equations (P.D.E.)   **8 + 3 Hours**
Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. **Applications of P.D.E.:** Classification of PDE, solution of one dimensional heat wave and two dimensional Laplace's equation by the method of separation of variables.

UNIT-IV :Numerical Solutions to the Partial differential equations   **8 + 2 Hours**
 Introduction, Finite difference approximation to derivatives, Elliptic equations, Solution of Laplace's equations, Parabolic equations, Solution of heat equation, Hyperbolic equations, Solution of wave equation.

UNIT-V :Calculus of Variation   **8 + 2 Hours**
Variation of a function and a functional, Extremal of a functional, Variational problems, Euler's equation, Standard Variational problems including geodesics, Minimal surface of revolution, hanging chain and Brachistrochrone problem.

Text Book:
1. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.

Reference Books:
1. Ramana .B.V, **"**Higher Engineering Mathematics**",** latest edition, Tata-McGraw Hill, 2016
2. Erwin Kreyszig, "Advanced Engineering Mathematics" , 10th edition, Wiley Publications, 2015.
3. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.

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ENGINEERING MATHEMATICS – III

(Industrial Engineering and Management)

Contact Hours/ Week	: 3 (L)+1(T)	Credits :	3.5
Total Lecture Hours	: 39 +13	CIE Marks :	50
Total Tutorial Hours	: 13	SEE Marks :	50
Sub. Code	: 3MAT3IM		

Course Objectives
The objectives of this course are:
1. To introduce the concept of analytic function, transformation for mapping
2. To introduce the concept of complex variables to evaluate the integrals
3. To introduce the concept of partial differential equations, use separation of variable method to solve wave, heat and Laplace equations
4. To find optimal solutions to engineering problems whose optimum may be a certain quantity, shape and function.
5. To introduce the basic concepts and applications of probability in engineering.

Course Outcomes:
Upon completion of this course the student will be able to:
1. Apply basic mathematical operations on complex numbers in Cartesian and polar forms. Determine continuity/differentiability/analyticity of a function and find the derivative of a function. Identify the transformation (L3,L1)
2. Evaluate a contour integral using Cauchy's integral formula. Compute singularities and also the residues (L3).
3. Formulate and solve partial differential equations. Use of separation of variable method to solve wave, heat and Laplace equations(L4).
4. Compute extreme values of a variational problems like geodesics, least time and shortest path(L3).
5. Determine the nature of the events and hence calculate the appropriate probabilities of the events (L3).

UNIT-I :Complex Variables   **9 + 3 Hours**
Functions of complex variable, Definition of Limit, Continuity, Differentiability. Analytic functions, Cauchy's-Reimann equation in Cartesian and polar forms (Statement only), Properties of analytic functions(Statement only). Geometrical representation $f(z)=w$, Conformal transformation: $w=e^z$, $w=z+\frac{1}{z}$, $w=z^2$, $w=cosh\ z$.

UNIT-II: Complex Integration   **6 + 3 Hours**
Bilinear transformation, Properties, Complex integration, Cauchy's theorem (statement only), Converse of Cauchy's theorem, Cauchy's integral formula (statement only), zeros & singularities of an analytic function, residues, residues theorem, calculation of residues.

UNIT – III: Partial differential equations (P.D.E.)   **8 + 3 Hours**

Formation of Partial Differential Equation, Solution of Langrange's Linear P.D.E. of the type Pp+Qq=R. Method of Separation of Variables. **Applications of P.D.E.:** Classification of PDE, solution of one dimensional heat wave and two dimensional Laplace's equation by the method of separation of variables.

UNIT-IV :Calculus of Variation   **8 + 2 Hours**

Variation of a function and a functional, Extremal of a functional, Variational problems, Euler's equation, Standard Variational problems including geodesics, Minimal surface of revolution, hanging chain and Brachistrochrone problem.

UNIT-V : Probability   **8+2 Hours**

Basic terminology, Definition of probability, Probability and set notations, Addition law of probability, independent events, conditional probability, multiplication law of probability, Baye's theorem.

Text Book:
1. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.

Reference Books:
1. Ramana .B.V, **"**Higher Engineering Mathematics**",** latest edition, Tata-McGraw Hill, 2016
2. Erwin Kreyszig, "Advanced Engineering Mathematics" , 10th edition, Wiley Publications, 2015.
3. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics", 6th edition, Tata-McGraw Hill 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd edition, McGraw Hill, 2014.

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Discrete Mathematical Structures (CSE/ISE)

Contact Hours/ Week	4(L)+1(T)		Credits	4.5
Total Lecture Hours	52		CIE Marks	50
Total Tutorial Hours	13		SEE Marks	50
Sub Code	3CCI04			

Prerequisites: Set Theory.

Course objectives:
1. To identify the domain and range of a relation and its properties, use function notation and evaluate function.
2. To understand the mathematical application of symmetry to an object to obtain knowledge of its physical properties
3. To identify and apply various properties of and relating to the integers including the well-ordering principle, prime, unique factorization, the division algorithm and greatest common divisor.
4. To compute multiplication inverse, expressing the whole in parts and test of primitive.
5. To study the theory of Boolean algebra and to representation of switching functions using Boolean expressions and their minimization technique. .

Course Outcomes:

Upon completion of this course the student will be able to:
1. Derive logical implications and equivalences using laws of logic, describe use quantifiers and prove given statement in different ways (L1, L2).
2. Compute zero-one matrix, composition of relations and draw Hasse diagram (L3).
3. Explain the concept of groups, subgroup, Abelian group and derive Lagrange's theorem in groups (L2).
4. Determine gcd by different methods and represent gcd as a linear combination. Euclidean algorithm and its applications(L3).
5. Perform congruence arithmetic. Compute inverse mod p using different methods and know the existence of primitive roots (L3).

UNIT-I: Fundamentals of set Theory and Logic   **12+ 3 Hours**

Sets and Subsets, Set operations and the Laws of Set theory, Basic connectives,   Logical equivalence using the Laws of Logic, Logical Implications and   Rules of Inference, Quantifiers, Definitions, Proofs of theorems.

UNIT-II: Relations and Function   **9+ 3 Hours**

Cartesian product and Relations, Properties of Relations, function, types of function, Computer Recognition- Zero-One Matrices and Digraphs, Partial order relation -Poset and Hasse-Diagrams, Equivalence Relation and Partitions, Extremal elements of a Poset, Lattice.

UNIT-III: Groups   **10 + 2 Hours**

Binary Operations and Properties, Definition of a Group, Examples and Elementary properties, Abelian Groups, Homomorphism, Isomorphism and Cyclic Groups, Cosets and Lagrange's Thoerem, Normal subgroups.

UNIT- IV: Number Theory – Divisibility Theory in Integers   **12 + 3 Hours**

Introduction, The division algorithm, greatest common divisor, Euclidean Algorithm, The Diophantine equation $ax + by = c$, Fundamental theorem of arithmetic, The Goldbach conjecture.

UNIT- V: The Theory of congruences   **9 + 2 Hours**

Basic properties of congruences, Binary and decimal representation of integers, Chinese remainder theorem, Fermat's Theorem, Wilson Theorem, The Fermat-Kraitchik Factorization method.

Text Books:
1. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics", 5th Edition, *Pearson Education*, 2012.
2. Bernard Kolman, Robert Busby and Sharon C. Ross, "Discrete Mathematical Structures", 6th edition, Pearson Education, 2012.
3. David M Burton, "Elementary Number Theory", 7th Edition, McGraw Hill Education, 2013.

Reference Books:
1. Kenneth H. Rosen, "Discrete Mathematical and its Applications", Tata-McGrawHill, 7th Edition-2011.
2. J.P.Tremblay and R. Manohar, "Discrete Mathematical Structures with Applications to computer science", Tata-McGraw Hill, 2010.
3. M. Ram Murthy and Jody Esmonde, "Problems in Algebraic number theory", Springer, 2006.
4. Erwin Kreyszig, "Advanced Engineering Mathematics" , 10th edition, Wiley Publications, 2015.

Siddaganga Institute of Technology, Tumkur – 572 103

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COMPUTATIONAL METHODS IN ELECTRICAL SCIENCE

Contact Hours/ Week	**3(L)**	**Credits**	**3**
Total Lecture Hours	**39**	**CIE Marks**	**50**
Sub Code	**4MCES1**		

Course Outcomes: Upon completion of this course the student will be able to:
1. obtain the mathematical model to determine the terminal velocity of a free falling body near the earth's surface, explain the different types of error and calculate the error occur in Taylor's series expansion.
2. Solve roots problem with bisection method, false position method, Newton –Raphson method, calculate the multiple roots by using Muller method , Newton –Raphson method and derive the convergence of Newton – Raphson method
3. Solve system of linear algebraic equations by using Gauss elimination method, Gauss-Jordan method, LU decomposition method and iterative methods.
4. Calculate the forward and backward interpolating polynomial for equal and unequal intervals and evaluate the definite integral by using numerical method.
5. Solve initial and boundary value problems for ordinary differential equation such as Taylor series method, Euler's method, Modified Euler's method, Runge-Kutta method of 4th order and Shooting method .

UNIT-I: Mathematical Modeling and Error Analysis
Simple Mathematical model: Modeling of free falling parachutist, Conservation laws. Approximations and Round-off errors: Significant figures, accuracy and precision, Errors, round-off errors. Truncation errors and Taylor series, numerical differentiation, error propagation, stability, condition number, total numerical error   8 Hours

UNIT – II: Roots of equation
Introduction, Bracketing methods – Bisection & Regula-falsi methods. Open methods – Newton-Raphson method, multiple roots, Muller's method.   8 Hours

UNIT – III: System of linear algebraic equations
Gauss elimination method, Gauss-Jordan method, LU decomposition. Iterative methods Jacobi iteration, Gauss-seidel iteration method.   8 Hours

UNIT – IV: Interpolation
 Introduction, Interpolation with equal intervals: Forward and backward Interpolation with unequal intervals: Newton's divided difference, Lagrange's interpolation. **Numerical Integration**: Trapezoidal rule, Simpson's rules, Weddel's rule.
          8 Hours
UNIT – V: Solution of Ordinary Differential Equation
 Solution of initial value problem – Taylor series method, Euler's method, Modified Euler's method, Runge-Kutta method of 4th order. Solution of boundary value problem – Shooting method.   7 Hours

Text Books:
1. Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers", 5th edition, Tata McGraw hill, 2014
2. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.

Reference Books
1. M. K. Jain, S. R. K. Iyengar and R.K.Jain, "Numerical methods for Scientific and Engineering Computation", 6th edition, NewAge International Publishers, 2012.

Siddaganga Institute of Technology, Tumkur – 572 103
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Foundations of Engineering Mathematics
(For Lateral Entry students only)

Contact Hours/ Week	05	Credits	05
Total Lecture Hours	62	CIE Marks	50
Total Tutorial Hours		SEE Marks	50
Sub Code	3MATF1		

Course objectives: This course will enable students to:
1. Know the behavior of the polar curve and its application, determine the derivatives of functions of two variables and to understand the behavior of the infinite series
2. Learn how the vectors govern the physical models.
3. Know how the real word problems governed by the first order differential equations.
4. Solve second and higher order differential equations.
5. Find the Laplace transform of the function f(t) and the Inverse Laplace transform of the function F(s).

Course Outcomes:
Upon completion of this course the student will be able to:
1. Find the angle between the polar curves and represent a function as a Infinite series.(L2)
2. Calculate the gradient of a scalar point function; divergence, curl and Laplacian of a vector point function. (L3)
3. Derive Laplace transform of basic functions and evaluate inverse Laplace transforms and also solve linear differential equations by the method of Laplace transform. (L3)
4. Solve first order and first-degree equations and solve Engineering problems. (L3)
5. Solve the linear differential equations of second and higher order with constant coefficients. (L3)

UNIT-1 Differential Calculus

Determination of nth derivative of standard functions, Leibnitz theorem (statement only) with examples, polar curves, Taylor's series, Maclaurin's series for functions of single variable. **Partial differentiation:** Definition, total differentiation, differentiation of composite and implicit functions, Jacobians illustrative examples and problems. Indeterminate forms. 14 hrs

UNIT-II Vectors

Vector Algebra: Vector addition, multiplication (dot and cross products), scalar and vector triple products.
Vector Differentiation: Velocity, acceleration of a vector point function, gradient, curl and divergence, solenoidal and irrotational vector fields, vector identities. 12 hrs

UNIT-III Laplace Transform

Definition, Laplace transform of elementary functions, properties of Laplace transforms, multiplication by t^n, division by t, derivatives and integrals. Inverse transforms, Applications of Laplace transforms to differential equation.
12 hrs

UNIT-IV Integral calculus:

Reduction formula for functions: $\sin^n x, \cos^n x, \sin^m x \cos^n x$. Double integrals and triple integrals, problems (with standard limits), Beta and Gamma functions, properties, relation between Beta and Gamma functions, problems.
12 hrs

UNIT-V Differential equations:

Solution of first order, first-degree differential equations- variable separable method, homogeneous, Linear, Bernoulli's and exact differential equations. Differential equations of second and higher orders with constant coefficients.
12 hrs

Text Books:
1. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.
2. H. K. Das and Er. Rajnish Verma, Higher Engineering Mathematics, 1st edition, S. Chand Publishers, 2011

Reference Books:
1. Ramana .B.V, **"**Higher Engineering Mathematics"**,** latest edition, Tata-McGraw Hill, 2016
2. Erwin Kreyszig, "Advanced Engineering Mathematics" , 10th edition, Wiley Publications, 2015.

Siddaganga Institute of Technology, Tumkur – 572 103
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Statistics and Probability for Engineering
(ALL BRANCHES EXCEPT CS, IS)

Contact Hours/ Week	: 3+1 (L+T)	Credits :	3.5
Total Lecture Hours	: 39	CIE Marks :	50
Total Tutorial Hours	: 13	SEE Marks :	50
Sub. Code	: 4MAT3		

Prerequisites: Engineering Mathematics-III

Course objectives:
1. To develop and conduct appropriate experimentation ,analyze and interpret data and use engineering judgment to draw conclusion.
2. To introduce the basic concepts and applications of probability in engineering.
3. To provide the knowledge about the random variable, random process and how to model the random processes in engineering.
4. To deal with multiple random variables and introduction of the most important types of stochastic processes.
5. To investigate the variability in sample statistics from sample to sample, measure of central tendency & dispersion of sample statistics and pattern of variability of sample.

Course Outcomes: Upon completion of this course the student will be able to:
1. Apply least square method to fit a curve for the given data and evaluate the correlation coefficient and regression lines for the data (L3).
2. Analyse the nature of the events and hence determine the appropriate probabilities of the events (L3).

3. Classify the random variables to determine the appropriate probability distributions (L2).
4. Determine the joint probability distribution, its mean, variance and covariance and calculate the transition matrix and fixed probability vector for a given Markov chain (L3).
5. Estimate the parameter of a population, important role of normal distribution as a sampling distribution (L2).

UNIT-I : Statistics   **8+2 Hours**
Introduction, Definitions, Curve Fitting: Straight line, parabola and exponential curves. Correlation and regression, formula for correlation coefficient, regression lines and angle between the regression lines.

UNIT-II :Probability   **7+2 Hours**
Basic terminology, Definition of probability, Probability and set notations, Addition law of probability, independent events, conditional probability, multiplication law of probability, Baye's theorem.

UNIT-III :Random Variable   **8+2 Hours**
Discrete Probability distribution, Continuous Probability distribution, expectation, Variance, Moments, Moment generating function, Probability generating function, Binomial distribution, Poisson distribution, Normal distribution and Exponential distributions.

UNIT-IV :Joint Probability   **8+3 Hours**
Joint probability distribution, Discrete and independent random variables, Expectation, Covariance, Correlation coefficient. Probability vectors, stochastic matrices, fixed point matrices, Regular stochastic matrices, Markov chains, Higher transition-probabilities, stationary distribution of regular markov chains and absorbing states.

UNIT-V: Sampling Distribution   **8+3 Hours**
Introduction, Objectives, sampling distribution, testing of hypothesis, level of significance, confidence limits, simple sampling of attributes, test of significance of large samples, comparison of large samples, sampling of variables, central limit theorem, confidence limits for unknown mean, test of significance for means of two large samples, Sampling of variables – small samples , Student's t-distribution.

Text Books:
1. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.
2. Ramana .B.V, **"Higher Engineering Mathematics",** latest edition, Tata-McGraw Hill, 2016

Reference Books:
1. Erwin Kreyszig, "Advanced Engineering Mathematics" , 10th edition, Wiley Publications, 2015.
2. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics", 6th Edition, Tata-McGraw Hill 2005.
3. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd Edition, McGraw Hill, 2014.

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Probability and its Applications for Information Technology (CSE/ISE)

Contact Hours/ Week	3(L)+1(T)	Credits	3.5
Total Lecture Hours	39	CIE Marks	50
Total Tutorial Hours	13	SEE Marks	50
Sub Code	4MAT4		

Prerequisites: Engineering Mathematics-III
Course objectives:
1. To provide the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science like disease modeling, climate prediction and computer networks etc.
2. To introduce the concept of a probability density function of a continuous random variable.
3. To deal with multiple random variables and introduction of the most important types of stochastic processes.

4. To investigate the variability in sample statistics from sample to sample, measure of central tendency & dispersion of sample statistics and pattern of variability of sample.
4. To understand the fundamentals of coding theory, concept of source coding and channel coding theorem.

Outcomes:
Upon completion of this course the student will be able to:
1. Identify a random variable as discrete and appropriate probability distribution, its statistical parameters(L1).
2. Identify a random variable as continuous and appropriate probability distribution, its statistical parameters (L1).
3. Determine the joint probability distribution, its mean, variance and covariance and calculate the transition matrix, fixed probability vector for a given Markov chain(L3).
4. Estimate the parameter of a population, important role of normal distribution as a sampling distribution(L2).
5. Apply concepts of probability in information theory and coding (L3).

Unit 1: Analysis of Discrete Random Variables
Discrete random variables, probability distribution and probability mass function, cumulative distributive functions, mean and variance of discrete random variable, discrete uniform distribution, binomial distribution, geometric distribution, negative binomial distribution and Poisson distribution.

8+3 Hours

Unit 2: Analysis of Continuous Random Variables
Continuous random variable, probability distribution and probability density function, cumulative distributive functions, mean and variance of continuous random variable, continuous uniform distribution, exponential distribution, normal distribution, normal approximation to the Binomial and Poisson distributions.

7+2 Hours

Unit 3: Joint Probability
Joint probability distribution, discrete and independent random variables, expectation, covariance, correlation coefficient, probability vectors, stochastic matrices, fixed point matrices, regular stochastic matrices, Markov chains, higher transition probabilities, stationary distribution of regular Markov chains and absorbing states.

7+2 Hours

Unit 4: Sampling Distribution
Introduction, Objectives, sampling distribution, testing of hypothesis, level of significance, confidence limits, simple sampling of attributes, test of significance of large samples, comparison of large samples, sampling of variables, central limit theorem, confidence limits for unknown mean, test of significance for means of two large samples, Sampling of variables – small samples , Student's t-distribution.

8+3 Hours

Unit 5: Information Theory
Introduction, Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy and Mutual Information, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality, Sufficient Statistics, Fano's Inequality

9+3 Hours

Text Books:
1. Douglas C Montgomery, George C Runger, "Applied Statistics and Probability for Engineers", 5th edition, Wiley India, 2010.
2. B.S.Grewal, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, 2015.
3. Thomas M. Cover, Joy A.Thomas, "Elements of Information Theory", 2nd edition, Wiley Publications, 2006.(Chapt and 2)

Reference Books:
1. Ramana .B.V, **"**Higher Engineering Mathematics**",** latest edition, Tata-McGraw Hill, 2016
2. Erwin Kreyszig, "Advanced Engineering Mathematics" , 10th edition, Wiley Publications, 2015.
3. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics", 6th Edition, Tata-McGraw Hill, 2005.
4. Louis A. Pipes and Lawrence R. Harvill, "Applied Mathematics for Engineers and Physicists", 3rd Edition, McGraw Hill, 2014.
5. Richard A Johnson, Irwin Miller and John Freund, "Probability and Statistics for Engineers", 9th edition, Pearson Publishers, 2011.
6. Robert G Gallager, "Information theory and Reliable communication", 2nd edition, Wiley Publishers, 1968.

GRAPH THEORY AND COMBINATORICS (CSE/ISE)

Contact Hours/ Week	: 4 + 0 (Lecture + Tutorial)	Credits :	4.0
Total Lecture Hours	: 52	CIE Marks :	50
Total Tutorial Hours	: 00	SEE Marks :	50
Sub. Code	:4CCI04		

Course Outcomes: Upon completion of this course the student will be able to:

1. Identify types of graph, outline properties of graphs, describe when the graphs are said to be same even though the shapes are different (isomorphism) and apply to some practical problems like seven bridge problem, traveling sales man problem.
2. Describe how to color the vertices/ edges of a graph, apply graph coloring in map coloring, describe what is a tree and its properties and apply the concept of trees in constructing optimal prefix codes. Determine the shortest path between two vertices, write algorithms for finding minimal spanning trees and apply the concepts in transport network.
3. Apply the techniques of counting to identify the number of ways in which a given task can be accomplished without listing all the possibilities explicitly.
4. Identify the different physical situations in which principle of inclusion and exclusion can be used for counting.
5. Derive the generating function for the given situation and evaluate the required coefficient. Solve the recurrence relation and interpret the solution.

UNIT –I : Graph Theory
Introduction to Graph Theory: Definitions and Examples, Subgraphs, Complements, and Graph Isomorphism, Vertex Degree, Euler Trails and Circuits, Planar Graphs, Hamilton Paths and Cycles.

10 Hrs

UNIT –II: Introduction to Graph Theory contd.: Graph Colouring, and Chromatic Polynomials.
Trees: Definitions, Properties, and Examples, Rooted Trees, Trees and Sorting, Weighted Trees and Prefix Codes. Minimal spanning Tree, Transport Networks: Max-Flow Min-cut Theorem, Matching theory.

12 Hrs

UNIT –III: Combinatorics
Fundamental Principles of Counting: The Rules of Sum and Product, Permutations(linear, circular, identical objects), Combinations – The Binomial Theorem, Combinations with Repetition, The Catalon Numbers.
The Principle of Inclusion and Exclusion: The Principle of Inclusion and Exclusion, Generalizations of the Principle.

12 Hrs

UNIT –IV: Derangements – Nothing is in its Right Place, Rook Polynomials.
Generating Functions: Introductory Examples, Definition and Examples – Calculational Techniques, Partitions of Integers. The Exponential Generating Function, The Summation Operator.   10 Hrs

UNIT –V: Recurrence Relations: First Order Linear Recurrence Relation, The Second Order Linear Homogeneous, Recurrence Relation with Constant Coefficients, The Non-homogeneous Recurrence Relation, The Method of Generating Functions.   8 Hrs

Text Books:
1. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics", 5th Edition, *Pearson Education*, 2012. (Chapter 11, Chapter 12.1-12.4, Chapter 13, Chapter 1.1-1.4 , Chapter 8.1-8.4, Chapter 9.1 to 9.5 Chapter 10.1 -10.4).
2. Alan Tucker, "Applied Combinatorics", 5th Edition, Wiley-India, 2011

Reference Books:
1. Dr.D.S.Chandrasekharaiah, "Graph Theory and Combinatorics", Prism, 2005.
2. Richard A. Brualdi, "Introductory Combinatorics", 5th Edition, Pearson Prentice Hall, 2014.
3. Geir Agnarsson & Raymond Geenlaw, "Graph Theory Modeling, Applications, and Algorithms", Pearson Prentice Hall, 2008.

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BIOSTATISTICS AND BIOMODELING

Contact Hrs./ Week	: 3+1 (Lecture + Tutorials)	Credits :	3.5
Total Lecture Hrs.	: 39	CIE Marks :	50
Total Tutorial Hrs.	: 13	SEE Marks :	50
Sub. Code	: 4BT05		

Prerequisites: Engg Mathmatics-III

Course objectives:
1. To study the scope of statistics in Biotechnology
2. To learn the laws & principles of probability distribution
3. To understand the significance of statistical inference in biological experiments
4. To learn the design of experiments
5. To study the biomodeling of microbial growth in a chemostat, growth equations of microbial populations, models for inheritance

Course outcomes:
A student who has met the objectives of the course will be able to:
1. Explain the concepts of data collection, presentation of charts, graphs & data (L2)
2. Describe different laws of probability (L2)
3. Apply concepts of analysis of variance in inferring the statistical data (L3)
4. Apply different methods in design of experiments (L3)
5. Outline the case studies of lung cancer, endangered plants species (L1)

UNIT –I: Introduction: Scope of biostatistics, definition, data collection, presentation of data, graphs, charts (scale diagram, histogram, frequency polygon, frequency curve, logarithmic curves). Sampling & selection bias, probability sampling, random sampling, sampling designs. Descriptive statistics: Measure of central tendency (arithmetic mean, geometric mean, harmonic mean, median, quartiles, mode); Measure of dispersion (range, quartile deviation, mean deviation and standard deviation, coefficient of variation). **08+3 Hrs.**

UNIT –II: Bi-Variate Distribution: Correlation and regression analysis (simple and linear) curve fitting (linear, non-linear and exponential).
Probability: Axioms, models, conditional probability, Bayes rule, Genetic Applications of Probability, Hardy - Weinberg law, Wahlund's Principle, Forensic probability determination, Likelihood of paternity, Estimation of probabilities for multilocus/ multi-allele finger print systems. **08+3 Hrs.**

UNIT –III: Statistical Inference: Estimation theory and testing of hypothesis, point estimation, interval estimation, sample size determination, simultaneous confidence intervals, parametric and non-parametric distributions (T-test, F-test, Chi Squared distribution, goodness of fit test) analysis of variance (one-way and two-way classifications). Case studies of statistical designs of biological experiments (RCBD, RBD). **09+2 Hrs.**

UNIT –IV: Probability Distributions: Discrete probability distributions - Binomial, Poisson, geometric – derivations. Central limit theorem. Continuous probability distribution – normal, exponential, gamma distributions, beta and Weibull distributions, T & F distributions.

Design of Experiments: Sample surveys, comparisons groups and randomization, random assignments, single and double blind experiments, blocking and extraneous variables, limitations of experiments.

07+2 Hrs.

UNIT –V: Case Studies: Cigarette smoking, Lung cancer, endangered plants species, epidemics.

Biomodeling: Microbial Growth in a Chemo stat, Growth Equations of Microbial populations, Models of Commensalisms, Mutualism, Predation and Mutation.Volterra's Model for n Interacting Species. Basic Models for Inheritance, Selection and Mutation Models, Genetic Inbreeding Models.

07+3 Hrs.

Text Book:
1. Marcello Pagano & Kimberlee Gauvreu, "Principles of Biostatistics", 2nd Edition, Thompson Learning, 2000.
2. Ronald N Forthofer and Eun Sul Lee, "Introduction to Biostatistics", 1st edition, Academic Press, 1996.
3. Norman T J Bailey, "Statistical methods in Biology", 3rd Edition, Cambridge University Press, 1995.
4. J.N.Kapur, "Mathematical Models in Biology and Medicine", Oscar Publication, 2010.
5. H Bancroft, J. Ispen and P Feigl, "Introduction to Biostatistics", 2nd edition, Harper & Row, New York,1970.
6. Dutta, Animesh, K, "Basic Biostatistics & its Applications",1st edition, New Central Book Agency, 2007.

Reference Books:
1. S I Rubinow, "Introduction to Mathematical Biology", 1st edition, Wiley Publishers, 1975.
2. P.S.S. Sundar Rao and J.Richard, "An Introduction to Biostatistics", 5th edition, Prentice Hall of India Pvt Ltd, 2006.
3. Miller, Freund's and Richard A Johnson, "Probability and Statistics for Engineers", 8th edition, Chegg Publishers, 2011.
4. Veer Bala Rastogi, "Fundamentals of Biostatistics", Ane Books India, 2009.

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LINEAR ALGEBRA (Open Elective)

Contact Hours/ Week	: 3	Credits:	03
Total Lecture Hours	: 40	CIE Marks:	50
Total Tutorial Hours	: 00	SEE Marks:	50
Sub. Code	: OE07		

Prerequisite: MAT1, MAT2

Course objectives: This Course will enable students to
1. To understand several important concepts in linear algebra, including systems of linear equations and their solutions; matrices and their properties; vector spaces; linear independence of vectors; subspaces, bases, and dimension of vector spaces; inner product spaces; linear transformations; and Eigen values and eigenvectors.
2. To apply these concepts to such real world phenomena as electrical networks, traffic flow, archeological dating, economic interdependencies, population movement, communication networks, and weather prediction.
3. To learn to use the computer package MATLAB to perform matrix computations and to explore and analyze linear algebra concepts.
4. To improve your ability (or to learn!) to prove mathematical theorems.
5. To improve your ability to think logically, analytically, and abstractly

Course Outcomes:
Upon completion of this course the student will be able to:
1. Apply the numerical methods to solve Systems of linear equations, row reduction and Echelon form, vector equations, Matrix equation, solution sets of linear systems, Linear independence (L3).
2. Solve the linear transformations, Matrix of a linear transformation. Matrix operations, Inverse of a matrix, characterization of invertible matrices, partitioned matrices, matrix factorizations, Determinants: Introduction, Properties, volume and linear transformations(L3).
3. Determine the Vector spaces and subspaces, Null spaces, column spaces, linear transformations, linearly independent sets, bases, dimension of a vector space, rank, change of basis (L3).
4. Determine and Describe characteristic equation, diagonalization, Eigen vectors and linear transformations, Complex Eigen values. Orthogonality- Inner product, length, and orthogonality, orthogonal sets, orthogonal projections (L1, L3).
5. Determine and Describe Gram-Schmidt process, least squares problems, Inner product spaces, diagonalization of symmetric matrices, quadratic forms (L1, L3).

UNIT-I: Linear equations: Systems of linear equations, row reduction and Echelon form, vector equations, Matrix equation, solution sets of linear systems, Linear independence.　　　　　**08 Hrs**

UNIT-II: Matrix Algebra: Introduction to linear transformations, Matrix of a linear transformation. Matrix operations, Inverse of a matrix, characterization of invertible matrices, partitioned matrices, matrix factorizations.　　　　　**08 Hrs**

UNIT-III:. Vector spaces: Vector spaces and subspaces, Null spaces, column spaces, linear transformations, linearly independent sets, bases, dimension of a vector space, rank, change of basis.　　　　　**08 Hrs**

UNIT-IV: Eigen values, Eigen vectors and Orthogonality: Introduction, characteristic equation, diagonalization, Eigen vectors and linear transformations, Complex Eigen values. Orthogonality- Inner product, length, and orthogonality, orthogonal sets, orthogonal projections.　　　　　**08 Hrs**

UNIT-V: Orthogonality and least squares: Gram-Schmidt process, least squares problems, Inner product spaces, diagonalization of symmetric matrices, quadratic forms.　　　　　**08 Hrs**

Text Book:
1. David C. Lay, "Linear algebra and its applications", 5th edition, Pearson Education, 2014.

Reference Books:
1. Gilbert Strang, "Linear algebra and its applications", 4th edition, Thomson Asia Pvt. ltd., 2007.
2. Kenneth Hoffman, Ray Kunze, "Linear algebra", 2nd edition, Prentice-Hall of India Pvt. Ltd., 2002.

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Statistical Computing
(Open Elective)

Contact Hours/ Week	3	Credits	3
Total Lecture Hours	40	CIE Marks	50
Total Tutorial Hours	-	SEE Marks	50
Sub Code	OE05		

Prerequisites: Elementary probability theory and Statistics.

Course objectives: This Course will enable students to
1. introduce the fundamental ideas of probability and Statistics and these through investigations of data and familiarize students with the statistical methods. A thorough grounding in the concept of probability allows having a better understanding of statistical inferences. Also aiming at the design of algorithm for implementing statistical methods on computers.

2. Estimate the parameters of a population, role of normal distribution as a sampling distribution. Understand the central limit theorem, point estimators, including bias, variance, and mean square error. Construct point estimators using method of moments, maximum likelihood and Bayesian approach.
3. Test hypothesis and construct confidence intervals on difference in means, ratio of the variance, difference in two population proportions of two normal distributions. Use of p-value approach for making decision in hypothesis tests. Use the relationship between confidence intervals and hypothesis tests.
4. solve problems in engineering and science involve exploring the relationship between two or more variables. Regression analysis is a statistical technique that is very useful for these types of problems. This can also used for process optimization, such as finding the level of temperature that maximizes yield.
5. Use multiple regression techniques to build empirical models to engineering and scientific data. Asses regression model adequacy. Build regression models with polynomial terms. Stepwise regression and other model to building techniques to select the appropriate set of variables for a regression model.

Course Outcomes: Upon completion of this course the student will be able to:
1. Apply the basic concepts of probability and statistics in an engineering models, various ways of data collections, interpretations and models. (L3)
2. Apply the methods of moments, methods of maximum likelihood to make decisions or to draw conclusions about a population using the information contained in a sample from the population drawing conclusion. (L3)
3. Apply hypothesis testing on the mean of a normal distribution using either a z-test or a t-test produce and test hypothesis on the variance or standard deviation of a normal distribution. Determine the p-value approach for making decision in hypothesis test. Explain and use the relationship between confidence intervals and hypothesis tests. (L2,3&5)
4. Apply simple linear regression for building empirical models to engineering and scientific data. Determine the method of least square is used to estimate the parameters in a linear regression model. Derive the regression model to make a prediction of a future observation and construct an appropriate prediction interval on the future observation. Apply the correlation model. (L2,4 & 5).
5. Determine the regression model to estimate the mean response and to make predictions and to construct confidence intervals and prediction intervals. (L5).

UNIT-I: The Role of Statistics in Engineering (Data Summary and Presentation): Statistical Thinking, Collecting data, Statistical Modeling Frame work, Measure of Central Tendency and Variance, Importance of Data Summary and Display, Tabular and Graphical display. 8 hrs

UNIT-II: Point Estimation: Sampling distributions and The Central Limit Theorem. General concept of Point Estimation-Unbiased Estimators, Variance of a Point Estimation, Standard error(reporting a point estimate), Mean square error of an estimator. Method of Point estimators: Method of moment, method of Maximum likelihood, Bayesian Estimation of parameters. 8 hrs

UNIT-III: Statistical Inference for a Single Sample and Two Samples: Hypothesis testing, Inference on the mean of a population (Variance known and unknown), Inference on the variance of a normal population, Inference on a Population Proportions, Testing for goodness of Fit, Inference for a difference in Means, Variances known, Inference for a difference in means of two normal distributions, Variances unknown, Inference on the variances of two normal Populations, Inference on two population proportions. 8 hrs

UNIT-IV: Simple Linear Regression and Correlation: Simple Linear Regression, Properties of Least Square Estimators and Estimation of variance, Common abuses of regression, Prediction of new observations, assessing the adequacy of regression model, Analysis of Variance. 6 hrs

UNIT-V: Multiple Linear Regression Model: Introduction, Least Sqaures Estimation of the Parameters. Matrix approach to Multiple Linear Regression, Properties of the Least Squares Estimators.
Hypothesis Tests in Multiple Linear Regression: Tests for significance of regression, Tests on Individual regression Coefficients and Subsets of Coefficients.
Confidence Intervals in Multiple Linear Regression: Confidence Interval on Individual Regression Coefficients, Confidence interval on the Mean Response. Prediction of New observations. Model Adequacy Checking: Residual Analysis, Influential Observations.
Aspects of Multiple Regression Modeling: Polynomial Regression models, Categorical Regressors and Indicator Variable, Selection of Variables and Model Building, Multi-colinearity. 10 hrs

Text Books
1. Douglas C Montgomery, George C Runger, "Applied Statistics and Probability for Engineers", 5th edition, Wiley India, 2010.
2. R. R. Walpole and R. H. Myers, "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Publications, 2012

Reference Books
1. Devore, "Probability and Statistics for Engineers and Sciences", 9th Edition.
2. Richard A Johnson, Irwin Miller and John Freund, "Probability and Statistics for Engineers", 9th edition, Pearson Publishers, 2011.

Siddaganga Institute of Technology, Tumkur – 572 103
(An Autonomous Institution affiliated to Visvesvaraya Technological University, Belgaum)

Mathematical Modeling
(Open Elective)

Contact Hours/ Week	3	Credits	3
Total Lecture Hours	40	CIE Marks	50
Total Tutorial Hours	-	SEE Marks	50
Sub Code	OE40		

Prerequisites: Differential Equations, Curve fitting.

Course objectives: This Course will enable students to
1. To make the student to identify the physical situation(s) which can be modeled as a difference equation and hence predict the future by finding its solution.
2. To introduce the systematic procedure to derive the mathematical model using the well defined physical laws.
3. To make the student to analyze the data, identify the type of curve to be fit and justify the fit through the parameters of fit.
4. To introduce the concept of probability to develop the mathematical model for the situation.
5. To make the student to apply the concept of differential equation to develop the mathematical model for the given situation.

Course Outcomes: Upon completion of this course the student will be able to:

1. Apply the solution of difference equation to given physical situation, explain the solution and interpret the results (Levels – 2, 3).
2. Describe the steps involved in deriving the model for the given situation by selecting the suitable physical law(s). (Levels – 2, 3, 4).
3. Derive the normal equations, apply them to fit a curve and evaluate the parameters to check the goodness of fit. (Levels – 3, 4, 5).
4. Calculate the reliability of the system whose components are in series or in parallel or a combination of them. Identify the better model from the available models. (Levels – 1, 3).
5. Derive a model using differential equation and find the numerical solution, identify an autonomous differential equation and draw solution curves. (Levels – 1, 4).

UNIT- I: Modeling Change
Introduction, Testing for proportionality, Modeling change with difference equations, Example 1: A savings certificate, Example 2: Mortgaging a home, Approximating Change with Difference equations, Example 1: Growth of a Yeast culture, Example 2: Growth of a Yeast culture revisited, Example 3: Decay of Digoxin in the blood stream, Solutions to Dynamical systems, Example 1: A savings certificate revisited, Example 2:Seavage treatment, Example 3: Prescription for Digoxin, Systems of Difference equations, Example1: A car rental company, Example 2: The battle of Trafalgar, Example 3: Travelers' Tendencies at a Regional Airport., Example 4: Discrete Epidemic Models.   09- Hrs

UNIT- II: The Modeling Process, Proportionality, and Geometric Similarity

The Modeling Process, Proportionality and Geometric similarity: Introduction, Mathematical Models, Example: Vehicular stopping distance, Modeling using proportionality, Example: Kepler's third law, Modeling using geometric similarity, Example1: Rain drops from a motionless cloud, Example 2: Modeling a bass fishing derby, Automobile Gasoline Mileage, Body weight and height strength and Agility.

08-Hrs

UNIT- III: Model fitting

Introduction, Fitting models to data graphically - Visual Model Fitting with the Original Data, Transforming the Data. Analytic methods of model fitting - Chebyshev Approximation Criterion, Minimizing the Sum of the Absolute Deviations, Least-Squares Criterion, Relating the Criteria. Applying the least squares criterion- Fitting a Straight Line, Fitting a Power Curve, Transformed Least Squares Fit, Choosing a best model, Example: Vehicular stopping distance
07 Hrs

UNIT- IV: Discrete Probabilistic Modeling

Introduction, Probabilistic modeling with discrete systems, Example 1: Rental car company revisited, Example 2: Voting tendencies, Modeling component and system reliability, Example1: series systems, Example 2: Parallel systems, Example3: Series and Parallel combinations. Linear Regression, Example 1: Ponderosa pines, Example 2: The bass fishing derby revisited.
08-Hrs

UNIT- V: Modeling with a differential equations

Introduction- The Derivative as a Rate of Change, The Derivative as the Slope of the Tangent Line. Population growth, Prescribing Drug Dosage, Breaking distance revisited. Graphical solutions of Autonomous differential equations, Example: Drawing a phase line and sketching solution curves, Numerical approximation methods - First-Order Initial Value Problems, Approximating Solutions to Initial Value Problems: Example 1: Using Euler's method, Example 2: A saving certificate revisited.

07 – Hrs

Text Books
1. Frank.R.Giordano, William.P.Fox, Steven B. Horton and Brooks Cole, "A First course in Mathematical modeling", 5th edition, 2013. [Chapters – 1,2,3,6 and 11]

Reference Books
1. Neil Gerschenfeld, "The nature of Mathematical Modeling", Cambridge University press, 1999.
2. A.C. Fowler, "Mathematical Models in applied sciences", Cambridge University press, 1997.

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Combinatorics
Open Elective

Contact Hours/ Week	: 3	Credits:	03
Total Lecture Hours	: 40	CIE Marks:	50
Total Tutorial Hours	: 00	SEE Marks:	50
Sub. Code	: OE49		

Course Objectives: The objectives of this course are:

1. To introduce the concept of elements of counting principles and to facilitate them to use the results in the appropriate situation.
2. To introduce the concept of systematic / formula driven counting through principle of inclusion and exclusion and its use.
3. To introduce the alternate way of counting namely, generating function and its use at the relevant place.

Course Outcomes:

Upon completion of this course the student will be able to:
1. Apply the techniques of counting to identify the number of ways in which a given task can be accomplished without listing all the possibilities explicitly.
2. Identify the different physical situations in which principle of inclusion and exclusion can be used for counting.
3. Derive the generating function for the given situation and evaluate the required coefficient.
4. Solve the first order recurrence relation and interpret the solution.
5. Solve the first order recurrence relation and interpret the solution.

UNIT –I: Fundamental Principles of Counting:

The Rules of Sum and Product, Permutations (linear, circular, identical objects), Combinations – The Binomial Theorem, Combinations with Repetition, The Catalon Numbers.   8 Hrs

UNIT –II: The Principle of Inclusion and Exclusion:

The Principle of Inclusion and Exclusion, Generalizations of the Principle. Derangements – Nothing is in its Right Place, Rook Polynomials, Arrangements with forbidden positions.

8 Hrs

UNIT –III: Generating Functions:

Introductory Examples, Definition and Examples – Calculational Techniques, Partitions of Integers. The Exponential Generating Function, The Summation Operator.   8 Hrs

UNIT –IV: Recurrence Relations: First Order Linear Recurrence Relation:

The First Order Linear Homogeneous Recurrence Relation with Constant Coefficients, The Non-homogeneous Recurrence Relation, The Method of Generating Functions.   8 Hrs

UNIT –V: Recurrence Relations: Second Order Linear Recurrence Relation:

The Second Order Linear Homogeneous Recurrence Relation with Constant Coefficients, The Non-homogeneous second order recurrence relation, The Method of Generating Functions.   8 Hrs

Text Books:
1. Ralph P. Grimaldi, ”Discrete and Combinatorial Mathematics”, 5th Edition, *Pearson Education*, 2012. (Chapter 11, Chapter 12.1-12.4, Chapter 13, Chapter 1.1-1.4 , Chapter 8.1-8.4, Chapter 9.1 to 9.5 Chapter 10.1 -10.4).
2. Alan Tucker, "Applied Combinatorics", 5th Edition, Wiley-India, 2011

Reference Books:
1. Dr.D.S.Chandrasekharaiah, "Graph Theory and Combinatorics", Prism, 2005.
2. Richard A. Brualdi, "Introductory Combinatorics", 5th Edition, Pearson Prentice Hall, 2014.