

**National Institute of Technology, Hamirpur (HP)**  
**Department of Mathematics**

S. No	Course No.	Course Name	(Branch & Year)
<b>B.Tech. 1<sup>st</sup> Semester</b>			
1.	CES-111	Engineering Mathematics-I	CE 1 <sup>st</sup> Year
2.	EES-111	Engineering Mathematics-I	EE 1 <sup>st</sup> Year
3.	MES-111	Engineering Mathematics-I	ME 1 <sup>st</sup> Year
4.	ECS-111	Engineering Mathematics-I	ECE 1 <sup>st</sup> Year
5.	CSS-111	Engineering Mathematics-I	CSE 1 <sup>st</sup> Year
6.	CHS-111	Engineering Mathematics-I	CHE 1 <sup>st</sup> Year
7.	ARS-115	Architecture Mathematics-I	Arch. 1 <sup>st</sup> Year
<b>B.Tech. 2<sup>nd</sup> Semester</b>			
8.	CES-121	Engineering Mathematics-II	CE 1 <sup>st</sup> Year
9.	EES-121	Engineering Mathematics-II	EE 1 <sup>st</sup> Year
10.	MES-121	Engineering Mathematics-II	ME 1 <sup>st</sup> Year
11.	ECS-121	Engineering Mathematics-II	ECE 1 <sup>st</sup> Year
12.	CSS-121	Engineering Mathematics-II	CSE 1 <sup>st</sup> Year
13.	CHS-121	Engineering Mathematics-II	CHE 1 <sup>st</sup> Year
<b>B.Tech. 3<sup>rd</sup> Semester</b>			
14.	CES-211	Engineering Mathematics-III	CE 2 <sup>nd</sup> Year
15.	EES-211	Advanced Engineering Mathematics	EE 2 <sup>nd</sup> Year
16.	MES-211	Engineering Mathematics-III	ME 2 <sup>nd</sup> Year
17.	ECS-211	Engineering Mathematics-III	ECE 2 <sup>nd</sup> Year
18.	CSS-210	Probability and Queuing Models	CSE 2 <sup>nd</sup> Year
<b>B.Tech. 4<sup>th</sup> Semester</b>			
19.	MES-221	Computer Programming & Numerical Methods for Mechanical Engineers	ME 2 <sup>nd</sup> Year
20.	MES-226	Computer Programming & Numerical Methods Lab	ME 2 <sup>nd</sup> Year
21.	CHS-224	Engineering Mathematics-III	CHE 2 <sup>nd</sup> Year
<b>B.Tech. 5<sup>th</sup> Semester</b>			
22.	MAO-316(a)	Operational Research	3 <sup>rd</sup> Year (Open Elective)
23.	MAO-316(b)	Linear Algebra	3 <sup>rd</sup> Year (Open Elective)
<b>B.Tech. 6<sup>th</sup> Semester</b>			
24.	MAO-325(a)	Probability, Statistics and Queuing Models	3 <sup>rd</sup> Year (Open Elective)
<b>Dual Degree (B.Tech.+M.Tech. ) 1<sup>st</sup> Semester</b>			
25.	ECS-111	Engineering Mathematics-I	ECE 1 <sup>st</sup> Year
26.	CSS-111	Engineering Mathematics-I	CSE 1 <sup>st</sup> Year
<b>Dual Degree (B.Tech.+M.Tech. ) 2<sup>nd</sup> Semester</b>			
27.	ECS-121	Engineering Mathematics-II	ECE 1 <sup>st</sup> Year
28.	CSS-121	Engineering Mathematics-II	CSE 1 <sup>st</sup> Year
<b>Dual Degree (B.Tech.+M.Tech. ) 3<sup>rd</sup> Semester</b>			
29.	ECS-211	Engineering Mathematics-III	ECE 2 <sup>nd</sup> Year
30.	CSS-210	Probability and Queuing Models	CSE 2 <sup>nd</sup> Year
<b>M.Tech. 2<sup>nd</sup> Semester</b>			
31.	MA-601	Methods of Applied Mathematical Physics	ME-M.Tech.
32.	CE-634	Statistical Analysis in Transportation Systems	CE-M.Tech.
33.	EN-624	Statistical Methods & Modelling	CEEE-M.Tech.

**Indian Institute of Information Technology (IIIT), Una (Saloh),  
Himachal Pradesh**

S. No	Course No.	Course Name	(Branch & Year)
<b>B.Tech. 1<sup>st</sup> Semester</b>			
34.	ECS-111	Engineering Mathematics-I	ECE 1 <sup>st</sup> Year
35.	CSS-111	Engineering Mathematics-I	CSE 1 <sup>st</sup> Year
<b>B.Tech 2<sup>nd</sup> Semester</b>			
36.	ECS-121	Engineering Mathematics-II	ECE 1 <sup>st</sup> Year
37.	CSS-121	Engineering Mathematics-II	CSE 1 <sup>st</sup> Year
<b>B.Tech. 3<sup>rd</sup> Semester</b>			
38.	ECS-211	Engineering Mathematics-III	ECE 2 <sup>nd</sup> Year
39.	CSS-210	Probability and Queuing Models	CSE 2 <sup>nd</sup> Year
<b>B.Tech. 5<sup>th</sup> Semester</b>			
40.	MAO-316(a)	Operational Research	3 <sup>rd</sup> Year (Open Elective)
41.	MAO-316(b)	Linear Algebra	3 <sup>rd</sup> Year (Open Elective)
<b>B.Tech. 6<sup>th</sup> Semester</b>			
42.	MAO-325(a)	Probability, Statistics and Queuing Models	3 <sup>rd</sup> Year (Open Elective)

**Courses offered by the Department of Mathematics, NITH for Ph.D.  
Programs in various specializations**

<b>Ph.D.</b>			
43.	MA-851	Numerical Techniques & Computer Simulations	Ph.D.
44.	MA-798	Advanced Mathematics	Ph.D.
45.	MA-851	Fixed Point Theory and Applications	Ph.D.
46.	MA-852	Graph & Matrix Theory	Ph.D.
47.	MA-852	Mathematical Methods	Ph.D.
48.	MA-852	Hydrodynamic and Hydromagnetic Stability	Ph.D.

# Engineering Mathematics-I [CES-111]

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## Unit I Linear Algebra

Algebra of matrices, inverse, rank, system of linear equations, symmetric, skew-symmetric, and orthogonal matrices. Hermitian, skew-Hermitian and unitary matrices. Eigen values and Eigen vectors, diagonalisation of matrices, Cayley-Hamilton Theorem.

## Unit II Calculus

Functions of single variable, limit, continuity and differentiability, Mean value theorems, Indeterminate forms and L'Hospital rule, Maxima and minima, Taylor's series, Fundamental and mean value theorems of integral calculus. Evaluation of definite and improper integrals, Beta and Gamma functions, Functions of two variables, limit, continuity, partial derivatives, Euler's theorem for homogeneous functions, total derivatives, maxima and minima, Lagrange method of multipliers, double and triple integrals and their applications, sequence and series, tests for convergence, power series, Fourier series, Half range sine and cosine series.

## Unit III Vector Calculus

Gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, Stokes, Gauss and Green's theorems (without proofs) applications.

## Unit IV Integral Calculus

Quadrature, Rectification, Surface and Volume of revolution for simple curves, Double integrals and their applications, Change of order of integration, Triple integrals and their applications, Change of variables.

## Unit V Complex Variables

Analytic functions, Cauchy-Riemann equations, Application in solving potential problems, Line integral, Cauchy's integral theorem and integral formula (without proof), Taylor's and Laurent' series, Residue theorem (without proof) and its applications.

## Books

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.
3. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill.
4. Differential & Integral Calculus: by N. Piskunov, MIR Publications.

# **ENGINEERING MATHEMATICS-I [EES-111]**

**L T P**  
**3 1 0**

## **1. MATRICES**

Matrices, Related matrices, Complex matrices (Hermitian and skew-Hermitian matrices, Unitary matrix), Solution of linear system of equations, Rank of a matrix, Gauss-Jordan method, Normal form of a matrix, Vectors, Linear dependence, Consistency of a linear system of equations, Rouché's theorem, System of linear homogeneous equations, Linear and orthogonal transformations, Characteristic equation, Eigen values, Eigen vectors, Properties of eigen values, Cayley-Hamilton theorem, Reduction to diagonal form, Quadratic form and their reduction to canonical form.

## **2. INFINITE SERIES**

Convergence and divergence of infinite series, Geometric series test, Positive term series, p-series test, [Comparison test, D'Alembert's ratio test, Cauchy's root test (Radical test), Integral test, Raabe's test, Logarithmic test, Gauss's test] (without proofs), Alternating series and Leibnitz's rule, Power series, Radius and interval of convergence.

## **3. DIFFERENTIAL CALCULUS**

Indeterminate forms, Partial Differentiation and its geometrical interpretation, Homogeneous functions, Euler's theorem and its extension, Total differentials, Composite function, Jacobian, Taylor's and Maclaurin's infinite series, Errors and increments, Introduction to limits and Indeterminate forms, Maxima and minima of functions of two variables, Method of undetermined multipliers. Curve tracing.

## **4. INTEGRAL CALCULUS**

Quadrature, Rectification, Surface and Volume of revolution for simple curves, Double and Triple integrals and their applications.

## **5. VECTOR CALCULUS**

Differentiation of vectors, Curves in space, Velocity and acceleration, Relative velocity and acceleration, Scalar and vector point functions, Vector operator del, gradient, divergence and curl with their physical interpretations, Formulae involving gradient, divergence and curl. Line, surface and volume integrals, Theorems of Green, Stokes and Gauss (without proofs) and their verifications and applications, Irrotational and Solenoidal fields.

## **TEXT & REFERENCE BOOKS**

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.
3. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill
4. Differential & Integral Calculus: by N. Piskunov, MIR Publications.

# **ENGINEERING MATHEMATICS-I [MES-111]**

L T P  
3 1 0

## **1. MATRICES**

Matrices, Related matrices, Complex matrices (Hermitian and skew-Hermitian matrices, Unitary matrix), Solution of linear system of equations, Rank of a matrix, Gauss-Jordan method, Normal form of a matrix, Vectors, Linear dependence, Consistency of a linear system of equations, Rouché's theorem, System of linear homogeneous equations, Linear and orthogonal transformations, Characteristic equation, Eigen values, Eigen vectors, Properties of eigen values, Cayley-Hamilton theorem, Reduction to diagonal form, Quadratic form and their reduction to canonical form.

## **2. INFINITE SERIES**

Convergence and divergence of infinite series, Geometric series test, Positive term series, p-series test, [Comparison test, D'Alembert's ratio test, Cauchy's root test (Radical test), Integral test, Raabe's test, Logarithmic test, Gauss's test] (without proofs), Alternating series and Leibnitz's rule, Power series, Radius and interval of convergence.

## **3. DIFFERENTIAL CALCULUS**

Indeterminate forms, Partial Differentiation and its geometrical interpretation, Homogeneous functions, Euler's theorem and its extension, Total differentials, Composite function, Jacobian, Taylor's and Maclaurin's infinite series, Errors and increments, Introduction to limits and Indeterminate forms, Maxima and minima of functions of two variables, Method of undetermined multipliers. Curve tracing.

## **4. INTEGRAL CALCULUS**

Quadrature, Rectification, Surface and Volume of revolution for simple curves, Double integrals and their applications, Change of order of integration, Change of variables, Triple integrals and their applications, Change of variables.

## **5. VECTOR CALCULUS**

Differentiation of vectors, Curves in space, Velocity and acceleration, Relative velocity and acceleration, Scalar and vector point functions, Vector operator del, gradient, divergence and curl with their physical interpretations, Formulae involving gradient, divergence and curl. Line, surface and volume integrals, Theorems of Green, Stokes and Gauss (without proofs) and their verifications and applications, Irrotational and Solenoidal fields.

## **TEXT BOOKS**

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.

## **REFERENCE BOOKS**

1. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill
2. Differential & Integral Calculus: by N. Piskunov, MIR Publications.

# **ENGINEERING MATHEMATICS-I [ECS-111]**

L T P  
3 1 0

## **1. MATRICES**

Matrices, Related matrices, Complex matrices (Hermitian and skew-Hermitian matrices, Unitary matrix), Solution of linear system of equations, Rank of a matrix, Gauss-Jordan method, Normal form of a matrix, Vectors, Linear dependence, Consistency of a linear system of equations, Rouché's theorem, System of linear homogeneous equations, Linear and orthogonal transformations, Characteristic equation, Eigen values, Eigen vectors, Properties of eigen values, Cayley-Hamilton theorem, Reduction to diagonal form, Quadratic form and their reduction to canonical form.

## **2. INFINITE SERIES**

Convergence and divergence of infinite series, Geometric series test, Positive term series, p-series test, [Comparison test, D'Alembert's ratio test, Cauchy's root test (Radical test), Integral test, Raabe's test, Logarithmic test, Gauss's test] (without proofs), Alternating series and Leibnitz's rule, Power series, Radius and interval of convergence.

## **3. DIFFERENTIAL CALCULUS**

Indeterminate forms, Partial Differentiation and its geometrical interpretation, Homogeneous functions, Euler's theorem and its extension, Total differentials, Composite function, Jacobian, Taylor's and Maclaurin's infinite series, Errors and increments, Introduction to limits and Indeterminate forms, Maxima and minima of functions of two variables, Method of undetermined multipliers. Curve tracing.

## **4. INTEGRAL CALCULUS**

Quadrature, Rectification, Surface and Volume of revolution for simple curves, Double integrals and their applications, Change of order of integration, Change of variables, Triple integrals and their applications, Change of variables.

## **5. VECTOR CALCULUS**

Differentiation of vectors, Curves in space, Velocity and acceleration, Relative velocity and acceleration, Scalar and vector point functions, Vector operator del, gradient, divergence and curl with their physical interpretations, Formulae involving gradient, divergence and curl. Line, surface and volume integrals, Theorems of Green, Stokes and Gauss (without proofs) and their verifications and applications, Irrotational and Solenoidal fields.

## **TEXT BOOKS**

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.

## **REFERENCE BOOKS**

1. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill
2. Differential & Integral Calculus: by N. Piskunov, MIR Publications.

# **ENGINEERING MATHEMATICS-I [CSS-111]**

L T P  
3 1 0

## **1. MATRICES**

Matrices, Related matrices, Complex matrices (Hermitian and skew-Hermitian matrices, Unitary matrix), Solution of linear system of equations, Rank of a matrix, Gauss-Jordan method, Normal form of a matrix, Vectors, Linear dependence, Consistency of a linear system of equations, Rouché's theorem, System of linear homogeneous equations, Linear and orthogonal transformations, Characteristic equation, Eigen values, Eigen vectors, Properties of eigen values, Cayley-Hamilton theorem, Reduction to diagonal form, Quadratic form and their reduction to canonical form.

## **2. INFINITE SERIES**

Convergence and divergence of infinite series, Geometric series test, Positive term series, p-series test, [Comparison test, D'Alembert's ratio test, Cauchy's root test (Radical test), Integral test, Raabe's test, Logarithmic test, Gauss's test] (without proofs), Alternating series and Leibnitz's rule, Power series, Radius and interval of convergence.

## **3. DIFFERENTIAL CALCULUS**

Indeterminate forms, Partial Differentiation and its geometrical interpretation, Homogeneous functions, Euler's theorem and its extension, Total differentials, Composite function, Jacobian, Taylor's and Maclaurin's infinite series, Errors and increments, Introduction to limits and Indeterminate forms, Maxima and minima of functions of two variables, Method of undetermined multipliers. Curve tracing.

## **4. INTEGRAL CALCULUS**

Quadrature, Rectification, Surface and Volume of revolution for simple curves, Double integrals and their applications, Change of order of integration, Change of variables, Triple integrals and their applications, Change of variables.

## **5. VECTOR CALCULUS**

Differentiation of vectors, Curves in space, Velocity and acceleration, Relative velocity and acceleration, Scalar and vector point functions, Vector operator del, gradient, divergence and curl with their physical interpretations, Formulae involving gradient, divergence and curl. Line, surface and volume integrals, Theorems of Green, Stokes and Gauss (without proofs) and their verifications and applications, Irrotational and Solenoidal fields.

## **TEXT BOOKS**

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.

## **REFERENCE BOOKS**

1. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill
2. Differential & Integral Calculus: by N. Piskunov, MIR Publications.

# **ENGINEERING MATHEMATICS-I [CHS-111]**

L T P  
3 1 0

## **1. MATRICES**

Matrices, Related matrices, Complex matrices (Hermitian and skew-Hermitian matrices, Unitary matrix), Solution of linear system of equations, Rank of a matrix, Gauss-Jordan method, Normal form of a matrix, Vectors, Linear dependence, Consistency of a linear system of equations, Rouché's theorem, System of linear homogeneous equations, Linear and orthogonal transformations, Characteristic equation, Eigen values, Eigen vectors, Properties of eigen values, Cayley-Hamilton theorem, Reduction to diagonal form, Quadratic form and their reduction to canonical form.

## **2. INFINITE SERIES**

Convergence and divergence of infinite series, Geometric series test, Positive term series, p-series test, [Comparison test, D'Alembert's ratio test, Cauchy's root test (Radical test), Integral test, Raabe's test, Logarithmic test, Gauss's test] (without proofs), Alternating series and Leibnitz's rule, Power series, Radius and interval of convergence.

## **3. DIFFERENTIAL CALCULUS**

Indeterminate forms, Partial Differentiation and its geometrical interpretation, Homogeneous functions, Euler's theorem and its extension, Total differentials, Composite function, Jacobian, Taylor's and Maclaurin's infinite series, Errors and increments, Introduction to limits and Indeterminate forms, Maxima and minima of functions of two variables, Method of undetermined multipliers. Curve tracing.

## **4. INTEGRAL CALCULUS**

Quadrature, Rectification, Surface and Volume of revolution for simple curves, Double integrals and their applications, Change of order of integration, Change of variables, Triple integrals and their applications, Change of variables.

## **5. VECTOR CALCULUS**

Differentiation of vectors, Curves in space, Velocity and acceleration, Relative velocity and acceleration, Scalar and vector point functions, Vector operator del, gradient, divergence and curl with their physical interpretations, Formulae involving gradient, divergence and curl. Line, surface and volume integrals, Theorems of Green, Stokes and Gauss (without proofs) and their verifications and applications, Irrotational and Solenoidal fields.

## **TEXT BOOKS**

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.

## **REFERENCE BOOKS**

1. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill
2. Differential & Integral Calculus: by N. Piskunov, MIR Publications.

# **ARCHITECTURE MATHEMATICS-I [ARS-115]**

L T P  
3 1 0

## **1. MATRICES**

Matrices, Related matrices, Complex matrices (Hermitian and skew-Hermitian matrices, Unitary matrix), Solution of linear system of equations, Rank of a matrix, Gauss-Jordan method, Normal form of a matrix, Vectors, Linear dependence, Consistency of a linear system of equations, Rouche's theorem, System of linear homogeneous equations, Linear and orthogonal transformations, Characteristic equation, Eigen values, Eigen vectors, Properties of eigen values, Cayley-Hamilton theorem.

## **2. DIFFERENTIAL CALCULUS**

Indeterminate forms, Partial Differentiation and its geometrical interpretation, Homogeneous functions, Euler's theorem and its extension, Total differentials, Composite function, Jacobian, Errors and increments, Maxima and minima of functions of two variables, Method of undetermined multipliers, Curvature, radius of curvature, Centre & Circle of curvature.

## **3. CURVE TRACING**

Asymptotes, Curves in Cartesian and Polar form, Standard curves- Cartesian & Polar curves, Parametric curves, standard Parametric curves.

## **4. THREE DIMENSIONAL GEOMETRY**

Review: Line, plane, sphere, vectors.

Tangent plane to sphere, cone, cylinder, Quadric surfaces-(Ellipsoids, Hyperboloid of one and two sheets, cone, elliptic paraboloid, hyperbolic paraboloid, cylinder) , surface of revolution, some standard surfaces of revolution.

## **5. SPHERICAL TRIGONOMETRY**

Sections of spheres, great circles, spherical triangle and its properties, relations in angles and sides of spherical triangle, spherical right triangle.

## **6. INTEGRAL CALCULUS**

Quadrature, Rectification, Surface and Volume of revolution for simple curves, Double integrals and their applications, Change of order of integration, Change of variables, Triple integrals and their applications, Change of variables. Numerical Integration-(Simpson's and Trapezoidal rule)

## **7. VECTOR CALCULUS**

Differentiation of vectors, Curves in space, Velocity and acceleration, Relative velocity and acceleration, Scalar and vector point functions, Vector operator del, gradient, divergence and curl with their physical interpretations, Formulae involving gradient, divergence and curl. Line, surface and volume integrals, Theorems of Green, Stokes and Gauss (without proofs) and their verifications and applications,

## **TEXT BOOKS**

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.
3. Spherical Trigonometry: Kishana Publications, Meerut.

## **REFERENCE BOOKS**

1. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill
2. Differential & Integral Calculus: by N. Piskunov, MIR Publications.

# **ENGINEERING MATHEMATICS-II [CES-121]**

L T P

3 1 0

## **Ordinary and Partial Differential Equations:**

First order equation (linear and nonlinear), Second order linear differential equations with variable coefficients, Variation of parameters method, higher order linear differential equations with constant coefficients, Cauchy- Euler's equations, power series solutions, Legendre polynomials and Bessel's functions of the first kind and their properties, Separation of variables method, Laplace equation and its application to engineering problem.

## **Integral Transform:**

Laplace transforms of standard functions and their properties, Properties of Inverse Laplace transforms, Convolution Theorem and its application.

## **Probability and Statistics:**

Definitions of probability and simple theorems, conditional probability, Bayes Theorem, random variables, discrete and continuous distributions, Binomial, Poisson, Gaussian and normal distributions, correlation and, linear regression, Probability density function, Types of error, methods of error analysis, uncertainty analysis, statistical analysis and rejection of data.

## **Books:**

- 1) Elementary Differential Equations and Boundary Value Problems 9th Edition by Richard C. Dippina, William E. Boyce
- 2) Vector Calculus by Michael Corral
- 3) Probability and Statistics for Programmers by Allen B. Downey, published by O'Reilly Media

# **ENGINEERING MATHEMATICS-II [EES-121]**

L T P

3 1 0

## **1. FOURIER SERIES**

Euler's formula, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval, Odd and even periodic functions, Expansion of odd and even periodic functions, Half-range series, Typical wave-forms, Parseval's formula, Practical harmonic analysis.

## **2. ORDINARY DIFFERENTIAL EQUATIONS**

Brief review of first order ordinary differential equations, Exact equations, Equations reducible to exact equations, Equations of the first order and higher degree, Clairaut's equation, Applications of differential equations of first order (Orthogonal trajectories). Linear differential equations with constant co-efficients, Complimentary functions and particular integral, Method of variation of parameters, Equations reducible to linear equations with constant co-efficients (Cauchy's and Legendre's linear equations), Simultaneous linear equations with constant co-efficients, Applications of linear differential equations in engineering.

## **3. COMPLEX NUMBERS**

Applications of De Moivre's theorem, Exponential, Circular, Hyperbolic and Logarithmic functions of a complex variable, Inverse Hyperbolic functions, Real and imaginary parts of Circular and Hyperbolic functions, Summation of the series-'C+iS' method.

## **4. FUNCTIONS OF COMPLEX VARIABLE**

Limit and derivative of complex functions, Cauchy-Riemann equations, Analytic functions and its applications, Geometrical representation of complex function, Conformal mapping and standard transformations, Complex integration, Cauchy's theorem, Cauchy's integral formula, Series of complex terms, Taylor's and Laurent's series, Cauchy's residue theorem and its application for the evaluation of real definite integrals.

## **5. INTEGRAL TRANSFORMS**

Laplace Transforms of standard functions and their properties, Inverse Laplace Transforms, General Properties of inverse Laplace transforms and Convolution Theorem, Laplace Transforms of periodic functions, Bessel functions, Error function, Dirac-delta Function, Heaviside's Unit Function, Applications to linear simultaneous differential equations.

### **TEXT BOOKS**

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.

### **REFERENCE BOOKS**

1. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill.
2. Vector Calculus: by C. E. Weatherburn. John Wiley and Sons, NC, New York.
3. Complex variables and Applications: by R. V. Churchill, T. J. Brown & R. F. Verhey, McGraw Hill.
4. Differential Equations: by Shepley L. Ross, John Wiley & Sons, New York.

# **ENGINEERING MATHEMATICS-II [MES-121]**

L T P

3 1 0

## **1. FOURIER SERIES**

Euler's formula, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval, Odd and even periodic functions, Expansion of odd and even periodic functions, Half-range series, Typical wave-forms, Parseval's formula, Practical harmonic analysis.

## **2. ORDINARY DIFFERENTIAL EQUATIONS**

Brief review of first order ordinary differential equations, Exact equations, Equations reducible to exact equations, Equations of the first order and higher degree, Clairaut's equation, Applications of differential equations of first order (Orthogonal trajectories). Linear differential equations with constant coefficients, Complimentary functions and particular integral, Method of variation of parameters, Equations reducible to linear equations with constant co-efficients (Cauchy's and Legendre's linear equations), Simultaneous linear equations with constant co-efficients, Applications of linear differential equations in engineering.

## **3. COMPLEX NUMBERS**

Applications of De Moivre's theorem, Exponential, Circular, Hyperbolic and Logarithmic functions of a complex variable, Inverse Hyperbolic functions, Real and imaginary parts of Circular and Hyperbolic functions, Summation of the series-'C+iS' method.

## **4. FUNCTIONS OF COMPLEX VARIABLE**

Limit and derivative of complex functions, Cauchy-Riemann equations, Analytic functions and its applications, Geometrical representation of complex function, Conformal mapping and standard transformations, Complex integration, Cauchy's theorem, Cauchy's integral formula, Series of complex terms, Taylor's and Laurent's series, Cauchy's residue theorem and its application for the evaluation of real definite integrals.

## **5. INTEGRAL TRANSFORMS**

Laplace Transforms of standard functions and their properties, Inverse Laplace Transforms, General Properties of inverse Laplace transforms and Convolution Theorem, Laplace Transforms of periodic functions, Bessel functions, Error function, Dirac-delta Function, Heaviside's Unit Function, Applications to linear simultaneous differential equations.

### **TEXT BOOKS**

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.

### **REFERENCE BOOKS**

1. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill.
2. Vector Calculus: by C. E. Weatherburn. John Wiley and Sons, NC, New York.
3. Complex variables and Applications: by R. V. Churchill, T. J. Brown & R. F. Verhey, McGraw Hill.
4. Differential Equations: by Shepley L. Ross, John Wiley & Sons, New York.

# **ENGINEERING MATHEMATICS-II [ECS-121]**

L T P

3 1 0

## **1. FOURIER SERIES**

Euler's formula, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval, Odd and even periodic functions, Expansion of odd and even periodic functions, Half-range series, Typical wave-forms, Parseval's formula, Practical harmonic analysis.

## **2. ORDINARY DIFFERENTIAL EQUATIONS**

Brief review of first order ordinary differential equations, Exact equations, Equations reducible to exact equations, Equations of the first order and higher degree, Clairaut's equation, Applications of differential equations of first order (Orthogonal trajectories). Linear differential equations with constant coefficients, Complimentary functions and particular integral, Method of variation of parameters, Equations reducible to linear equations with constant co-efficients (Cauchy's and Legendre's linear equations), Simultaneous linear equations with constant co-efficients, Applications of linear differential equations in engineering.

## **3. COMPLEX NUMBERS**

Applications of De Moivre's theorem, Exponential, Circular, Hyperbolic and Logarithmic functions of a complex variable, Inverse Hyperbolic functions, Real and imaginary parts of Circular and Hyperbolic functions, Summation of the series-'C+iS' method.

## **4. FUNCTIONS OF COMPLEX VARIABLE**

Limit and derivative of complex functions, Cauchy-Riemann equations, Analytic functions and its applications, Geometrical representation of complex function, Conformal mapping and standard transformations, Complex integration, Cauchy's theorem, Cauchy's integral formula, Series of complex terms, Taylor's and Laurent's series, Cauchy's residue theorem and its application for the evaluation of real definite integrals.

## **5. INTEGRAL TRANSFORMS**

Laplace Transforms of standard functions and their properties, Inverse Laplace Transforms, General Properties of inverse Laplace transforms and Convolution Theorem, Laplace Transforms of periodic functions, Bessel functions, Error function, Dirac-delta Function, Heaviside's Unit Function, Applications to linear simultaneous differential equations.

### **TEXT BOOKS**

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.

### **REFERENCE BOOKS**

1. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill.
2. Vector Calculus: by C. E. Weatherburn. John Wiley and Sons, NC, New York.
3. Complex variables and Applications: by R. V. Churchill, T. J. Brown & R. F. Verhey, McGraw Hill.
4. Differential Equations: by Shepley L. Ross, John Wiley & Sons, New York.

# **ENGINEERING MATHEMATICS-II [CSS-121]**

L T P

3 1 0

## **1. FOURIER SERIES**

Euler's formula, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval, Odd and even periodic functions, Expansion of odd and even periodic functions, Half-range series, Typical wave-forms, Parseval's formula, Practical harmonic analysis.

## **2. ORDINARY DIFFERENTIAL EQUATIONS**

Brief review of first order ordinary differential equations, Exact equations, Equations reducible to exact equations, Equations of the first order and higher degree, Clairaut's equation, Applications of differential equations of first order (Orthogonal trajectories). Linear differential equations with constant coefficients, Complimentary functions and particular integral, Method of variation of parameters, Equations reducible to linear equations with constant co-efficients (Cauchy's and Legendre's linear equations), Simultaneous linear equations with constant co-efficients, Applications of linear differential equations in engineering.

## **3. COMPLEX NUMBERS**

Applications of De Moivre's theorem, Exponential, Circular, Hyperbolic and Logarithmic functions of a complex variable, Inverse Hyperbolic functions, Real and imaginary parts of Circular and Hyperbolic functions, Summation of the series-'C+iS' method.

## **4. FUNCTIONS OF COMPLEX VARIABLE**

Limit and derivative of complex functions, Cauchy-Riemann equations, Analytic functions and its applications, Geometrical representation of complex function, Conformal mapping and standard transformations, Complex integration, Cauchy's theorem, Cauchy's integral formula, Series of complex terms, Taylor's and Laurent's series, Cauchy's residue theorem and its application for the evaluation of real definite integrals.

## **5. INTEGRAL TRANSFORMS**

Laplace Transforms of standard functions and their properties, Inverse Laplace Transforms, General Properties of inverse Laplace transforms and Convolution Theorem, Laplace Transforms of periodic functions, Bessel functions, Error function, Dirac-delta Function, Heaviside's Unit Function, Applications to linear simultaneous differential equations.

### **TEXT BOOKS**

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.

### **REFERENCE BOOKS**

1. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill.
2. Vector Calculus: by C. E. Weatherburn. John Wiley and Sons, NC, New York.
3. Complex variables and Applications: by R. V. Churchill, T. J. Brown & R. F. Verhey, McGraw Hill.
4. Differential Equations: by Shepley L. Ross, John Wiley & Sons, New York.

# **ENGINEERING MATHEMATICS-II [CHS-121]**

L T P

3 1 0

## **1. FOURIER SERIES**

Euler's formula, Conditions for a Fourier expansion, Functions having points of discontinuity, Change of interval, Odd and even periodic functions, Expansion of odd and even periodic functions, Half-range series, Typical wave-forms, Parseval's formula, Practical harmonic analysis.

## **2. ORDINARY DIFFERENTIAL EQUATIONS**

Brief review of first order ordinary differential equations, Exact equations, Equations reducible to exact equations, Equations of the first order and higher degree, Clairaut's equation, Applications of differential equations of first order (Orthogonal trajectories). Linear differential equations with constant co-efficients, Complimentary functions and particular integral, Method of variation of parameters, Equations reducible to linear equations with constant co-efficients (Cauchy's and Legendre's linear equations), Simultaneous linear equations with constant co-efficients, Applications of linear differential equations in engineering.

## **3. COMPLEX NUMBERS**

Applications of De Moivre's theorem, Exponential, Circular, Hyperbolic and Logarithmic functions of a complex variable, Inverse Hyperbolic functions, Real and imaginary parts of Circular and Hyperbolic functions, Summation of the series-'C+iS' method.

## **4. FUNCTIONS OF COMPLEX VARIABLE**

Limit and derivative of complex functions, Cauchy-Riemann equations, Analytic functions and its applications, Geometrical representation of complex function, Conformal mapping and standard transformations, Complex integration, Cauchy's theorem, Cauchy's integral formula, Series of complex terms, Taylor's and Laurent's series, Cauchy's residue theorem and its application for the evaluation of real definite integrals.

## **5. INTEGRAL TRANSFORMS**

Laplace Transforms of standard functions and their properties, Inverse Laplace Transforms, General Properties of inverse Laplace transforms and Convolution Theorem, Laplace Transforms of periodic functions, Bessel functions, Error function, Dirac-delta Function, Heaviside's Unit Function, Applications to linear simultaneous differential equations.

### **TEXT BOOKS**

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons, NC, New York.
2. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.

### **REFERENCE BOOKS**

1. Advanced Engineering Mathematics: by C. R. Wylie & L. C. Barrett, McGraw Hill.
2. Vector Calculus: by C. E. Weatherburn. John Wiley and Sons, NC, New York.
3. Complex variables and Applications: by R. V. Churchill, T. J. Brown & R. F. Verhey, McGraw Hill.
4. Differential Equations: by Shepley L. Ross, John Wiley & Sons, New York.

# **ENGINEERING MATHEMATICS-III [CES-211]**

L T P  
3 1 0

## **Solution of Nonlinear and Transcendental equations:**

Basic concepts on polynomial equations, Roots of equations by Bisection method, iterative method, Regula-falsi method, Newton-Raphson method, Secant method.

## **Numerical Interpolation:**

Least square curve fit and trigonometric approximations, Finite differences and difference operators, Newtons interpolation formulae, Gauss forward and backward formulae, Sterling, Bessel's and Evertte's formulae, Interpolation with unevenly space d data points-Lagrange's interpolation.

## **Numerical differentiation and integration:**

Numerical differentiation, errors in numerical differentiation, Numerical integration-Trapezoidal, Simpson's 1/3 and 3/8 rules, Romberg integration-recursive formulae, Evaluation of double integrals by Trapezoidal and Simpson's rules.

## **Numerical Interpolation:**

Least square curve fit and trigonometric approximations, Finite differences and difference operators, Newtons interpolation formulae, Gauss forward and backward formulae, Sterling, Bessel's and Evertte's formulae, Interpolation with unevenly space d data points-Lagrange's interpolation.

## **Numerical differentiation and integration:**

Numerical differentiation, errors in numerical differentiation, Numerical integration-Trapezoidal, Simpson's 1/3 and 3/8 rules, Romberg integration-recursive formulae, Evaluation of double integrals by Trapezoidal and Simpson's rules.

## **System of simultaneous algebraic equations:**

Matrix inversion and solution of transcendental and system of algebraic equations-Gauss eliminattion method, Jacobi's method and Gauss-Seidal method, Eigen values and Eigen vectors, Jacobi's method

## **Ordinary differential equations:**

Picard's method , Euler's method , Modified Euler's method , Runge- Kutta methods of 2<sup>nd</sup> and 4<sup>th</sup> order.

## **Numerical solution of Partial Differential Equations**

Classification, various types of governing conditions, Finite Difference representation of derivatives, Parabolic PDE: Solution for one Dimensional equation, explicit and implicit schemes, Elliptic PDE, Solution of Laplace/ Poisson PDE, ADI and SOR schemes.

## **Books:**

- 1) Grewal, B.S., Numerical methods in engineering and science, Khanna Publishers, Delhi.
- 2) Rajasekaran, S. Numerical methods in science and engineering : a practical approach, Wheeler Publishing, New Delhi.
- 3) Sharma, J.N., Numerical Methods for Engineers and Scientists, Narosa Publishers, New Delhi.

# ADVANCED ENGINEERING MATHEMATICS [EES-211]

L T P

3 1 0

## 1. Fourier and Z-Transforms

Fourier transforms, Finite Fourier and Cosine Transforms, Properties of Fourier Transforms, Finite Fourier transform, Z-Transform and Its properties, Applications of Transforms to simple engineering problems.

## 2. PARTIAL DIFFERENTIAL EQUATIONS

Formation and solutions of partial differential equations, Lagrange's linear equation of the first order, Non-linear equations, Charpit's method, Homogeneous linear equations with constant coefficients, Non-homogeneous linear equations, Nonlinear equations of the second order (Monge's method), Method of separation of variables, Solution of wave equations, Heat flow equations, Laplace's equations and transmission line equations and their applications to engineering problems.

## 3. Numerical Methods

Revision of some basic concepts on polynomial equations, Bisection method, iterative method, Regula-Falsi method, Newton-Raphson Method, Generalized Newton's method for multiple roots, Solution of system of linear algebraic equations- Jacobi's method and Gauss-Seidel method. Eigen Values, vectors and eigen value problems Interpolation.

## 4. Numerical differentiation and integration:

Method of Least squares, Newton's forward and Backward Interpolation. Central Interpolation: Gauss Forward interpolation, Stirling formula. Lagrange's interpolation. Numerical differential and integration, Numerical solution of ode-Taylor's series method, Picard's method, Euler's method, Modified Euler's method, Runge-Kutta method of 2<sup>nd</sup> and 4<sup>th</sup> order.

## 5. Probability and Random variable:

Introduction to probability, permutations and combinations, Random variable, Probability Distribution- Binomial, Poisson and Normal Distribution, Mean, Median, Mode and Standard Deviation. Probability density Function Expected Value,

## Text & References Books

1. Advanced Engineering Mathematics: by Erwin Kreyszig. John Wiley and Sons, NC, New York.
2. Partial Differential Equation for Engineers and Scientists: by J.N. Sharma and Kehar Singh Narosa Publishing House, New Delhi/ Alpha Science Int. Ltd, UK.
3. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.
4. Engg. Mathematics, Babu Ram, Person
5. Numerical Methods for Engineers and Scientists, I.N.sharma Narosa.
6. Numerical Methods, S.S.Shastrri.
7. Elements of Partial Differential Equations: By Lan N. Sneddon, McGraw-Hill, Singapore.
8. Differential Equations: by Shepley L.Ross, John Wiley & Sons, New York.
9. Advanced Engineering Mathematics by Chandrka Prasad.
10. Higher Engg. Mathematics, B.V. Ramana TMH

# ENGINEERING MATHEMATICS-III [MES-211]

L T P  
3 1 0

## 1. PARTIAL DIFFERENTIAL EQUATIONS

Formation and solutions of partial differential equations, Lagrange's linear equation of the first order, Non-linear equations, Charpit's method, Homogeneous linear equations with constant co-efficients, Non-homogeneous linear equations, Nonlinear equations of the second order (Monge's method), Method of separation of variables, Solution of wave equations, Heat flow equations, Laplace's equations and transmission line equations and their applications to engineering problems.

## 2. SPECIAL FUNCTIONS

Series solutions about ordinary and singular point, Series solutions of Bessel's and Legendre's equations, Bessel's functions and Legendre's, polynomials, Modified Bessel's functions, Recurrence relations, generating functions and orthogonal properties, Equations reducible to Bessel's equation, Ber and Bei functions.

## 3. INTEGRAL TRANSFORMS

Definitions and Types of Integral Transforms, Application of Laplace transform to IVP and BVP, Periodic functions, Fourier transforms, Finite Fourier Sine and Cosine Transforms, Properties of Fourier Transforms, Applications of Integral Transforms to simple engineering problems. Hankel Transforms and its applications

## 4. Fundamental Concept of Probability

Mutually Exclusive, Independent events, Conditional probability, Tree diagram, Algebra of events, Multiplication rule, Baye's rule, Series and Parallel system, product law of reliability and unreliability.

## 5. Probability Distributions

Introduction to discrete and continuous Random variables, probability functions, probability density function, cumulative distribution function and their properties, two dimensional random variables, joint distribution of several random variables, cumulative marginal and conditional distribution functions, Expected value. Bernoulli Trials, Binomial Distribution, Poisson and Normal Distribution, Expected value and variance of continuous and discrete random variables,

## TEXT BOOKS

1. Advanced Engineering Mathematics: by Erwin Kreyszig . John Wiley and Sons, NC, New York.
2. Partial Differential Equation for Engineers and Scientists: by J.N. Sharma and Kehar Singh Narosa Publishing House, New Delhi/ Alpha Science Int. Ltd, UK.
3. Engg. Mathematics, Babu Ram, Pearson
4. Advanced Engineering Mathematics: by R. K. Jain & S. R. K lyengar, Narosa Pub. House.

## REFERENCE BOOKS

1. Elements of Partial Differential Equations: by Ian N. Sneddon, McGraw-Hill, Singapore.
2. Differential Equations: by Shepley L. Ross, John Wiley & Sons, New York.
3. Advanced Engineering Mathematics by Chandrika Prasad.
4. Higher Engg. Mathematics, B. V. Ramana TMH

# ENGINEERING MATHEMATICS III [ECS-211]

L	T	P
3	1	0

## 1. Fourier transforms

Periodic functions, Fourier transforms, Finite Fourier Sine and Cosine Transforms, Properties of Fourier Transforms, Applications of Integral Transforms to simple engineering problems differential Equations in Electric Circuits.

## 2. Partial Differential Equations:

Formation and solution of partial differential equations, Lagrange's Linear Equation of the first order, homogenous linear equations with constant coefficients, Classification of Partial Differential Equations, Method of Separation of variables, Solution of Wave equations, diffusion equations, Laplace's equations, transmission line equations, simple applications of pdes.

## 3. SPECIAL FUNCTIONS:

Series solutions ordinary differential equations, Solution of Bessel and Legendre differential equation, Bessel functions, Legendre functions, recurrence relations, orthogonality properties, Ber and Bei Functions

## 4. Probability & Distributions:

Introduction to Random variables & probability, Conditional Probability, Probability density function, Discrete and continuous distribution, Mean, medium, mode and standard deviations of standard distributions, Central Limit theorem, Generating functions, correlation and regression analysis. Urn model, Stochastic Independence, Independent trials, Baye's Rule, Bernoulli Trials, Binomial, Gaussian, Rayleigh, exponential, geometrical and uniform distributions and their density functions, and applications.

## 5. Convolution Ergodicity & Queuing Models:

Stochastic process, Queuing systems and displines, Poisson and exponential process, classification of queues, Markov chains, definition, examples, Markovian models & finite population Markovian Models, Ergodicity, Random walk with retaining barrier, absorbing barriers, characteristics of queuing systems, queuing Notations.

## Books Recommended:

1. Advanced Engineering Mathematics: by Erwin Kreyszig, John Wiley and Sons.
2. Advanced Engineering Mathematics: by C.R. Wylie & L C Barrett, McGraw Hill.
3. Differential Equations: by Shepley L. Ross, John Wiley and Sons.
4. Probability, Random Variables and Stochastic Processes, McGraw Hill
5. Probability and Statistics with Reliability and Queuing and Computer Science Applications: by K S Trivedi, Prentice Hall of India.

# PROBABILITY AND QUEUEING MODELS[CSS-210]

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>1</b>	<b>0</b>

## PROBABILITY AND RANDOM VARIABLE

Axioms of probability – Conditional probability – Total probability – Baye's theorem – Random variable- Probability mass function – probability density function – properties – Moments – Moment generating function and their properties.

## STANDARD DISTRIBUTIONS

Binomial, poisson, Geometric, Negative Binomial, Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties- Function of a random variable. Probability density function and its properties

## TWO DIMENSIONAL RANDOM VARIABLES

Joint distributions – Marginal and conditional distribution – Covariance – Correlation and regression – Transformation of random variables- Central limit theorem.

## RANDOM PROCESSES AND MARKOV CHAINS

Classification – Stationary process – Markov process –Poisson process- Birth and death process – Markov chains- transition probabilities – Limiting distributions.

## QUEUEING THEORY

Markovian models – M /M/1, M/M/C, finite and infinite capacity- M/M/8 queues – Finite source model – M/G/1 queue (steady state solution only) – Pollaczek – Khintchine formula- Special cases.

## TEXT BOOKS

1. Ross, S., "A first course in probability " , Sixth Edition , Pearson Education , Delhi , 2002.
2. Medhi j., "Stochastic Processes " , New Age Publishers, New Delhi, 1994. ( Chapters 2,3 & 4)
3. Taha, H.A., "Operations Research – An introduction", Seventh Edition, Pearson Education Edition Asia, Delhi, 2002.

## REFERENCES

1. Veerarajan. T., "Probability, Statistics and Random. Processes", Tata McGraw – Hill, Second Edition, New Delhi, 2003.
2. Allen., A.O., " Probability , Statistics and Queuing Theory " , Academic press , New Delhi, 1981.
3. Gross, D. and Harris, C.M., "Fundamentals of Queuing theory " , John Wiley and Sons, Second Edition, New York, 1985.

# COMPUTER PROGRAMMING AND NUMERICAL METHODS FOR MECHANICAL ENGINEERS [MES- 221]

L	T	P/D	Cr
3	1	0	3

**1. Programming fundamentals & Techniques:** Steps in program development, algorithm, flowchart, psuedocode, evolution and classification of programming languages, Basics of mathematical programming languages such as FORTRAN, MATLAB, C, C++ etc.

**2. Numerical computations and errors analysis :** Introduction, Numbers and their accuracy, Floating point arithmetic, errors in numbers, Computational methods for error estimation, General error formulae-approximation of a function, series approximations and error propagation in computation.

**3. Algebraic and transcendental equations:** Revision of some basic concepts on polynomial equations, Bisection method, iterative method, Regula-falsi method, Newton-Raphson method, Secant method, Generalized Newton's method for multiple roots, solution of non- linear simultaneous equations and finding complex roots by Newton-Raphson method.

**4 .System of simultaneous algebraic equations:** Solution of system of algebraic linear equations-Gauss elimination method, Jacobi's method and Gauss-Seidal method, Eigen values and eigen vectors-Power method, Jacobi's method and Householder method.

**5. Interpolation and function approximations:** Least square curve fit and trigonometric approximations, Approximations by trigonometric polynomials and quality of approximations, Finite differences and difference operators, Newtons interpolation formulae, Gauss forward and backward formulae, Sterling, Bessel's and Evertte's formulae, Interpolation with unevenly spaced data points-Lagrange's interpolation.

**6. Numerical differentiation and integration:** Numerical differentiation, errors in numerical differentiation, Maximum and minimum values of a tabulated function, Numerical integration- Trapezoidal, Simpson's 1/3 and 3/8 rules, Boole's and Weddle's rules, Romberg integration- recursive formulae, Evaluation of double integrals by Trapezoidal and Simpson's rules.

**7 .Ordinary differential equations:** Taylor's series method, Picard's method, Euler's method, Modified Euler's method, Runge- Kutta methods of 2<sup>nd</sup> and 4th order, Adams-Moltan and Milne methods, Solution of simultaneous and higher order equations. Finite Difference Method to solve ordinary differential equation.

**8.** Application of Programming and Numerical methods to solve various problems related to mechanical engineering.

## Books:

1. Numerical Methods for Engineers and Scientists :J.N. Sharma
2. Numerical Analysis : F. B. Hildbrand
3. Numerical Method for Engineers and Scientists : Jain, lyngar and R. K. Jain
4. Introductory Methods of Numerical Analysis :S.S. Sastry
5. Programming with C : Byron GottFried
6. An Introduction to Programming and Numerical Methods in MATLAB: Otto & Denier

## COMPUTER PROGRAMMING & NUMERICAL METHODS LAB [ MES – 226 ]

To develop algorithm and Programs for the implementation of Following Numerical methods in C++ and FORTRAN on the Computer

1. Bisection method to Solve algebraic and transcendental equations.
2. Regula- Falsi method to solve algebraic and transcendental equations.
3. Newton –Raphson method to solve algebraic and transcendental equations.
4. Secant method to solve algebraic and transcendental equations.
5. Gauss elimination method to solve system of linear algebraic equations.
6. Jacobi method to solve system of linear algebraic equations.
7. Gauss-Seidal method to solve system of linear algebraic equations.
8. Power method to find largest eignvalues and eignvectors.
9. Newton Forward Interpolation formula.
10. Lagrange's Interpolation formula.
11. Trapezodial rule to evaluate definite intergrals.
12. Simpson's  $\frac{1}{3}$  rd rule to evaluate definite integral.
13. Runge- Kutta method ( $2^{\text{nd}}$  &  $4^{\text{th}}$  order) to solve differential equations.
14. Solution of Laplace equation.
15. Bendre-Schmidt method to solve diffusion equation.
16. Solution of wave equation.

# **ENGINEERING MATHEMATICS-I1 [CHS-224]**

**L T P**  
**3 1 0**

## **1. PARTIAL DIFFERENTIAL EQUATIONS**

Formation and solutions of partial differential equations, Lagrange's linear equation of the first order, Non-linear equations, Charpit's method, Homogeneous linear equations with constant coefficients, Non-homogeneous linear equations, Nonlinear equations of the second order (Monge's method), Method of separation of variables, Solution of wave equations, Heat flow equations, Laplace's equations and transmission line equations and their applications to engineering problems. p

## **2. SPECIAL FUNCTIONS**

Series solutions about ordinary and singular point, Series solutions of Bessel's and Legendre's equations, Bessel's functions and Legendre's, polynomials, Modified Bessel's functions, Recurrence relations, generating functions and orthogonal properties, Equations reducible to Bessel's equation, Ber and Bei functions.

## **3. INTEGRAL TRANSFORMS**

Definitions and Types of Integral Transforms, Application of Laplace transform to IVP and BVP, Periodic functions, Fourier transforms, Finite Fourier Sine and Cosine Transforms, Properties of Fourier Transforms, Applications of Integral Transforms to simple engineering problems. Hankel Transforms and its applications

## **4. PROBABILITY**

Introduction to probability, Conditional Probability, Total Probability, Bay's theorem, Random variables, probability distribution: Binomial, Poisson Normal Distribution and Gamma distribution.

## **5. STATISTICS**

Mean, Median, Mode and standard deviation. Correlation and regression rank correlation, Regression, skewness and kurtosis, Principle of least squares, Tests based on Normal, t, Chi -Square and F distributions. Analysis of variance —one-way and two-way classifications.

## **TEXT BOOKS**

1. Advanced Engineering Mathematics: by Erwin Kreyszig John Wiley and Sons, NC, NewYork.
2. Partial Differential Equation for Engineers and Scientists: by J.N. Sharma and Kehar Singh Narosa Publishing House, New Delhi/ Alpha Science Int. Ltd, UK.
3. Engg. Mathematics, Babu Ram, Pearson Education
4. Advanced Engineering Mathematics: by R. K. Jain & S. R. K Iyengar, Narosa Pub. House.
5. A First Course in Probability: by Ross, S, Pearson Education.
6. Miller, I. and Freund, E. F. "Probability and Statistics for Engineers", Prentice Hall, Inc.

## **REFERENCE BOOKS**

1. Elements of Partial Differential Equations: by Ian N. Sneddon, McGraw-Hill, Singapore.
2. Differential Equations: by Shepley L. Ross, John Wiley & Sons, New York.
3. Advanced Engineering Mathematics by Chandrika Prasad.
4. Higher Engg. Mathematics, B. V. Ramana TMH
5. Probability, Statistics and Random Processes: by Verrarajan, T., Tata McGra Hill Publication.

# **OPERATION RESEARCH [MAO-316(a)]**

L T P  
3 1 0

## **Introduction:**

Origin, development and nature of O.R., meaning, scope and techniques of O.R., O.R. as a tool in decision making , classification of O.R. models, methods of deriving solution, limitations of O.R.

## **Linear Programming:**

Mathematical formulation of LPP, graphical solution method , exceptional cases, general and standard LPP, matrix formulation, simplex method , two phase simplex method problems of degeneracy , duality in LPP, fundamental theorem of duality and dual simplex method.

## **Transportation and assignment Problems:**

Mathematical formulation and solution procedure (Hungarian method) of assignment models, formulation and solution of traveling salesman problem, transportation problem, mathematical formulation and optimal solution of transportation problem, degeneracy in T.P.

## **Dynamic Programming:**

Introduction, Recursive approach, computational procedure and characteristics, solution of LPP by dynamics programming, sequencing problems with n-job and two, three, m-machines, graphical solution.

## **Network Analysis:**

Network scheduling by PERT/CPM, basic concepts, activities, nodes, network, critical paths, constraints, CPM and PERT calculations probability of meeting the schedule time.

## **BOOKS RECOMMENDED:**

1. 'Operation Research' by S.D.Sharma (Kedar Narh & Co.)
2. 'Operation Research' by Kanti Swarup, P.K.Gupta & Manmohan (S.Chand & Sons)

# Linear Algebra: [MAO-316(b)]

L T P  
3 0 0

## Introduction (Basic concepts and definitions):

Algebraic structures, Binary operation, Scalars, Vectors, Vectors in  $R^n$  and  $C^n$ , Definition of n-space, Vector Addition, Scalar Multiplication, Zero Vector, Definition of Dot or inner product in  $R^n$  and  $C^n$ , Orthogonal (Perpendicular) Vectors, Basic properties of the dot or inner product in  $R^n$ ,  $C^n$ , Real and Complex Euclidean n-space, Distance and Norm in  $R^n$  and  $C^n$ , Length (or norm) of Vector, Unit Vector (Normal vector), Cauchy-Bunyakovsky-Schwartz Inequality, Minkowski's Inequality, Algebraic structure, Group, Ring, Field and subfield and their properties.

## Systems of Linear Equations:

Introduction, System of Linear Equations, Gaussian elimination method, Matrices and elementary row operations, Row-reduced Echelon matrices, Matrix multiplications, Elementary Matrix, Invertible matrices.

## Vector Spaces or Linear Spaces:

Introduction, Basic concepts, Vector Spaces and its properties, Vector subspaces, criteria for identifying subspaces, Algebra of subspaces, Linear combinations, linear span of vectors, set, subspace spanned by vectors, Row and column space of matrix, Sum and Direct sums of subspaces, Linear Dependent and Linear Independent, Bases and dimension of vector space, Properties of finite dimension vector space, Replacement theorem, Dimension of subspace and linear span, Ordered basis, Coordinates.

## Linear maps or transformations:

Linear maps or transformations, linear operator, linear functional and their Properties, Range, Null space, kernel, Rank and Nullity of Linear transformations, Algebra of Linear transformations, Isomorphism, Isomorphic image, Invertible linear transformation, singular and non-singular transformations, Representation of Transformations by matrices, Change of Basis, Transition matrix.

## Inner Product Spaces:

Introduction, Standard Norm, Inner Product in vector space, Inner Product Space, Real and complex Inner Product Space and its examples, Norm of a vector in an inner product space, Unit vector, Normed vector space, Distance in an inner product space, Cauchy-Schwartz Inequality, Triangle Inequality, Orthogonality: Orthogonal Set, Orthonormal Sets, Orthogonal Complement, Orthogonal complement of an orthogonal complement, Orthogonal Projection,

Gram-Schmidt Orthogonalization Process, Linear functional on vector space and inner product space, Adjoints of linear operators, self-adjoint, Unitary, Orthogonal Operators, Normal Operators.

## TEXT/ REFERENCE BOOKS:

1. K. Hoffman and R. Kunje, **Linear Algebra**, Prentice-Hall (India), (1986).
2. Gilbert Strang, **Linear Algebra and Applications**, Sanders College Publishers.
3. G. H. Golub and C. F. Van Loan, **Matrix Computations**, North Oxford Academics, (1983).
4. G. Bachman and L. Narici, **Functional Analysis**, Academic Press, (1966).
5. E. Kreyszig, **Introductory Functional Analysis with Applications**, John Wiley, (1978).
6. Thomas S. Shores, **Applied Linear Algebra**
7. B. Kanti Datta, **Matrix and Linear Algebra**, Prentice Hall of India.
8. W. Keith Nicholson, **Linear Algebra with Applications**, McGraw Hill.
9. Promode Kumar Saikia, **Linear Algebra**, Pearson.
10. Bernard Kolman and David R. Hill, **Introductory Linear Algebra**, Pearson.
11. Otto Bretscher, **Linear Algebra with Applications**, Pearson.
12. Seymour Lipschutz, **Theory and Problems of Linear Algebra**, Schaum's Outline series.

# **PROBABILITY, STATISTICS AND QUEUING MODELS**

## **[MAO-325(a)]**

L T P  
3 1 0

### **Fundamental of Probability:**

Concept of Probability, Mutually Exclusive , Independent events, Conditional probability, Tree diagram, Algebra of events, Multiplication rule, Baye's rule , Series and Parallel system, product law of reliability and unreliability.

### **Random variables and density functions:**

Introduction to discrete and continuous Random variables, probability functions, probability density function, cumulative distribution function and their properties, two dimensional random variables, joint, Several random variables, cumulative marginal and conditional distribution functions, combinatorics, Expected value.

### **Probability Distribution and Densities:**

Bernoulli Trials, Binomial Distribution, Poisson and normal Distribution, Geometric and Hypergeometric distribution, Continuous distributions Uniform, Exponential, t, F, and Chi-square distribution, Generating function. Expected value and variance of continuous and discrete random variables, Sum of Random variables, Law of large numbers and central limit theorem. Generating functions, Moment and moment generating functions.

### **Hypothesis testing:**

Critical regions and level of significance, error in testing of hypothesis , one and two tailed test, procedure for testing of hypothesis , Null hypothesis , test of significance for large and small numbers, Chi-square test of goodness of fit and independence of attributes.

### **Markov process & chain and Queuing Models:**

Real queuing systems, M /M /1 (single channel poisson arrivals with exponential service rate), M /M /k and other waiting line models. Random processes, their classification, Gaussian process and its properties, Poisson's process and its properties. Markov process, Markov chains, absorbing and ergodic Markov chains (definition and examples), continuous parameter Markov chains, Birth and death process, pure birth and death process.

### **Books Recommended:**

1. Probability , Random Variables and Stochastic Process, McGraw Hill
2. Probability and Statistics with Reliability and Queuing and Computer Science Application: by K S Trivedi, Prentice Hall of India.
3. Introduction to probability, Charles M.Grinstead and J.Laurie Snell, American Mathematical Society.
4. Higher Engineering Mathematics, B, V. Ramana, TMH
5. Advance Engineering Mathematics: by Erwin Kreyszig, Jhon Wiley and Sons.
6. Advance Engineering Mathematics: by C.R.Wylie & LC Barrett, McGraw Hill.
7. Probability, Statistics and Random processes, T. Veerajan, Tata McGraw- Hill Publishing company limited New Delhi.
8. Operations Research for Management, G.V.Hsenoy, U.K.Srivactava, S.C. Sharma New Age International Limited Publishers.

# **METHODS OF APPLIED MATHEMATICAL PHYSICS**

**[MA-601]**

<b>L</b>	<b>T</b>	<b>P</b>
<b>3</b>	<b>0</b>	<b>0</b>

## **MATRICES AND LINEAR EQUATIONS:**

Linear equations; Gauss-Jordan Reduction; matrices & determinants; solvability of linear equations; characteristic value problems; equivalent matrices & transformations; discernments and invariants; coordinate transformation; numerical solution of characteristic value problem; Sturm-Liouville problems.

## **CALCULUS OF VARIATIONS:**

Maxima & minima; natural boundary and transmission conditions; constraints and Lagrangian multipliers; variable end points; Sturm-Liouville problems; Hamilton's principles; Lagrange's equation; generalized dynamical entities, constraints in dynamical system; small vibration, normal coordinates; variational problem in deformable bodies; elastic plates; Rayleigh-Ritz method.

## **PARTIAL DIFFERENTIAL AND INTEGRAL EQUATIONS:**

Introduction, Green's functions; singular integral equations, approximate methods of solutions eg. Method of collocation, weighting functions and least squares. Classification of PDE, Solutions Laplace, Diffusion and waves equation and their applications.

## **INTEGRAL TRANSFORMS:**

Fourier & Laplace transform; Inverse transforms; rectangle, triangle, exponential, Heaviside's step, sgn, filtering, sine function; impulse symbol; basic theorems similarity, addition, stiff, modulation, convolution Rayleigh, power, derivative theorems; transform of generalized functions; discrete Fourier transform; fast Fourier transform (FFT); applications of FFT.

## **BOOKS RECOMMENDED:**

1. Methods of Applied Mathematics -F.B. Hilderbrand, Prentice-Hall of India Ltd. , 1972
2. Partial Differential Equations by J.N.Sharma & Kehar Singh Narosa Publishing House New Delhi- 2000
3. The Fourier Transform and its Applications Ronald N. Bracewell, McGraw Hill International Ed. 1986
4. Theory and Problems of Laplace Transforms Murray R. Spiegel, Schaum's series, McGraw Hill,

# **STATISTICAL ANALYSES IN TRANSPORTATION SYSTEMS**

**[CE-634]**

**L T P**

**3 0 0**

Elements of Probability Theory, Linear and Non-linear Regression, Experimental Data and Model Parameters, Transportation and Assignment problems. Dynamic Programming, queuing theory, Decision theory, Hypothesis Testing and Model Evaluation, Computer Simulation.

**References:**

- Sheffi, Y. (1984), Urban transportation networks: Equilibrium analysis with mathematical programming methods, New Jersey.
- Benjamin J.R & Comell G.A., " Probability , Statistics , & Decision for Civil engineers".
- H.S. Ang and W.H. Tang, Probability Concepts in Engineering , Planning and Design, John Wiley,1975
- Erwin Kreyszig, Introductory mathematical Statics, John Wiley, 1970.

# **STATISTICAL METHODS AND MODELLING [EN-624]**

L T P  
3 0 0

## **Introduction**

Measures of Central tendency, dispersion, skewness and kurtosis- Principle of least squares- Correlation and regression –rank correlation.

## **Sampling Distribution and Estimation**

Sampling distribution-Point and Interval estimates for population proportions, mean and variance- Maximum likelihood estimate method – Method of moments.

## **Testing of Hypothesis**

Sampling distributions-Test Based on Normal , t, Chi-square and F distributions  
Analysis of variance- one–way and two-way classifications.  
Mathematical modelling and simulation, defining systems and its components, Types of models and their applications.

## **Introduction to Soft Computing Techniques**

Fuzzy set Theory and logic, Fuzzy MCDM and FRBS, simple applications in environmental engineering. Neural networks and Genetic algorithms

## **Models for Fate and Transport of Contaminants**

Modelling of Volatilization, chemical transformation, sorption/desorption, photochemical transformations, biological transformations. Brief review of mass, momentum and energy balance, advection, molecular diffusion, dispersion, their application in modelling of rivers, lakes, sediments, wetland, subsurface flow and transport, air pollution modelling

## **References**

1. Box GEP , Hunter JS and Hunter WG Statistics for Experimenters, 2<sup>nd</sup> Edition, John Wiley and Sons, 2005
2. Berthouex P M and Brown L C. Statistics for Environmental Engineers, 2<sup>nd</sup> Edition , CRC Press, 2002
3. Freund, J.E. and Miller, I.R., probability and Statics for Engineers, Prentice-Hall of India, 5<sup>th</sup> Edition, New Delhi,1994
4. Ramaswami, A, milford, J,B, small , M.J. integrated Environmental Modeling- Pollutant Transport, Fate, and Risk in the Environment John Wiley & Sons,2005.
5. Burrough, P.A. and McDonnell, R.A., Principles of Geographical Information Systems, Oxford University Press, 1998.
6. Snape, J.B., Dunn I.J.Ingham J and Prenosil J Dynamics of environmental Bioprocesses, Modelling and simulation Weinheim: VCH, 1995.
7. International Water association-activated sludge modelling Asm1 and Asm2
8. Chapra S C, Surface Water Quality Modeling , Mcgraw –Hill, Inc., New York, 1997.

## NUMERICAL TECHNIQUES AND COMPUTER SIMULATION [ MA-851 ]

L T P  
3 0 0

**1. SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS:** Bisection method, Regula-Falsi method, Newton-Raphson methods, iterative method, Muller's method, Quotient-Difference method, Miller method Newton-Raphson iteration method for non-linear equations. Convergence criteria of above methods.

**2. SYSTEM OF ALGEBRAIC EQUATIONS:** Gauss-elimination, Gauss-Jordan methods, Partitioning and Factorization methods, solutions of tridiagonal and Centro-Symmetric systems of equations, Gauss-Seidel and Jacobi's iterative methods, eigen values and eigen vectors. Householder method, Bairstow's method, Power method Convergence criteria.

**3. NUMERICAL DIFFERENTIATION AND INTEGRATION:** Numerical differentiation, maximum and minimum values, Newton-cotes integration formulae, Repeated interval halving and Romberg integration Richardson extrapolation technique, orthogonal polynomials, Gaussian quadrature, Double integration.

**4. SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS:** Taylor series and Picard's methods of approximations, Euler's method, Runge Kutta Methods, Multistep methods, predictor corrector methods, Truncation error, stability and step size control, boundary value problems, simultaneous equations, Relaxation and Finite difference method.

**5. SOLUTION OF PARTIAL DIFFERENTIAL METHODS:** Classification of partial differential equations, Finite difference approximations of partial derivatives, explicit and implicit form of difference equations convergence, stability and consistency, solution of parabolic equations, Laplace and Poisson's equations; Jacobi's method, Gauss-Seidel method SoR method, Crank-Nicolson Method, Unconditionally stable Explicit Procedures, DuFort-Frankel method, Solutions of Laplace and hyperbolic equations solution of non linear partial differential equations. Fourier series and Harmonic analysis. Finite Element Method: Rayleigh-Ritz method, Galerkin method and its applications.

**6. COMPUTER PROGRAMMING AND SOFTWARES:** Numerical programming and software MATLAB, FORTRAN and C++ for solving Boundary Value Problem / initial Value Problem.

### BOOKS RECOMMENDED

1. Numerical Methods for Engineers and Scientists J.N.Sharma, Naresh Publishing House, NewDelhi
2. Introductory methods of numerical Analysis by PHI 3<sup>rd</sup> Eds. 1999
3. Numerical methods for Scientists and Engineers:by MK Jain, SRK. Iyengar and R.K. Jain: Wiley Eastern
4. Numerical Analysis by FB Hildbrand 1 :-Tata McGraw Hill Co.
5. Getting Started with MATLAB by Rudra Pratap, Oxford University Press

**Section A: Linear Algebra**

Vector spaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Canonical forms, diagonal forms, triangular forms, Jordan forms, Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms.

**Section B: Real Analysis**

Finite, countable and uncountable sets, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Function of bounded variation.

**Section C: Complex Analysis**

Power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Contour integral, Cauchy's theorem, Liouville's theorem, Maximum modulus principle, Taylor series, Laurent series, calculus of residues, Rouché theorem, Morera's theorem.

**Section D: Algebra**

Symmetric and alternating groups; the Sylow Theorems; Special Linear Group; General Linear Group; Ring theory; Zero-divisor; Integral domain; Polynomial rings; Quaternion Group; Klein's Group; Modulo Groups; Field theory; Principal ideal domains; ideals.

**Section E: Elasticity**

Analysis of strains and stresses, type of strains and stresses, Elastic moduli generalized Hooke's law and its reduction to isotropic media and connection between them, Strain energy density function, Equation of equilibrium and motion, elastic waves in solids and their nomenclature, Thermo elasticity, Duhmal-Neumann relations, Thermo elastic waves and stresses, B.V.P of Elastic media.

**Referred Books:**

1. Hoffman, Kenneth; Kunze, Ray (April 25, 1971), Linear Algebra (2nd ed.), Prentice Hall.
2. Schaum's Outline of Linear Algebra (3rd ed.), McGraw-Hill.
3. Walter Rudin, "Real Analysis" McGraw-Hill.
4. Tom M. Apostol, "Mathematical Analysis", Narosa Publishing House.
5. H.S Kasana, "Complex variables", PHI Learning Pvt. Ltd..
6. L. V. Ahlfors, "Complex variables", McGraw-Hill.
7. John B. Fraleigh, "A First Course in Abstract Algebra" Addison-Wesley.
8. Joseph A. Gallian, "Contemporary Abstract Algebra", Narosa Publishing House.
9. I.S. Sokololuikoff, "Mathematical theory of Elasticity", McGraw-Hill.
10. Karl F. Graff, "Wave motion in Elastic Solids", Dover Publications, INC., New York.

**Note: Sections A, B and C are compulsory. One section can be selected from Section D and E**

## **FIXED POINT THEORY AND APPLICATIONS [ MA-851 ]**

**L T P**  
**3 0 0**

### **FUNDAMENTALS**

Topological spaces, Normed spaces, Dense set and separable space, Linear operators, Space of bounded linear operators, Hahn-Banach theorem and applications, Compactness, Reflexivity, Weak topologies, Continuity of mappings.

### **APPROXIMATION OF FIXED POINTS**

Basic properties and lemmas, Convergence of successive iterates, Mann iteration process, Nonexpansive and quasi- nonexpansive mappings, the modified Mann iteration process, The Ishikawa iteration process, The S-iteration process.

### **STRONG CONVERGENCE THEOREMS**

Convergence of approximants of self-mappings, Convergence of approximants of non-self mappings, Convergence of Halpern iteration process.

### **APPLICATIONS OF FIXED POINT THEOREMS**

Attractors of the IFS, Best approximation theory, Solutions of operator equations, Differential and integral equations, Variational inequality, Variational inclusion problem.

### **FUNDAMENTAL ORDER-THEORETIC PRINCIPLES**

Recursions and Iterations in Posets , Fixed Point Results in Posets, Solvability of Operator Equations and Inclusions, Fixed Point Results in Ordered Topological Spaces, Equations and Inclusions in Ordered Normed Spaces, Fixed Point Results for Maximalizing Functions.

### **NIELSEN FIXED POINT THEORY**

Nielsen and Reidemeister numbers, Wecken theorem, Some computations of the Nielsen number Jiang group, Projective spaces, Nielsen number of self-maps of tori, Nielsen relation of the fibre map, Fixed point index product formula, Nielsen number naive product formula, Nielsen classes on the fibres, Transformation Tu in coordinates, Nielsen number product formula, Fixed point theory and obstructions.

## GRAPH AND MATRIX THEORY [ MA-852 ]

L T P  
3 0 0

### Section A

Basic definition and notation graph; Perfect graph theorem; The spectrum the graph; Line and total graph; co-spectral graph; clique of the graph; dominating number graph; coloring number the graph; Strong graph; Regular graph; connected graph; Degree sequence the graph, Bipartite graph; Line chromatic number, Total chromatic number; The Achromatic number; independence number; Sum and product the graph; Homomorphism and automorphism of the graph; Graph with given group with properties; Entire graph; Symmetry in graph; Planer graph and outer planer graph; Eularian graph; Hamiltonian graph; Girth: Diameter; Trees and cycles ; intersection graph.

### Section B

Stochastic matrix and doubly stochastic matrix; Eigen values of the matrix; Nearly Reduced matrix; Decompose matrix ; graph related matrices; Adjacency Matrix; Fuzzy adjacency matrices; eigen values of the adjacency matrix ; General properties; The number of walks; Regulars graphs; Bounds for the largest, positive eigenvalues; Eigenvalue spacings; Density function of the eigenvalues; Examples of spectral density functions; Density of a sparse regular graph ; Bonds on a matrices; Algebraic Connectivit; Distance Matrix of a Tree; Resistance Distance; Laplacian Eigenvalues of Threshold Graphs; Positive Definite Completion Problem; Matrix Games Based on Graphs.

### References:

1. Graph Spectra for Complex Networks : PIET VAN MIEGHEM : Published in the United States of America by Cambridge University Press, New York , ISBN 978-0-521-19458-7
2. Graph and matrices ; R.B. Bapat, ISI Delhi, Springer, Hindustan book agency, ISBN 978-1-84882-980-0
3. Algorithmic graph theory and perfect graph , Martin Charles golumbic. Academic Press New York London , ISBN 0-12-289260-1
4. Graph Theory, Frank Harary, Narosa Publishing House , ISBN :8185015554
5. Introduction to graph theory , Douglas B. West , Prentise- Hall, ISBN-8120314808.

## MATHEMATICAL METHODS [ MA-852 ]

L T P

3 0 0

- 1. CALCULUS OF VARIATIONS:** maxima & minima; natural boundary and transmission conditions; constraints and lagrangian multipliers; variable end points; Sturm-Liouville problems; Hamilton's principles; Lagranges equation, generalised dynamical entities, constraints in dynamical system; small vibration, normal coordinates; variational problem in deformable bodies; elastic plates; Rayleigh-Ritz method.
- 2. DIFFERENTIAL AND INTEGRAL EQUATIONS:** Series solution of ODE; Bessel, Legendre, Hermite and Laguerre functions and their properties; introduction to integral equations, Fredholm and Voltera integral equations ;Green's functions; singular integral equations, approximate methods of solutions eg. Method of collocation, weighting functions and least squares. Classification of PDE, Solutions Laplace, Diffusion and waves equation and their applications.
- 3. INTEGRAL TRANSFORMS:** Fourier & Laplace transform; inverse transforms; rectangle, triangle, exponential, Heaviside's step, sgn, filtering, sinc function; impulse symbol; basic theorems similarity, addition, stiff, modulation, convolution Rayleigh, power, derivative theorems; transform of generalized functions; discrete Fourier transform; fast Fourier transform (FFT); applications of FFT.
- 4. Classical and non-classical thermoelasticity:** Thermal strains and stresses; equation of equilibrium and their motion & their derivatives, Boundary conditions and some BVP of thermoelastic continuum such as beams, plates, dishes and shells.

### BOOKS RECOMMENDED

1. Methods of Applied Mathematics -F.B. Hilderbrand , Prentic-Hall of India Ltd. 1972
2. Partial Differential Equations by J.N.Siirma & Kehar Singn Narosa Pubiisliing House New Delhi-2000
3. The Fourier Transform and its Ronald N. McGraw Hill international Ed. 1986
4. Theory and Problems of Laplace Transforms' Murray R. Spiegel , Schaum's series, McGraw Hill,1986.
5. Dynamical theory of Coupled Thermoelasticity by W. Nowaoki (2<sup>nd</sup> Edition ) PWN Sci Pub . Warszawa, 1975.
6. Dynamic Coupled Thermoelasticity by RS. Dhaliwal and A Singh, Hindustan Pub. House New Delhi , 1980

## HYDRODYNAMIC AND HYDROMAGNETIC STABILITY (MA-852)

L T P  
3 0 0

### **Unit 1: Basic concepts**

Introduction, basic concepts, analysis in terms of normal modes, non-dimensional number.

### **Unit 2: The thermal instability of a layer of fluid heated from below- Bénard problem**

Bénard problem, basic hydrodynamic equations, Boussinesq approximation, perturbation equations, analysis into normal modes, principal of exchange of stabilities, equations governing the marginal state, exact solution when instability sets in as stationary convection for two free boundaries.

### **Unit 3: The thermal instability of a layer of fluid heated from below- The effect of rotation**

Thermal instability in rotating fluid, perturbation equation, analysis in terms of normal modes, variational principle for stationary convection, solution when instability sets in as stationary convection for two free boundaries, on the onset of convection as overstability; the solution for the case of two free boundaries.

### **Unit 4: The thermal instability of a layer of fluid heated from below- The effect of magnetic field**

Thermal instability in presence of magnetic field, perturbation equations, the case when instability sets in as stationary convection; a variational principle, solution for stationary convection and for overstability for the case of two free boundaries.

### **Unit 5: The stability of superposed fluids: Rayleigh Taylor Instability**

Rayleigh-Taylor instability, perturbation equations, inviscid case, effect of rotation, effect of vertical magnetic field.

### **Text books:**

1. Hydrodynamic and Hydromagnetic Stability, S. Chandrasekhar, Dover Publication, New york, 1981.
2. Hydrodynamic Stability, P.G. Drazin & W. H. Reid, Cambridge Press, Cambridge, 1981.