Course Code	MAIR11 (Chemical, Civil, Mechanical, MME and Production)
Title of the Course	Matrices and Calculus
Prerequisite	Nil
Credits (L-T-P)	3 – 0 – 0

Course Learning Objectives: The objective of this course is to

1. introduce the fundamental concepts of eigenvalues, eigenvectors and its properties.
2. explain the criteria for convergence of sequences and infinite series using various tests.
3. analyse and discuss continuity, partial derivatives, total derivative and the extrema of functions of several variables.
4. explore the fundamentals of multiple integrals and its applications.
5. teach the use of Green's theorem, Stoke's theorem and Gauss divergence theorem in solving problems related to line and surface integrals.

Course Content:

Matrices – Eigenvalues and eigenvectors – Diagonalization of matrices – Cayley-Hamilton theorem and quadratic form.

Sequence and series – Convergence of sequence – Infinite series –Tests for convergence – Integral test, comparison test, ratio test, root test, Raabe's test, logarithmic test and Leibnitz's test – Power series.

Functions of two variables – Limit, continuity and partial derivatives – Total derivative – Jacobian – Taylor series – Maxima, minima and saddle points – Method of Lagrange multipliers.

Double and triple integrals – Change of variables – Multiple integrals in cylindrical and spherical coordinates – Applications.

Gradient, divergence and curl – Line and surface integrals – Green's theorem, Stoke's theorem and Gauss divergence theorem (without proofs).

Reference Books:

1. D. Zill, W. S. Wright and M. R. Cullen, *Advanced Engineering Mathematics*, 4th edition, Jones & Bartlett Learning, 2011.
2. E. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley and Sons, 2023.
3. J. E. Marsden and A. Tromba, *Vector Calculus*, 5th edition, W. H. Freeman, 2009.
4. M.J. Strauss, G.L. Bradley and K.J. Smith, *Multivariable Calculus*, 3rd edition, Prentice Hall, 2002.
5. W. Cheney and D. Kincaid, *Linear Algebra: Theory and Applications*, 2nd edition, Jones and Bartlett Publishers, 2012.

Course Outcomes: On completion of the course, students will be able to

1. find eigenvalues, eigenvectors of matrices and perform the process of diagonalization.
2. test the convergence of sequence and series.
3. explain the properties of functions of two variables, including limits, continuity, partial derivatives and evaluate extrema.
4. evaluate multiple integrals in cylindrical and spherical polar coordinates.
5. apply Green's, Stoke's and Gauss divergence theorems to evaluate line, surface and volume integrals.

Course Code	MAIR12 (CSE, EEE, ECE, ICE)
Title of the Course	Linear Algebra and Calculus
Prerequisite	Nil
Credits (L-T-P)	3 – 0 – 0

Course Learning Objectives: The objective of this course is to

1. introduce vector spaces, inner product spaces and its properties.
2. study eigenvalues, eigenvectors and its properties.
3. discuss the convergence of sequences and infinite series.
4. analyse and discuss continuity, partial derivatives, total derivative and the extrema of functions of several variables.
5. explore multiple integrals and their applications.

Course Content:

Vector space – Subspace – Linear dependence and independence – Spanning of a subspace – Basis and dimension – Inner product – Inner product space – Orthonormal basis – Gram-Schmidt orthogonalization process – Linear transformation.

Matrices – Eigenvalues, eigenvectors and its properties – Diagonalization of matrices – Cayley-Hamilton theorem – Quadratic form.

Sequence and series – Convergence of sequence – Infinite Series –Tests for convergence – Integral test, comparison test, ratio test, root test, Raabe's test, logarithmic test and Leibnitz's test – Power series.

Functions of several variables – Limit, continuity and partial derivatives – Total derivative – Jacobian– Taylor series – Maxima, minima and saddle points – Method of Lagrange multipliers.

Double and triple integrals – Change of variables – Multiple integrals in cylindrical and spherical coordinates – Applications.

Reference Books:

1. D. Zill, W. S. Wright and M. R. Cullen, *Advanced Engineering Mathematics*, 4th edition, Jones & Bartlett Learning, 2011.
2. E. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley and Sons, 2023.
3. M.J. Strauss, G.L. Bradley and K.J. Smith, *Multivariable Calculus*, 3rd edition, Prentice Hall, 2002.
4. W. Cheney and D. Kincaid, *Linear Algebra: Theory and Applications*, 2nd edition, Jones and Bartlett Publishers, 2012.
5. S. H. Friedberg, A. J. Insel and L. E. Spence, *Linear Algebra*, 5th edition, Pearson, 2022.

Course Outcomes: On completion of the course, students will be able to

1. find a basis and the dimension of a vector space, identify linear transformations and produce orthogonal basis using Gram-Schmidt process.
2. compute eigenvalues, eigenvectors of matrices and transform quadratic form into canonical form.
3. examine the convergence of sequences and series using various tests.
4. calculate partial and total derivatives of functions and apply the techniques of differential calculus to find the extrema of functions of several variables.
5. evaluate multiple integrals and apply it to find area and volume.

Course Code	MAIR21
Title of the Course	Complex Analysis and Differential Equations
Prerequisite	Nil
Credits (L-T-P)	3 – 0 – 0

Course Learning Objectives: The objective of this course is to

1. introduce the analytic functions, power series, various Cauchy's theorems and its applications in evaluation of integrals.
2. discuss various approaches to find general solution of ordinary differential equations.
3. investigate series solution techniques for solving ordinary differential equations.
4. study fundamentals of Laplace transform techniques and its applications.
5. familiarize the basics of partial differential equations and the use of method of separation of variables.

Course Content:

Analytic functions – Cauchy-Riemann equations – Line integral – Cauchy's integral theorem and integral formula (without proof) – Taylor's series and Laurent series – Residue theorem (without proof) and its applications.

Higher order linear differential equations with constant coefficients – Second order linear differential equations with variable coefficients – Method of variation of parameters – Cauchy-Euler equation.

Power series solutions – Legendre polynomials – Bessel functions of the first kind and its properties.

Laplace transform of standard functions – Derivatives and integrals – Inverse Laplace transform – Convolution theorem – Periodic functions – Application to ordinary differential equation.

Formation of partial differential equations by eliminating arbitrary constants and functions – Solution of first order partial differential equations – Four standard types – Lagrange's equation – Method of separation of variables.

Reference Books:

1. D. Zill, W. S. Wright and M. R. Cullen, *Advanced Engineering Mathematics*, 4th edition, Jones & Bartlett Learning, 2011.
2. E. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley and Sons, 2023.
3. J. W. Brown and R. V. Churchill, *Complex Variables and Applications*, 9th edition, McGraw-Hill Higher Education, 2021.
4. I. N. Sneddon, *Elements of Partial Differential Equations*, Dover Publication, 2006.
5. W. E. Boyce, R. C. Di Prima and D. B. Meade, *Elementary Differential Equations and Boundary Value Problems,* 12th edition, Wiley, 2021.

Course Outcomes: On completion of the course, students will be able to

1. decide analyticity of a function, find its series representation and apply Cauchy's residue theorem to evaluate complex integrals.
2. solve various types of first and higher order ordinary differential equations.
3. obtain series solution of ordinary differential equations.
4. apply Laplace transforms to solve initial value problems.
5. formulate and solve standard partial differential equations.

Course Code	MAIR31 (CSE)
Title of the Course	Probability and Operations Research
Prerequisite	Nil
Credits (L-T-P)	3 – 1 – 0

Course Learning Objectives: The objective of this course is to

1. familiarize the fundamental concepts, results in probability and some standard distributions.
2. study one dimensional and multi-dimensional random variables.
3. discuss Markov chain, Markov process and Poisson process.
4. introduce linear programming problem and discuss several methods to solve it.
5. explore transportation problems, assignment problems and project management techniques.

Course Content:

Definitions of probability – Conditional probability – Bayes' theorem – Random variable – Probability mass and density function – Binomial distribution – Poisson distribution – Normal distribution – Moment generating function.

Joint probability density function – Marginal and conditional densities – Function of random variable – Covariance and conditional expectation – Correlation coefficient.

Random process – Finite Markov chain – Various states of a Markov chain – Limiting probability – Markov process – Poisson process.

Linear programming problem (LPP) – Graphical method – Simplex method – Big-M method – Duality – Sensitivity analysis – Dual simplex method.

Transportation and assignment problems – Project management and network – Critical path method (CPM) – Program evaluation and review technique (PERT).

Reference Books:

1. F. S. Hillier and G. J. Lieberman, *Introduction to Operations Research*, 10th edition, McGraw Hill, 2017.
2. A. Ravindran, D.T. Phillips and J.J. Solberg, *Operations Research- Principles and Practice*, 2nd edition, John Wiley, 2007.
3. S. M. Ross, *Introduction to Probability and Statistics for Engineers & Scientists*, 5th edition, Academic press, 2014.
4. K. S. Trivedi, *Probability and Statistics with Reliability, Queuing and Computer Science Applications*, 2nd edition, John Wiley and Sons, 2016.
5. H. A. Taha, *Operations Research-An Introduction*, 10th edition, Pearson, 2019.

Course Outcomes: On completion of the course, students will be able to

1. find the probability of an event and the moment generating function of binomial, Poisson and normal variables.
2. determine marginal, conditional probability distributions and correlation between two random variables.
3. analyze and solve certain real-life problems using random process.
4. solve linear programming problems using graphical, simplex, big-M and dual simplex methods.
5. evaluate an optimal solution for transportation, assignment problems and expected project completion time in a project network.

Course Code	MAIR32 (EEE)
Title of the Course	Fourier analysis and Numerical Techniques
Prerequisite	Nil
Credits (L-T-P)	3 – 1 – 0

Course Learning Objectives: The objective of this course is to

1. familiarize basic theory as well as applications of Fourier series.
2. introduce Fourier transforms and related theorems.
3. teach different methods to solve system of linear equations.
4. discuss various root finding methods, interpolation techniques, numerical differentiation and integration.
5. explore curve fitting and difference equations.

Course Content:

Fourier series – Dirichlet's conditions – Half range Fourier cosine and sine series – Parseval's relation – Fourier series in complex form – Harmonic analysis.

Fourier transforms – Fourier cosine and sine transforms – Inverse transforms – Convolution theorem and Parseval's identity for Fourier transforms – Finite cosine and sine transforms.

Solution of linear system – Gauss elimination and Gauss-Jordan methods – LU decomposition methods – Crout's method – Jacobi and Gauss-Seidel iterative methods – Sufficient conditions for convergence – Power method to find the dominant eigenvalue and eigenvector.

Solution of nonlinear equation – Bisection method – Secant method – Regula-falsi method – Newton - Raphson method for $f(x) = 0$ and for $f(x, y) = 0,\ g(x, y) = 0$ – Newton's forward, backward and divided difference interpolation – Lagrange's interpolation – Numerical differentiation and integration – Trapezoidal rule – Simpson's 1/3 and 3/8 rules.

Curve fitting – Method of least squares and group averages – Solution of linear difference equations with constant coefficients.

Reference Books:

1. E. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley & Sons, 2023.
2. R. K. Jain, S. R. K Iyengar, *Advanced Engineering Mathematics,* CRC Press, 2002.
3. L. Debnath and D. Bhatta, *Integral Transforms and Their Applications*, 3rd edition, CRC press, 2014.
4. K. E. Atkinson, *An Introduction to Numerical Analysis,* 2nd edition, Wiley and Sons, 2008.
5. W. Cheney and D. Kincaid, *Numerical Mathematics and Computing*, 7th edition, Brooks/Cole, 2012.

Course Outcomes: On completion of the course, students will be to

1. find Fourier series of a function.
2. obtain Fourier and inverse Fourier transform of a function.
3. solve linear system of equations by direct and iterative methods.
4. work with various root finding algorithms interpolation techniques, numerical differentiation and integration.
5. fit a curve and solve difference equation with constant coefficient.

Course Code	MAIR 33 (ECE)
Title of the Course	Real Analysis and Probability Theory
Prerequisite	Nil
Credits (L-T-P)	3 – 1 – 0

Course Learning Objectives: The objective of this course is to

1. introduce sequences, convergence, Bolzano-Weierstrass and Heine-Borel properties.
2. explore Riemann integration, related theorems, sequences and series of function.
3. study functions of one and two random variables, distributions, densities, mean, covariance, moments and characteristic functions of random variables.
4. teach the theory and applications of random processes.
5. examine specific random processes.

Course Content:

Real number system – Sets, relations and functions – Properties of real numbers – Sequences – Cauchy sequences – Bolzano-Weierstrass and Heine-Borel properties.

Riemann integral – Mean value theorems – Sequences and series of functions – Pointwise and uniform convergence – Power series and Taylor series.

Random variable and random vectors – Distributions and densities – Functions of one and two random variables – Mean and covariance – Moments and characteristic functions.

Random processes – Strict sense and wide sense stationary processes – Covariance function and its properties – Spectral representation – Wiener-Khinchine theorem.

Gaussian processes – Poisson processes – Low pass and bandpass noise representations.

Reference Books:

1. R. G. Bartle and D. R. Sherbert, *Introduction to real analysis*, 4th edition, Wiley, 2014.
2. W. F. Davenport, *Probability and Random Processes: An Introduction for Applied scientists and Engineers*, New York, McGraw-Hill, 1970.
3. W. A. Gardner, *Introduction to Random Processes with Applications to signals and systems*, 2nd edition, McGraw Hill, 1990.
4. A. L. Garcia, *Probability, Statistics, and Random Processes for Electrical Engineering,* Pearson, 3rd edition, 2008.
5. A. Papoulis and S. U. Pillai, *Probability, random variables, and stochastic processes*, McGraw Hill, 4th edition, 2017.

Course Outcomes: On completion of the course, students will be able to

1. identify Cauchy sequences and apply the Bolzano-Weierstrass, Heine-Borel properties to solve problems.
2. compute Riemann integrals and determine the convergence of sequences and series of functions.
3. interpret various types of distributions, densities, means, covariances, moments and characteristic functions.
4. apply spectral representation theorem, Wiener-Khinchine theorem in the analysis of random processes.
5. model Gaussian and Poisson processes to specific problems.

Course Code	MAIR34 (ICE)
Title of the Course	Probability and Distribution Theory
Prerequisite	Nil
Credits (L-T-P)	3 – 1 – 0

Course Learning Objectives: The objective of this course is to

1. familiarize basic concepts of probability and random variables.
2. discuss random variables in practical problems.
3. examine mean, variance and moments of random variables.
4. introduce two dimensional random variables and various moments.
5. explore real-world problems using probability approximations.

Course Content:

Probability space – Properties of probability – Conditional probability – Joint events – Statistically independent events – Bayes' theorem and applications.

Discrete and continuous random variables – Probability mass and density functions – Cumulative distribution functions – Simple transformations – Important probability mass/density functions – Approximation of the binomial random variable with Poisson random variable.

Expectation of discrete/continuous random variables – Variance – Higher order moments – Moment generating functions – Characteristic functions – Applications.

Jointly distributed random variables – Expectations – Joint moments – Joint characteristic functions and conditional mass/density functions – Applications.

Probability and moment approximations – Law of large numbers – Central limit theorem – Applications.

Reference Books:

1. M. C. Douglas, and R. C. George, *Applied Statistics and Probability for Engineers*, 7th edition, Wiley, Inda, 2020.
2. S. M. Kay, *Intuitive Probability & Random Processes using MATLAB*, 1st edition, Springer, New York, 2017.
3. S. M. Ross, *Introduction to Probability & Statistics for Engineers and Scientists*, 5th edition, Academic Press, USA, 2014.
4. Y. Viniotis, *Probability & Stochastic Processes for Electrical Engineers*, 1st edition, Tata McGraw Hill, US, 1998.
5. M. J. Evans and J. S. Rosenthal, *Probability & Statistics: The Science of Uncertainty*, 2nd edition, W.H. Freeman & Co Ltd., University of Toronto, 2010.

Course Outcomes: On completion of the course, students will be able to

1. apply probability concepts and Bayes' theorem to practical problems.
2. explain some of the special distributions and solve problems based on it.
3. compute various moments, moment generating function and characteristic function of random variables.
4. characterize multiple input and output system probability models based on single and multiple random variables.
5. use the concept of probability approximations to solve real-life problems.

Course Code	MAIR41 (Chemical, MME)
Title of the Course	Fourier Series and Numerical Methods
Prerequisite	Nil
Credits (L-T-P)	3 – 1– 0

Course Learning Objectives: The objective of this course is to

1. discuss periodic and non-periodic functions in terms of sinusoidal functions.
2. explore standard partial differential equations and solution strategies.
3. teach numerical methods for solving linear systems and nonlinear equations.
4. introduce several methods for the interpolation of engineering data.
5. study various numerical techniques and apply to engineering problems.

Course Content:

Fourier series – Dirichlet's conditions – Half range Fourier cosine and sine series – Parseval's relation – Fourier series in complex form – Harmonic analysis.

Classification of second order linear partial differential equations – Method of separation of variables – Laplace equation – Solutions of one-dimensional heat and wave equations – Fourier series solution.

Solution of linear system – Gaussian elimination and Gauss-Jordan methods – LU decomposition methods – Crout's method – Jacobi and Gauss-Seidel methods – Sufficient conditions for convergence.

Solution of nonlinear equation – Bisection method – Secant method – Regula-falsi method – Newton - Raphson method for $f(x) = 0$ and for $f(x, y) = 0,\ g(x, y) = 0$ – Newton's forward, backward and divided difference interpolation – Lagrange's interpolation – Numerical differentiation and integration – Trapezoidal rule – Simpson's 1/3 and 3/8 rules.

Numerical solutions of first order ordinary differential equations by Taylor's and Picard's methods – Euler's method – Modified Euler's method – 4^{th} order Runge-Kutta method.

Reference Books:

1. K. E. Atkinson, *An Introduction to Numerical Analysis*, 2nd edition, Wiley & Sons, 2008.
2. R. Haberman, *Applied Partial Differential Equations: with Fourier Series and Boundary Value Problems*, 4th edition, Pearson, 2013.
3. M. K. Jain, S. R. K. Iyengar and R. K. Jain. *Numerical Methods: For Scientific and Engineering Computation*, 7th edition, New Age International Publishers, 2019.
4. E. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, Wiley, 2011.
5. K. S. Rao, *Introduction to Partial Differential Equations*, 3rd edition, PHI Learning Pvt Ltd, 2010.

Course Outcomes: On completion of the course, students will be able to be

1. express periodic as well as non-periodic functions in terms of sinusoidal functions.
2. solve standard partial differential equations of three types.
3. solve system of linear equations numerically.
4. work with interpolation and root finding techniques.
5. find approximate solutions for first order ordinary differential equations using various numerical techniques.

Course Code	MAIR42 (Civil)
Title of the Course	Probability and Numerical Techniques
Prerequisite	Nil
Credits (L-T-P)	3 – 1 – 0

Course Learning Objectives: The objective of this course is to
1. introduce various standard probability distributions and its applications to engineering problems.
2. explore different tests for testing of hypothesis, correlation and regression for the given data.
3. teach numerical methods for solving linear system of equations.
4. discuss numerical methods for solving non-linear equations, numerical interpolation, differentiation and integration.
5. study numerical methods to solve ordinary differential equations and partial differential equations.

Course Content:

Definitions of probability – Bayes' theorem – Random variable – Standard distributions (Binomial, Poisson and Normal distributions) – Moment generating function – Characteristic function – Central limit theorem – Law of large numbers.

Tests of significance – Large and small samples – t-test, F-test and chi-square test for goodness of fit – Simple, multiple and partial correlation – Regression.

Solution of linear system – Gaussian elimination and Gauss-Jordan methods – LU decomposition methods – Crout's method – Jacobi and Gauss-Seidel iterative methods.

Solution of nonlinear equation – Bisection method – Secant method – Regula-falsi method – Newton - Raphson method for $f(x) = 0$ and for $f(x, y) = 0,\ g(x, y) = 0$ – Newton’s forward, backward and divided difference interpolation – Lagrange’s interpolation – Numerical differentiation and integration – Trapezoidal rule – Simpson’s 1/3 and 3/8 rules.

Euler's method – Euler's modified method – Taylor's method – Runge-Kutta method for simultaneous equations and second order differential equations – Numerical solution of Laplace equation and Poisson equation by Liebmann's method – Crank -Nicolson method.

Reference Books:

1. S. M. Ross, *Introduction to Probability Models*, 11th edition, Academic Press, 2014.
2. D. C. Montgomery and G. C. Runger, *Applied Statistics and Probability for Engineers*, 5th edition, John Wiley & Sons, 2010.
3. E. W. Cheney and D. R. Kincaid, *Numerical Mathematics and Computing*, 7th edition, Cengage Learning, 2012.
4. C. F. Gerald and P. O. Wheatley, *Applied Numerical Analysis*, 7th edition, Pearson Education, 2004.
5. M. K. Jain, S. R. K. Iyengar and R. K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 7th edition, New Age international, 2019.

Course Outcomes: On completion of the course, students will be able to
1. model with various standard probability distributions in engineering problems.
2. execute testing of hypothesis, correlation and regression.
3. compute numerical solution of system of linear system of equations by direct and iterative methods.
4. find roots of nonlinear equations, interpolate data, numerically differentiate and integrate.
5. obtain numerical solutions of ordinary and partial differential equations by various methods.

Course Code	MAIR43 (Mechanical)
Title of the Course	Fourier Transforms and Numerical Techniques
Prerequisite	Nil
Credits (L-T-P)	3 – 1 – 0

Course Learning Objectives: The objective of this course is to

1. introduce Fourier series, Dirichlet's conditions and Parseval's relation.
2. teach Fourier transforms and inverse transforms, its properties.
3. discuss solutions of linear systems of equations using standard numerical methods.
4. explore numerical methods to solve ordinary differential equations.
5. introduce numerical solution to partial differential equations.

Course Content:

Fourier series – Dirichlet's conditions – Half range Fourier cosine and sine series – Parseval's relation –Fourier series in complex form – Harmonic analysis.

Fourier transforms – Fourier cosine and sine transforms – Inverse transforms – Convolution theorem and Parseval's identity for Fourier transforms – Finite cosine and sine transforms.

Solution of linear system – Gauss elimination and Gauss-Jordan methods – LU decomposition methods – Crout's method – Jacobi and Gauss-Seidel iterative methods – Sufficient conditions for convergence – Power method to find the dominant eigenvalue and eigenvector.

Numerical solution of ordinary differential equations – Euler's method – Euler's modified method – Taylor's method and Runge-Kutta method for simultaneous equations and second order equations – Stability analysis of single step methods – Multistep methods – Milne's and Adams' methods.

Numerical solution of Laplace equation and Poisson equation by Liebmann's method –Solution of one-dimensional heat flow equation – Bender-Schmidt recurrence relation – Crank-Nicolson method – Solution of one-dimensional wave equation.

Reference Books:

1. L. Debnath, and D. Bhatta, *Integral Transforms and Their Applications*, 2nd edition, Chapman & Hall / CRC press, 2010.
2. E. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley & Sons, 2023.
3. D. Kincaid and W. Cheney, *Numerical Analysis*: *Mathematics of Scientific Computing*, 3rd edition, S. Chand, 2001.
4. C. F. Gerald, and P. O. Wheatley, *Applied Numerical Analysis*, 7th edition, Addison-Wesley Publishing Company, 1994.
5. M. K. Jain, S. R. K. Iyengar and R. K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 7th edition, New Age international, 2019.

Course Outcomes: On completion of the course, students will be able to

1. apply Fourier series to analyze periodic functions and solve problems in harmonic analysis.
2. utilize Fourier transforms to solve integral equations and boundary value problems.
3. solve linear system of equations using Gauss elimination, LU decomposition and iterative methods.
4. solve ordinary differential equations and also analyze stability and accuracy of numerical methods.
5. obtain solutions of heat and wave equations numerically.

Course Code	MAIR44 (Production)
Title of the Course	Probability and Statistics
Prerequisite	Nil
Credits (L-T-P)	3 – 1 – 0

Course Learning Objectives: The objective of this course is to

1. introduce random variables and some of the special distributions.
2. impart knowledge on hypothesis testing for large and small sample.
3. explore point estimator and interval estimation for various statistical measures.
4. examine Markov chain and its applications.
5. discuss probability models for time series and some applications.

Course Content:

Random variable – Two dimensional random variables – Binomial, Poisson and normal distributions – Moment generating function.

Sampling distributions – Testing of hypotheses – Large sample test for mean and proportion – t-test, F-test and Chi-square test – Independence of attributes – Analysis of variance.

Point estimation – Interval estimation – Measures of quality of estimators – Confidence interval for mean and variance – Correlation – Rank correlation, multiple and partial correlation – Regression analysis.

Random process – Markov chains – Definition, examples and ergodicity – Finite Markov chain – Classification of states – Limiting probability – Application of Markov chain to simple problems.

Time series analysis – Introduction, probability models for time series, moving average and method of least squares – Auto-regressive models – Application to simple problems.

Reference Books:

1. J. Medhi, *Stochastic Processes*, 5th edition, New Age Publishers, 2020.
2. S.C. Gupta and V. K. Kapoor, *Fundamentals of Mathematical Statistics,* 12th edition, S. Chand and Sons, 2014.
3. S. M. Kay, *Intuitive Probability & Random Processes using MATLAB*, 5th edition, Springer, 2017.
4. K. S. Trivedi, *Probability and Statistics with Reliability, Queueing and Computer Applications,* 2nd edition, John Wiley and Sons, 2016.
5. A. Papoulis, *Probability, Random Variables and Stochastic Processes*, 4th edition, McGraw Hill Education, 2017.

Course Outcomes: On completion of the course, students will be able to

1. explain some of the special distributions and solve problems based on them.
2. apply basic statistical knowledge in testing of hypotheses on large and small samples.
3. compute point estimators and interval estimation for various statistical measures.
4. describe Markov chains and classification of states.
5. solve practical problems using probabilistic model for time series.