Matrices and Calculus

(Common to All Branches)

I Year I Semester

L	T	P	C
3	1	0	4

Pre-requisites: Mathematical Knowledge at pre-university level

Objectives:

To learn

- Types of matrices and their properties.
- Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
- Concept of eigenvalues and eigenvectors and to reduce the quadratic form to canonical form
- Geometrical approach to the mean value theorems and their application to the mathematical problems
- Evaluation of surface areas and volumes of revolutions of curves.
- Evaluation of improper integrals using Beta and Gamma functions.
- Partial differentiation, concept of total derivative
- Finding maxima and minima of function of two and three variables.
- Evaluation of multiple integrals and their applications

UNIT-I: Matrices **10 L**

Rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Gauss Seidel Iteration Method.

UNIT-II: Eigen values and Eigen vectors **10 L**

Linear Transformation and Orthogonal Transformation: Eigenvalues, Eigenvectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation.

UNIT-III: Calculus **10 L**

Mean value theorems: Rolle’s theorem, Lagrange’s Mean value theorem with their Geometrical Interpretation and applications, Cauchy’s Mean value Theorem, Taylor’s Series.

Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (Only in Cartesian coordinates), Definition of Improper Integral: Beta and Gamma functions and their applications.

UNIT-IV: Multivariable Calculus (Partial Differentiation and applications) **10 L**

Definitions of Limit and continuity.

Partial Differentiation: Euler’s Theorem, Total derivative, Jacobian, Functional dependence & independence. Applications: Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

UNIT-V: Multivariable Calculus (Integration) 8 L

Evaluation of Double Integrals (Cartesian and polar coordinates), change of order of integration (only Cartesian form), Evaluation of Triple Integrals: Change of variables (Cartesian to polar) for double and (Cartesian to Spherical and Cylindrical polar coordinates) for triple integrals.

Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals).

Course outcomes:

After learning the contents of this paper the student must be able to

- Write the matrix representation of a set of linear equations and to analyse the solution of the system of equations
- Find the Eigenvalues and Eigen vectors
- Reduce the quadratic form to canonical form using orthogonal transformations.
- Solve the applications on the mean value theorems.
- Evaluate the improper integrals using Beta and Gamma functions
- Find the extreme values of functions of two variables with/ without constraints.
- Evaluate the multiple integrals and apply the concept to find areas, volumes,

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th Editon, 2016.

References

1. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition,Pearson, Reprint, 2002.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
4. H. K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S Chand and Company Limited, New Delhi.

Ordinary Differential Equations and Vector Calculus

(Common to All Branches)

I Year II Semester

L	T	P	C
3	1	0	4

Pre-requisites: Mathematical Knowledge at pre-university level

Objectives:

To learn

- Methods of solving the differential equations of first and higher order.
- Concept, properties of Laplace transforms
- Solving ordinary differential equations using Laplace transforms techniques.
- The physical quantities involved in engineering field related to vector valued functions
- The basic properties of vector valued functions and their applications to line, surface and volume integrals

UNIT-I: First Order ODE **8 L**

Exact differential equations, Equations reducible to exact differential equations, linear and Bernoulli's equations, Orthogonal Trajectories (only in Cartesian Coordinates). Applications: Newton's law of cooling, Law of natural growth and decay.

UNIT-II: Ordinary Differential Equations of Higher Order: **10 L**

Second order linear differential equations with constant coefficients: Non-Homogeneous terms of the type $e^{ax}, \sin ax, \cos ax,$ polynomials in x, $e^{ax}V(x)$ and $x\,V(x)$, method of variation of parameters, Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Euler equation. Applications: Electric Circuits

UNIT-III: Laplace transforms: **10 L**

Laplace Transforms: Laplace Transform of standard functions, First shifting theorem, Second shifting theorem, Unit step function, Dirac delta function, Laplace transforms of functions when they are multiplied and divided by 't', Laplace transforms of derivatives and integrals of function, Evaluation of integrals by Laplace transforms, Laplace transform of periodic functions, Inverse Laplace transform by different methods, convolution theorem (without proof). Applications: solving Initial value problems by Laplace Transform method.

UNIT-IV: Vector Differentiation: **10 L**

Vector point functions and scalar point functions, Gradient, Divergence and Curl, Directional derivatives, Tangent plane and normal line, Vector Identities, Scalar potential functions, Solenoidal and Irrotational vectors.

UNIT-V: Vector Integration **10 L**

Line, Surface and Volume Integrals, Theorems of Green, Gauss and Stokes (without proofs) and their applications.

Course outcomes:

After learning the contents of this paper the student must be able to

- Identify whether the given differential equation of first order is exact or not
- Solve higher differential equation and apply the concept of differential equation to real world problems.
- Use the Laplace transforms techniques for solving ODE's.
- Evaluate the line, surface and volume integrals and converting them from one to another

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th Editon, 2016.

References

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint, 2002.
3. H. K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S Chand and Company Limited, New Delhi.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

Appendix - III

Probability and Statistics

(For CIVIL Engineering branch)

II Year I Semester

L	T	P	C
3	**1**	**0**	**4**

Pre-requisites: Mathematics courses of first year of study.

Objectives: To learn

- The theory of Probability, and probability distributions of single and multiple random variables
- The sampling theory and testing of hypothesis and making statistical inferences

UNIT-I: : Probability **8 L**

Sample Space, Events, Counting Sample Points, Probability of an Event, Additive Rules, Conditional Probability, Independence, and the Product Rule, Baye's Rule.

Random Variables and Probability Distributions: Concept of a Random Variable, Discrete Probability Distributions, Continuous Probability Distributions.

UNIT-II: Expectation and discrete distributions **10 L**

Mean of a Random Variable, Variance and Covariance of Random Variables, Means and Variances of Linear Combinations of Random Variables, Chebyshev's Theorem.

Discrete Probability Distributions: Binomial Distribution, Poisson distribution.

UNIT-III: Continuous Distributions and sampling **10 L**

Uniform Distribution, Normal Distribution, Areas under the Normal Curve, Applications of the Normal Distribution, Normal Approximation to the Binomial Distributions.

Fundamental Sampling Distributions: Random Sampling, Some Important Statistics, Sampling Distributions, Sampling Distribution of Means and the Central Limit Theorem, t – Distribution, F-Distribution.

UNIT-IV: Estimation & Tests of Hypotheses **10 L**

Introduction, Statistical Inference, Classical Methods of Estimation, Single Sample: Estimating the mean, standard error of a point estimate, prediction interval. Two sample: Estimating the difference between two means, Single sample: Estimating a proportion, Two samples: Estimating the difference between two proportions, Two samples: Estimating the ratio of two variances.

Statistical Hypotheses: General Concepts, Testing a Statistical Hypothesis, Single sample: Tests concerning a single mean, Two samples: tests on two means, One sample: test on a single proportion. Two samples: tests on two proportions, Two- sample tests concerning variances.

UNIT-V: Applied Statistics **10 L**

Curve fitting by the method of least squares, fitting of straight lines, second degree parabolas and more general curves, Correlation and regression, Rank correlation.

Course outcomes:

After learning the contents of this paper the student must be able to

- Apply the concepts of probability and distributions to some case studies.
- Correlate the concepts of one unit to the concepts in other units.

Text Books

1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statistics For Engineers & Scientists, 9th Ed. Pearson Publishers.
2. S C Gupta and V K Kapoor, Fundamentals of Mathematical statistics, Khanna publications.

References

1. T.T. Soong, Fundamentals of Probability And Statistics For Engineers, John Wiley & Sons, Ltd, 2004. .
2. Sheldon M Ross, Probability and statistics for Engineers and scientists, academic press.

Appendix - IV

Computer Oriented Statistical Methods

(Common for CSE, IT, CSE (AI & ML), CSE (Cyber Security), CSE (Data Science), CSE (Network), Computer Engineering(Software Engg.), CSIT and Computer Science & Design

II Year I Semester

L	T	P	C
3	1	0	4

Pre-requisites: Mathematics courses of first year of study.

Objectives: To learn

- The theory of Probability, Probability distributions of single and multiple random variables
- The sampling theory, testing of hypothesis and making statistical inferences
- Stochastic process and Markov chains.

UNIT-I : Probability **10 L**

Sample Space, Events, Counting Sample Points, Probability of an Event, Additive Rules, Conditional Probability, Independence, and the Product Rule, Baye's Rule,

Random Variables and Probability Distributions: Concept of a Random Variable, Discrete Probability Distributions, Continuous Probability Distributions.

UNIT-II: Expectation and discrete distributions **10 L**

Mean of a Random Variable, Variance and Covariance of Random Variables, Means and Variances of Linear Combinations of Random Variables, Chebyshev's Theorem.

Discrete Probability Distributions: Binomial Distribution, Poisson distribution.

UNIT-III: Continuous and Sampling Distributions **10 L**

Uniform Distribution, Normal Distribution, Areas under the Normal Curve, Applications of the Normal Distribution, Normal Approximation to the Binomial Distributions.

Fundamental Sampling Distributions: Random Sampling, Some Important Statistics, Sampling Distributions, Sampling Distribution of Means and the Central Limit Theorem, t - Distribution, F-Distribution.

UNIT-IV: Sample Estimation & Tests of Hypotheses **10 L**

Introduction, Statistical Inference, Classical Methods of Estimation, Single Sample: Estimating the mean, standard error of a point estimate, prediction interval. Two sample: Estimating the difference between two means, Single sample: Estimating a proportion, Two samples: Estimating the difference between two proportions, Two samples: Estimating the ratio of two variances.

Statistical Hypotheses: General Concepts, Testing a Statistical Hypothesis, Single sample: Tests concerning a single mean, Two samples: tests on two means, One sample: test on a single proportion. Two samples: tests on two proportions, Two- sample tests concerning variances.

UNIT-V: Stochastic Processes and Markov Chains **8L**

Introduction to Stochastic processes- Markov process. Transition Probability, Transition Probability Matrix, First order and Higher order Markov process, n-step transition probabilities, Markov chain, Steady state condition, Markov analysis.

Course outcomes:

After learning the contents of this paper the student must be able to

- Apply the concepts of probability and distributions to case studies.
- Formulate and solve problems involving random variables and apply statistical methods for analyzing experimental data.
- Apply concept of estimation and testing of hypothesis to case studies.
- Correlate the concepts of one unit to the concepts in other units.

Text Books

1. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statistics For Engineers & Scientists, 9th Ed. Pearson Publishers.
2. S C Gupta and V K Kapoor, Fundamentals of Mathematical statistics, Khanna publications.
3. S.D.Sharma, Operations Research, Kedarnath and Ramnath Publishers, Meerut, Delhi.

References

1. T.T. Soong, Fundamentals of Probability and Statistics For Engineers, John Wiley & Sons, Ltd, 2004. .
2. Sheldon M Ross, Probability and statistics for Engineers and scientists, academic press.
3. Miller and Freund’s, Probability and Statistics for Engineers, 8th Edition, Pearson Educations.

Appendix - V

Probability, Statistics & Complex Variables

(Common for Mechanical, Metallurgical, Chemical, Mining, Automation & Robotics and Textile Engineering)

II Year I Semester

L	T	P	C
3	1	0	4

Pre-requisites: Mathematics courses of first year of study.

Objectives: To learn

- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
- The basic ideas of statistics including measures of central tendency, correlation and regression.
- The statistical methods of studying data samples.
- Differentiation and integration of complex valued functions.
- Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
- Expansion of complex functions using Taylor's and Laurent's series.

UNIT-I: Basic Probability **8 L**

Probability spaces, conditional probability, independent events, and Baye's theorem.

Random variables: Discrete and continuous random variables, Expectation of Random Variables, Variance of random variables

UNIT-II: Probability distributions **10 L**

Binomial, Poisson, evaluation of statistical parameters for these distributions, Poisson approximation to the binomial distribution, Continuous random variables and their properties, distribution functions and density functions,

Normal and exponential, evaluation of statistical parameters for these distributions

UNIT-III: Estimation & Tests of Hypotheses **10 L**

Introduction, Statistical Inference, Classical Methods of Estimation.: Estimating the Mean, Standard Error of a Point Estimate, Prediction Intervals, Estimating a Proportion for single sample, Difference between Two Means, difference between two proportions for two Samples.

Statistical Hypotheses: General Concepts, Testing a Statistical Hypothesis, Tests Concerning a Single Mean, Tests on Two Means, Test on a Single Proportion, Two Samples: Tests on Two Proportions.

UNIT-IV: Complex Differentiation **10 L**

Limit, Continuity and Differentiation of Complex functions, Analyticity, Cauchy-Riemann equations (without proof), finding harmonic conjugate, elementary analytic functions (exponential, trigonometric, logarithm) and their properties, Conformal mappings, Mobius transformations.

UNIT-V: Complex Integration **10 L**

Line integral, Cauchy's theorem, Cauchy's Integral formula, Zeros of analytic functions, Singularities, Taylor's series, Laurent's series, Residues, Cauchy Residue theorem (All theorems without Proof).

Course outcomes:

After learning the contents of this paper the student must be able to

- Formulate and solve problems involving random variables and apply statistical methods for analyzing experimental data.
- Apply concept of estimation and testing of hypothesis to case studies.
- Analyze the complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems
- Taylor's and Laurent's series expansions of complex function

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, keying Ye, Probability and statistics for engineers and scientists, 9th Edition, Pearson Publications.

References

1. Fundamentals of Mathematical Statistics, Khanna Publications, S C Guptha and V.K. Kapoor.
2. Miller and Freund's, Probability and Statistics for Engineers, 8th Edition, Pearson Educations.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Edition, Mc-Graw Hill, 2004.

Appendix - VI

Numerical Methods and Complex Variables

(Common for EEE & ECE Branches)

II Year II Semester

L	T	P	C
3	1	0	4

Pre-requisites: Mathematics courses of first year of study.

Objectives: To learn

- Expressing periodic function by Fourier series and a non-periodic function by Fourier transforms
- Various numerical methods to find roots of polynomial and transcendental equations.
- Concept of finite differences and to estimate the value for the given data using interpolation.
- Evaluation of integrals using numerical techniques
- Solving ordinary differential equations of first order using numerical techniques.
- Differentiation and integration of complex valued functions.
- Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
- Expansion of complex functions using Taylor's and Laurent's series.

UNIT-I: Fourier Series & Fourier Transforms: 10 L

Fourier series - Dirichlet's Conditions - Half-range Fourier series - Fourier Transforms: Fourier Sine and cosine transforms - Inverse Fourier transforms.

UNIT-II: Numerical Methods-I 10 L

Solution of polynomial and transcendental equations: Bisection method, Iteration Method, Newton-Raphson method and Regula-Falsi method. Jacobi and Gauss-Seidal iteration methods for solving linear systems of equations.

Finite differences: forward differences, backward differences, central differences, symbolic relations and separation of symbols, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae, Lagrange's method of interpolation.

UNIT-III: Numerical Methods-II 8 L

Numerical integration: Trapezoidal rule and Simpson's $1/3^{rd}$ and $3/8^{th}$ rules.

Ordinary differential equations: Taylor's series, Picard's method, Euler and modified Euler's methods, Runge-Kutta method of fourth order for first order ODE

UNIT-IV: Complex Differentiation 10 L

Limit, Continuity and Differentiation of Complex functions. Cauchy-Riemann equations (without proof), Milne- Thomson methods, analytic functions, harmonic functions, finding harmonic conjugate, elementary analytic functions (exponential, trigonometric, logarithm) and their properties. (All theorems without Proofs), Conformal mappings, Mobius transformations.

UNIT-V: Complex Integration: 10 L

Line integrals, Cauchy's theorem, Cauchy's Integral formula, zeros of analytic functions, singularities, Taylor's series, Laurent's series, Residues, Cauchy Residue theorem.

and their properties. (All theorems without Proofs)

Course outcomes:

After learning the contents of this paper the student must be able to

- Express any periodic function in terms of sine and cosine
- Find the root of a given polynomial and transcendental equations.
- Estimate the value for the given data using interpolation
- Find the numerical solutions for a given first order ODE's
- Analyze the complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems
- Taylor's and Laurent's series expansions in complex function

Text Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.

References

1. M. K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical methods for Scientific and Engineering Computations , New Age International publishers.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Edition, Mc-Graw Hill, 2004.

Appendix - VII

Numerical Methods for Engineers

(Open Elective)

L	T	P	C
3	0	0	3

Pre-requisites: Mathematics courses in first two years of study

Objectives: To learn

- The importance of numerical methods.
- Identifying the root of an equation geometrically and finding its approximate value by different techniques.
- The concept of interpolation and fitting a interpolating polynomial.
- Finding the derivatives and proper integrals of given functions using finite differences.
- Fitting linear, non- linear and exponential curves for the given data by the method of least squares.
- Solving initial value problems using numerical methods.
- Solving boundary value problems involving PDE's using finite difference methods.

UNIT-I: Solution of Algebraic, Transcendental Equations and System of Linear Equations **6 L**

Bisection method, Regula-Falsi method, Iteration method, Newton-Raphson method. Iterative methods of solution of system of equations: Jacobi's iteration method, Gauss-Seidel iteration method.

UNIT-II: Interpolation **6 L**

Finite differences: Forward, Backward and Central differences, Other difference operators and relations between them, Differences of a polynomial, Missing terms, Newton's interpolation formulae, Central difference interpolation formulae: Gauss's forward and backward interpolation formulae, Interpolation with unequal intervals: Lagrange's interpolation formula.

UNIT-III: Numerical Differentiation , Integration and Curve fitting **6 L**

Numerical differentiation: Derivatives using Newton's interpolation formulae. Numerical integration: Newton-cotes quadrature formula, Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rule. Curve Fitting: Method of least squares**,** Fitting a straight line, Second degree parabola and Non-linear curves of the form $y = ae^{bx}$, $y = ab^{x}$, $y = ax^{b}$ by the method of least squares..

UNIT-IV: Numerical Solution of Ordinary Differential Equations of First Order **6 L**

Taylor's series method, Picard's method, Euler's and modified Euler's Method, Runge-Kutta method of fourth order, Predictor and Corrector methods: Milne's method, Adams-Bashforth-Moulton method.

UNIT- V : Numerical Solution of Partial Differential Equations **6 L**

Finite difference approximations to partial derivatives, Elliptic equations: Solution of Laplace equation by Liebmann's iteration process, Parabolic equations: Solution of one dimensional Heat equation by Schmidt explicit method and Crank-Nicolson implicit method, One dimensional wave equation (explicit scheme) .

Course outcomes:

After learning the contents of this paper the student is able to

- Find a better approximate root of a given Algebraic, Transcendental equations.
- Find solution of system of linear equations.
- Find the finite difference operators and find the missing terms in a given data or value of the dependent variable for a given independent variable
- Evaluate the derivative at a given value and integral of a function.
- Solve the initial value problems and apply predictor and corrector methods.
- Solve Laplace equations, parabolic equations with given boundary conditions.

Text Books

1. S S Sastry, Introductory Methods of Numerical Analysis, Fifth Edition, PHI Learning Pvt. Ltd, New Delhi, 2012.
2. M K Jain and S R K Iyengar, Numerical Methods for Scientific and Engineering Computation, 5th Edition, New Age International Publishers, New Delhi, 2007.

References

1. B S Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. B V Ramana, Higher Engineering Mathematics, Tata McGraw Hill Education Private Limited, New Delhi, 29th Reprint, 2017.
3. T K V Iyengar, B Krishna Gandhi & Others, Numerical Methods, Second Revised Edition, New Delhi, S.Chand & Co. Ltd, 2013.

Appendix - VIII

Operations Research

(Open Elective)

L	T	P	C
3	0	0	3

Pre-requisites: Mathematics courses in first two years of study

Objectives: To learn

- Optimization techniques with constraints involving inequalities.
- Simplex method.
- Formulation and solution of a transportation and assignment problems.
- Optimization techniques in the problems of replacement and sequencing.

UNIT-I: Introduction to Operations Research 6 L

Basic definition, scope, objectives, phases, models and limitations of Operations Research. Linear Programming Problem, Formulation and Graphical solution of Linear Programming Problem. Simplex method.

UNIT-II: Artificial Variables Techniques 6 L

Big -M method, Two-phase simplex method, Duality in simplex method, Dual simplex method, degeneracy in simplex and unbound solutions.

UNIT-III: Transportation problem 6 L

Formulation, solution, unbalanced Transportation problem. Finding initial basic feasible solutions, North-West corner rule, lowest cost entry method and Vogel's approximation method. Optimality test- MODI method, degeneracy in transportation, restricted transportation problem, conditional transportation problem.

UNIT-IV: Assignment Model 6 L

Formulation, Hungarian method for optimal solution, solving unbalanced problem, restricted assignment, conditional assignment problems, crew assignment problems, Travelling salesman problem, Transportation problem as assignment problem.

UNIT- V : Replacement Models and Sequencing Models 6 L

Replacement Models**:** Replacement of Items that Deteriorate whose maintenance costs increase with time without change in the money value, Replacement of items that fail suddenly, individual replacement policy, group replacement policy.

Sequencing Models :Solution of Sequencing Problem, Processing n Jobs through two machines, Processing n Jobs through three machines, Processing two Jobs through m machines, Processing n Jobs through m Machines.

Course outcomes:

After learning the contents of this paper the student is able to

- Solve a LPP by using graphical and simplex method.
- Employ two phase simplex method and dual simplex method of LPP s.
- Obtain basic feasible and optimum solutions to transportation and assignment problems.
- Suggest optimum policy for a replacement model and sequencing model.

Text Books

1. M. Natarajan, P. Balasubramani, A. Tamilarasi (2006), Operations Research, Pearson Education, India.
2. S. D. Shama (2009), Operation Research, Tata McGraw Hill, New Delhi.
3. J. K. Sharma (2007), Operations Research – Theory and Applications, 3rdedition, Macmillan India Ltd, India.

References

1. R. Panneer Selvam (2008), Operations Research, 2ndedition, Prentice Hall of India, India.
2. F. S. Hillier, G. J. Lieberman (2007), Introduction to Operations Research,8th Edition, Tata McGraw Hill, New Delhi, India.

Appendix - IX

Mathematics for Machine Learning

(Open Elective)

L	T	P	C
3	0	0	3

Pre-requisites: 1**.** Matrix Algebra and Calculus 2. Applied and Multivariable Calculus

Objectives: To learn

- Mathematical Techniques which are applied in Machine learning
- Machine learning and its applications.

6 L

UNIT-I: Vector Spaces:

Vector spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces.

UNIT-II: Inner Product Spaces: **6 L**

Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations.

UNIT-III: Clustering & PCA: **6 L**

Clustering, Limkage-Based Clustering Algorithms, *k*-Means and other cost minimization clustering. **PCA:** Problem Setting, Maximum Variance Perspective, Projection Perspective, Eigenvector Computation and Low rank Approximations.

UNIT-IV: Support Vector Machines: **6 L**

Separating Hyperplanes, Primal support vector machine, Dual support vector machine.

UNIT- V : Kernel Methods: **6 L**

Embeddings into feature spaces, The Kernel trick, Kernels as a way to express prior knowledge.

Course outcomes:

After learning the contents of this paper the student must be able to

- Apply the concepts of Machine learning in computer and Data Sciences.

Text Books

1. Marc Peter Deisenroth, A.AldoFaisai, Cheng Soon Ong, Mathematics for machine learning, Cambridge University Press(2020).
2. Shai Shaley-Shwartz and Shai Ben-David, Understanding Machine Learning from Theory of Algorithm, Cambridge University Press, 2014.

References

1. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, Vipin Kumar. Introduction to Data Mining, Second Edition, Pearson Addison-Wesley
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley &Sons, 2006.
3. Gilbert Strong, Linear Algebra and its applications, Forth Edition, Cengage Learning.

Appendix- X

Numerical Methods Lab

(Common to all branches)

II Year II Semester

L	T	P	C
1	**0**	**2**	**2**

Pre-requisites: No Pre Requisites, Foundation Course.

Objectives:

- The aim of this lab is to develop programming skills in C language / MATLAB / Python for the numerical methods and allied problems. More emphasis will be on writing programs with minimum possible code.

UNIT- 1: Interpolation

Introduction, Finite differences, Forward Differences, Backward differences, Central differences. Difference Equations: Differences of a polynomial, Newton's formulae for interpolation (forward and backward), Lagrange's Interpolation formula.

Programming Tasks:

A) Write a program to determine y for a given x, if two arrays of x and y of same size are given.(using Newton's interpolation both forward and backward)

B) Write a program to determine y for a given x, if two arrays of x and y of same size are given.(using Lagrange 's interpolation)

UNIT- 1I: Curve fitting:

Fitting a straight line, second degree curve, exponential curve, power curve by method of least squares.

Programming Tasks:

A) Write a program to find a straight line of best fit from the given two arrays of x and y of same size.

B) Write a program to find a curve of the form $y = Ae^{Bx}$ from the given two arrays of x and y of same size.

C) Write a program to find a curve of the form $y = Ax^B$ from the given two arrays of x and y of same size.

D) Write a program to find a curve of the form $y = Ax^2 + Bx + C$ from the given two arrays of x and y of same size.

UNIT- III: Solution of Algebraic and Transcendental Equations:

Solution of Algebraic and Transcendental Equations and Linear system of equations.

Introduction, Graphical interpretation of solution of equations, Bisection Method, Method of False Position, Iteration Method and Newton-Raphson Method.

Programming Tasks:

A) Write a program to find the root of a given equation using bisection method.
(Write this program such that the initial values given to the system are not usable, then the system should ask us to give new set of initial values)
B) Write a program to find the root of a given equation using method of false position(regula false position)
C) Write a program to find the root of a given equation using iteration method
D) Write a program to find the root of a given equation using Newton Rophson method

UNIT- 1V: Linear system of equations:

Solving system of non-homogeneous equations by Jacobi's and Gauss-Seidel Iteration method

Programming Tasks:

A) Write a program to find the solution of given system of linear equations using jacobi's method
B) Write a program to find the solution of given system of equations using Gauss sidel iteration method

UNIT- V: Numerical Differentiation, Integration, and Numerical solutions of First order differential equations:

Numerical differentiation, Numerical integration: Trapezoidal rule, Simpson's $1/3^{rd}$ and 3/8 Rule. Numerical solution of Ordinary Differential equations: Solution by Taylor's series method, Euler's Method, Runge-Kutta Method.

Programming Tasks:

A) Write a program to evaluate definite integral using trapezoidal rule, Simpson's $1/3^{rd}$ rule and $3/8^{th}$ rule.
B) Write a program to solve a given differential equation using Taylor's series.
C) Write a program to solve a given differential equation Euler's method.
D) Write a program to solve a given differential equation using Ruge-Kutta method.

Text Books:

1) Introductory Methods of Numerical Analysis by SS Sastry
2) Numerical and Statistical Methods with Programming in C by Sujatha Sinha and Subhabrada Dinda, Scitech Publishers.
3) Numerical Methods, Principles, Analysis and Algorithms by Srimantapal & Subodh C. Bhunia, Oxford University Press.
4) Applied Numerical Methods using MATLAB by Rao.V.Dukkipati, New Age publishers.

References:

1) Advanced Engineering Mathematics by Alan Jeffery
2) Numerical Methods in Science and Engineering –A practical Approach By S.Rajasekharan, S. Chand Publications.

Outcomes:

- After completion of this lab course, student will be well acquainted with the programming skills in C language / MATLAB / Python and able to write the codes for the problems they come across in engineering courses.