P18MAT1108 Mathematical foundations for Computer science

L	T	P	PJ	C
3	1	0	0	4

COURSE OUTCOMES
On the successful completion of the course, the students would be able to

CO1: Evaluate the validity of logical argumentsand construct mathematical proofs.
CO2: Analyse whether given graphs are isomorphic and apply different algorithms to find the shortest path.
CO3: Apply the concept of two dimensional random variables to correlation, regression and Central limit theorem.
CO4: Learn and apply multivariate analysis necessary for Principal Component Analysis.
CO5: Identify the Markovianqueueing model in the given system, find the performance measures and analyse the results.

CO/PO MAPPING
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	PROGRAMME OUTCOMES (POs)			
	PO1	PO2	PO3	PO4
CO1				
CO2				
CO3				
CO4				
CO5				

COURSE ASSESSMENT METHODS

DIRECT
1. Mid-term test 2. Written Assignment, Open book test, Written tests (Theory) 3. End Semester Examination
INDIRECT
1. Course-end survey

LOGIC 9 + 3

Propositional logic – Logical connectives – Truth tables – Normal forms (principal conjunctive and principal disjunctive normal forms) - Predicate logic - Universal and existential quantifiers - Proof techniques – Directand indirect proofs – Proof by contradiction – Mathematical Induction.

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GRAPH THEORY9 + 3

Introduction to Graphs- Graph terminology and special types of graphs – Matrix representation of graphs-Graph Isomorphism- ConnectedGraphs-Euler Graphs-Hamilton paths and circuits-Shortest path problem.

TWO DIMENSIONAL RANDOM VARIABLES9 + 3

Joint distributions – Marginal and conditional distributions – Expected values of functions of two variables– Correlation and regression - Central limit theorem.

MULTIVARIATE ANALYSIS 9 + 3

Random vectors and matrices – Mean vectors and covariance matrices –Principal components - Population principal components – Principal components from standardized variables

QUEUEING MODELS 9 + 3

Markovian Queues – Single and Multi-server Models – Little's formula – MachineInterference Model – Self Service Queue.

REFERENCES

1. Kenneth H. Rosen, "Discrete Mathematics and its applications: With Combinatorics and Graph Theory (Seventh Edition)", Tata McGraw-Hill Edition, 2015
2. J.P.Trembly, R. "Manohar," Discrete Mathematical Structures with applications to Computer Science", TMH International Edition 2017.
3. NarsinghDeo, "Graph Theory with Applications to Engineering and Computer Science", Prentice – Hall, 2016
4. Gupta S.C. & Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 2007.
5. Freund John, E and Miller, Irvin, "Probability and Statistics for Engineering", Duxbury Press; 6 edition, 2003.
6. Veerarajan. T., "Probability, Statistics and Random Process", Tata McGraw Hill,2015
7. Richard A. Johnson and Dean W. Wichern, ―Applied Multivariate Statistical Analysis‖, 5th Edition, Pearson Education, Asia, 2012.
8. Anderson, T. W , An Introduction to Multivariate Statistical Analysis, John Wiley and Sons, 2003

WEBSITES

1. https://www.coursera.org/specializations/mathematics-machine-learning
2. www.coursera.org/learn/datasciencemathskills
3. http://home.iitk.ac.in/~psraj/mth101/lecture_notes/lecture31.pdf

Theory: 45 Tutorial: 15 Practical: 0 Project: 0 Total: 60 Hours

P18MAT1107 MATHEMATICS FOR DATA SCIENCE
(M.Tech.(Data Science))

L	T	P	J	C
3	1	0	0	4

COURSE OUTCOME

On the successful completion of the course, the students would be able to

CO1: Check linear dependency of vectors and identify Eigen values, Eigen vectors and derivative of a matrix, which will form the basis for Principal Component Analysis.

CO2: Apply the concept of probability andrandom variables, which will help in learning Bayesian classifiers.

CO3: Apply the concepts of two dimensional random variables, central limit theorem and multivariate normal distribution, which lay the foundation for Machine Learning.

CO4: Fit curves to given data ,analyse the correlation and regression and find the maximum likelihood estimate

CO5: Learn and apply multivariate analysis necessary for Principal Component Analysis.

CO6: Determine the extreme values of functions without constraint, and with equality constraints

Course Assessment methods

Direct
1. Continuous Assessment Test I, II 2. Lab Assignment, Lab assessment, Open book test, Written tests (Theory) 3. End Semester Examination
Indirect
1. Course-end survey

Matrices **5 + 2hours**

Linearly dependent and independent vectors - Eigenvalues and eigenvectors - Inner product and outer product of vectors - Derivative of a matrix - Jacobian matrix – Area differential.

Probability and Random Variables **9+ 3 hours**

Axioms of probability - Conditional probability – Statistical independence - Law of total probability – Baye's theorem - Random variable – Discrete and Continuous random variables - Probability mass function – Probability density function – Expected value of a random variable –Moments.

Two Dimensional Random Variables **11 + 3 hours**

Pairs of random variables - Marginal and conditional distributions – Expected values of functions of two variables– Central limit theorem - Normal distribution –properties - Fitting of Normal distribution-Bivariate Normal distribution - Multivariate Normal distribution

Regression Analysis and Estimation **10 + 3 hours**

Curve fitting by method of least squares - Correlation – Properties of correlation coefficient –Linear regression – Least square estimation of regression coefficients – Regression lines – Maximum Likelihood Estimation

Multivariate Analysis **5 + 2 hours**

Random vector –MeanVector – Correlation Matrix - Covariance Matrix – Principal Components – Population Principal Components - Principal Components from standardized variables

Classical Optimization Theory **5 + 2 hours**

Unconstrained extremal problems – Equality constraints – Lagrange's method

REFERENCES

1. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007
2. Gupta S.C. & Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 2007.
3. Freund John, E and Miller, Irvin, "Probability and Statistics for Engineering", Duxbury Press; 6 edition, 2003.
4. Veerarajan. T., "Probability, Statistics and Random Process", Tata McGraw Hill,2003
5. Richard A. Johnson and Dean W. Wichern, —Applied Multivariate Statistical Analysis||, 5th Edition, Pearson Education, Asia, 2012.
6. Anderson, T. W ,An Introduction to Multivariate Statistical Analysis, John Wiley and Sons, 2003
7. Sharma J. K., "Operations Research", Macmillan India Ltd, Delhi, 2nd Edition, 2003

Websites

https://www.coursera.org/specializations/mathematics-machine-learning
www.coursera.org/learn/datasciencemathskills
http://home.iitk.ac.in/~psraj/mth101/lecture_notes/lecture31.pdf

LabAssignments (Self-study)

Assignments will be given to the students on the following topics and their knowledge will be assessed through a lab practical test (which will be included in the internal assessment)

Determine determinants, inverse of a matrix, eigenvalues and eigenvectors using MATLAB
Graphical Representation(Simple Bar graphs and Pie charts) in R
Finding Mean, Median, Mode and SD using R.
Curve fitting, finding Correlation and Regression lines usingR
Solving problems involving Normal distribution usingR

Theory: 45 Tutorial: 15 Practical: 0 Project: 0 Total: 60 Hours

P18MAT1101 MATHEMATICS FOR COMPUTER APPLICATIONS

L	T	P	J	C
3	1	0	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1 : Analyze the given propositions and finding results using mathematical logic operators.

CO2 : Identify the different types of grammars and able to generate various languages.

CO3 : Find eigenvalues and eigenvectors of real symmetric and non symmetric matrices.

CO4 : Solve the system of linear homogeneous as well as non homogeneous equations and analyze the consistency of the system of linear equations.

CO5 : Find the solution of non linear algebraic and transcendental equations by numerical methods.

CO6 : Predict the interpolated values using difference formulae.

Pre-requisite: Nil

CO/PO Mapping

S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S				M				M			
CO2	S			M	M				M			
CO3		S			M				M	W		
CO4		S			M				M	W		
CO5		S	W		M				M			
CO6												

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. End semester examination	

Course Content

Mathematical Logic **10hrs**

Propositions and logical operators – Truth table – Equivalence and implication – Basic laws – Normal forms – Principal conjunctive and disjunctive normal forms – Rules of inference – Arguments – Validity of arguments – Proofs in Propositional calculus – Predicate calculus - Validity of arguments.

Formal Languages **9hr**

Languages and Grammars–Phrase Structure Grammar – Classification of Grammars – Languages generated by grammars - Pumping lemma for Regular Languages.

Matrices **9 hrs**

Characteristic equation - Eigen values and eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors (Without proof) - Eigenvalues of a matrix by Power method - Cayley Hamilton theorem.

Solution of a system of linear equations **8hrs**

Rank of a matrix - Consistency of a system of linear equations -Rouche's theorem - Solution of linear system of equations by Gauss elimination method and Gauss Jordan method - Gauss Seidel method - Matrix Inversion by Gauss Jordan method.

Numerical solution of algebraic and transcendental equations **5hrs**

Solution of nonlinear equations - Method of False Position - Fixed point iteration method - Newton Raphson method for a single equation.

Interpolation **4hrs**

Interpolation: Newton's forward and backward difference formulas –Lagrange's interpolation – Inverse interpolation.

` **L: 45Hr; T: 15Hr; TOTAL = 60 HOURS**

REFERENCES

1. McGraw Kenneth. Rosen H., "Discrete Mathematics and its Applications", Tata McGraw Hill, 7th Edition 2011.
2. Venkatraman M. K., "Engineering Mathematics", 2nd Edition Volume II, NationalPublishingCompany, 1989.
3. Veerarajan.T, " Discrete Mathematics with Graph Theory and Combinatorics", Tata MCGraw Hill, 10th Edition 2010.
4. Grewal.B.S, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition.
5. Gerald.C.F. andWheatley.P.O, "Applied Numerical Analysis", Pearson Education, New Delhi, 2002.
6. Jain.M.K, Iyengar.S.R.K, and Jain.R.K, "Numerical Methods for Scientific and Engineering Computation, New Age International (P) Limited, Publishers, New Delhi, 3rd Edition 2002.
7. J.P.Trembly, R. Manohar, Discrete Mathematical Structures with applications to Computer Science, TMH International Edition (Latest Edition)

P18MAI1201 Applied Mathematics for Structural Engineering (CE)

L	T	P	J	C
3	0	2	0	4

Course outcomes

After successful completion of the course, the student would be able to:

CO 1: Solve a set of algebraic equations representing steady state models formed in engineering problems

CO 2: Fit smooth curves for the discrete data connected to each other or to use interpolation methods over these data tables

CO 3: Find the trend information from discrete data set through numerical differentiation.

CO 4: Estimate integrals from discrete data through numerical methods.

CO 5: Predict the system dynamic behaviour through solution of ODEs modeling the system

CO 6: Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.

Direct
1. Continuous Assessment Test I, II (Theory component) 2. Assignment, Group Presentation (Theory component) 3. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (Lab component) 4. Model examination (Lab component) 5. End Semester Examination (Theory and Lab components)
Indirect
1. Course-end survey

NUMERICAL SOLUTION OF ALGEBRAIC EQUATIONS 10Hrs

Solution of nonlinear equations – Newton's method, Secant method and Muller method for a single equation. Numerical evaluation of multiple roots: Brent's algorithm. Solution of non - linear system of equations by Newton's method.

INTERPOLATION AND CURVE FITTING 9 Hrs

Divided differences – Newton's divided difference formula - Curve fitting – Method of least squares. Spline curves - Bezier curves and B – spline curves- Bezier surfaces and B- spline surfaces-Cubic spline interpolation

NUMERICAL DIFFERENTIATION AND INTEGRATION 6 Hrs

Numerical differentiation by using Newton's divided difference formula – Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules – Numerical double integration.

NUMERICAL SOLUTION OF BOUNDARY VALUE PROBLEMS 9 Hrs

Bounday value problems (ODE)–Finite difference methods – Shooting Methods – Collocation Methods.

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 11Hrs

Parabolic equations: explicit and implicit finite difference methods, weighted average approximation- Dirichlet and Neumann conditions– Two dimensional parabolic equations– ADI method; First order hyperbolic equations– method of characteristics, different explicit and implicit methods.

REFERENCES:

1. Kendall E. Atkinson, An Introduction to numerical analysis, John Weley & Sons, second edition, 1990.
2. Conte S.D and Carl de Boor, Elementary Numerical Analysis - An Algorithmic Approach, McGraw-Hill.
3. Steven C.Chapra and Raymond P. Canale, "Numerical Methods for Engineers with Programming and Software Applications", McGraw-Hill, 2004.
4. John H. Mathews and Kurtis D. Fink, "Numerical Methods using Matlab", Prentice Hall of India, 2004.
5. Gerald C. F. and Wheatley P.O, "Applied Numerical Analysis", Pearson Education Asia, New Delhi, 2002.
6. Richard L. Burden , J. Douglas Faires, "Numerical Analysis" 9th Edition, Thomson Brooks/Cole (2010)

LAB COMPONENT: Using MATLAB 30 Hours

1. Solving a non- linear equation using Newton's method, Secant method
2. Solving a system non- linear equation using Newton's Method
3. Fitting of curves by Method of least squares. Spline curves
4. Interpolation using Newton divided difference.
5. Numerical differentiation – Newton divided difference.
6. Numerical Integration using Trapezoidal rule, Simpson's rule.
7. Solution of ODE using Shooting Methods.
8. Solution of ODE using Collocation Methods.
9. Solution of PDE using weighted average approximation
10. Solution of PDE using explicit and implicit methods.

Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total :75 Hours

P18MAI3201/ P17MAI3201 **Probability and Statistics for Data Analysis**

L	T	P	J	C
3	0	2	0	4

COURSE OUTCOME

On the successful completion of the course, the students would be able to

CO1: Know about the graphical representation using bar chart and pie chart
CO2: Know the use of measures of central tendency and dispersion for analysis of data
CO3: Apply the concept of statistical measures to correlation and regression
CO4: Know about random variables and to solve problems under normal distribution
CO5: Check for testing hypothesis using various tests of large samples and Chi square
CO6: Analyse experiments based on one-way, two-way and Latin square classifications

Classification of data and graphical representation **6 hours**

Collection of data-Classification-Tabulation-Graphical representation – Simple bar chart – Pie chart

Statistical Measures **10 hours**

Measures of central tendency: Arithmetic Mean, Median and Mode – Measures of variation: Range, Quartile deviation - Standard deviation and Coefficient of variation – Five number summary – Box Plot technique.

Correlation and regression **6 hours**

Correlation (Discrete Data) – Scatter diagram - Karl Pearson's Correlation coefficient – Spearman's Rank Correlation – Regression lines (Discrete Data).

Random variables **9 hours**

Random variable – Distribution function – properties – Probability mass function – Probability density function – Expectation - Normal distribution

Testing of hypothesis **6 hours**

Testing of hypothesis for large samples (single mean, difference of means, single proportion, difference of proportions) - Chi-square test for independence of attributes

Analysis of variance **8 hours**

Analysis of Variance (ANOVA) – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD).

REFERENCES

1. Gupta S.C. & Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 2007.
2. Freund John, E and Miller, Irvin, "Probability and Statistics for Engineering", Duxbury Press; 6 edition, 2003.
3. Sharma J. K., "Operations Research", Macmillan India Ltd, Delhi, 2nd Edition, 2003

4. Veerarajan. T., “Probability, Statistics and Random Process”, Tata McGraw Hill,2003.

Statistical Lab using R-programming

List of Experiments

1. Introduction, Basic data representation,
2. Importing data from MS-Excel
3. Data presentation methods - Bar Chart, Pie Chart
4. Mean, median, mode,
5. Standard deviation, five number summary, box plot
6. Scatter diagram, correlation
7. Regression
8. Normal distribution
9. Large sample test
10. Application of Chi square test-independence of attributes

Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total: 75 Hours

L	T	P	J	C
3	1	0	0	4

P18MAT0101 APPLIEDMATHEMATICS

(Common to Applied Electronics & Communication systems)

COURSE OUTCOMES

On successful completion of the above course, the student would be able to

CO1 : Apply matrix operations and properties of determinants.

CO2: Understand and apply the concepts of vector space, linear independence, basis and dimension; evaluate eigenvalues, eigenvectors and diagonalise symmetric matrices.

CO3: Apply the concepts of inner product, length, orthogonality of vector spaces to image processing.

CO4: Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.

CO5: Understand and apply the concepts of graphs and trees

MATRIX ALGEBRA 6+1 hrs

Matrix operations - Inverse of a matrix - Characteristics of invertible matrices - Partitioned matrices -Matrix factorizations - Introduction to determinants - Properties of determinants - Cramer's rule.

VECTOR SPACES 9+3 hrs

Vector spaces and subspaces - Null spaces, column spaces and linear transformations - Linearly independent sets; Bases - Coordinate systems - Dimension of a vector space – Rank - Change of basis - Eigenvalues and Eigenvectors - Characteristic equation – Diagonalization of symmetric matrices - Eigenvectors and linear transformations.

ORTHOGONALITY AND LEAST SQUARES 9+3 hrs

Inner product, length and Orthogonality - Orthogonal sets - Orthogonal projections –Gram - Schmidt process - Inner product spaces-Applications of inner product spaces - Quadratic forms - Singular value decomposition-Applications to image processing.

RANDOM VARIABLES 12+5 hrs

One-dimensional Random Variables – Moments and MGF – Binomial, Poisson, Geometric, Exponential and Normal distributions – Two-dimensional Random Variables – Marginal and Conditional distribution – Covariance and Correlation coefficient.

GRAPH THEORY 9+3 hrs

Basic Terminologies- Paths and Circuits- Isomorphism-Sub graphs – Walks - Paths and Circuits- Connected graphs-Hamiltonian paths and Circuits. Trees – Properties-Distance and centers in a tree- Rooted and binary tree-Spanning Tree.

REFERENCES:

1. Howard A. Anton , “Elementary Linear Algebra”, John Wiley & Sons, Singapore, Eleventh edition, 2013.
2. Richard Bronson, “Schaum's Outline of Matrix Operations”, McGraw-Hill Education; 2nd edition, 2011
3. David C. Lay, “Linear Algebra and its Applications”, Pearson Education Asia, New Delhi, Fifth edition, 2016.
4. Gilbert Strang, “Linear Algebra and its Applications”, Brooks/Cole Ltd., New Delhi, Fourth Edition.
5. Seymour Lipschutz , Marc Lipson, “Schaum's Outline of Linear Algebra”, McGraw Hill Trade; New Delhi, Sixth Edition, 2017.
6. Veerarajan. T., “Probability, Statistics and Random Process”, Tata McGraw Hill, Third edition, 2008.
7. Narsingh Deo, “Graph Theory with Applications to Engineering and Computer Science”, Dover Publication, 2016.
8. J.A. Bondy , U.S.R. Murty, “Graph Theory With Applications” , North Holland, New York, 1976

Theory : 45 **Tutorial : 15** **Practicals:0** **Total: 60 hours**