VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

(An Autonomous Institute of Government of Maharashtra)

Department of Mathematics

[NEP 2020]

First Year B. Tech. Syllabus Semester I and II

Effective from Academic Year 2023 – 24

Table of Contents

Course code	R5MA1001T	Semester	I	Credits	3	Lectures/week	2L:1T:0P
Course	Mathematics – I *(Civil Engineering/ Textile Technology)*						

Course Outcomes:

After the completion of course, the student should be able to

1. Characterize a linear system in terms of number of solutions, whether it is consistent or not.
2. Compute eigenvalues and eigenvectors of a square Matrix and determine if it is diagonalizable
3. Calculate functional value of some point in a neighborhood using Taylor's series expansion and find the limit of a function at a point or at infinity using L'Hospital's rule.
4. Determine if an infinite series is convergent or not using suitable test.
5. Be familiar with the theorems of differentiability such as mean value theorem and interpret it geometrically.
6. Evaluate partial derivatives and implement/ apply it to find minima and maxima of a multivariate function. Also Find directional derivatives and gradient and illustrate geometric meaning with the help of sketches.
7. Apply definite integration to evaluate surface areas and volumes of revolution and evaluate improper integrals.
8. Evaluate multiple integrals for regions in a plane and find volume, area bounded by the curves, mass, center of gravity of solid geometric figures.
9. Estimate the solution of non -linear equations using numerical methods.
10. Apply different techniques like interpolation, numerical integration to solve different engineering problems.

Module	Content	Lectures
1	**Linear Algebra:** Rank of a matrix, System of linear equations- check for consistency, Eigenvalues & eigenvectors of a matrix, Diagonalization, Cayley-Hamilton theorem, Minimal polynomial, Finding Inverse and Powers of a matrix.	08
2	**Differential Calculus:** Mean value theorem, Rolle's theorem, Indeterminate form, L' Hospital's rule, Taylor's theorem and Truncation error, Partial Derivatives, Chain rule, Total Derivative, Differentiation of an implicit function, Directional Derivative, Gradient, maxima, minima and saddle points of a multivariable function, Lagrange's multipliers method, tangent plane and normal line, Convergence of sequence and series, Tests for convergence -ratio test, root test, p-series test, comparison test, alternating series test, absolute convergence test.	09

3	**Integral Calculus:** Evaluation of definite integration to find surface areas and volumes of revolution, Introduction to Improper Integrals and Gamma functions and its properties, Multiple integrals, change of order of integration in double integrals, Change of variables (Cartesian to polar), Triple integrals (Cartesian, cylindrical and spherical co-ordinates). Applications: areas and volumes, Center of mass and Gravity (constant and variable densities).	09
4	**Numerical methods:** Numerical solutions of non-linear equations, Interpolation by Newton's and Lagrange polynomials, Integration by trapezoidal and Simpson's rule.	06

References:

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & sons, 2006.
- Ramana B. V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
- Veerarajan T., Engineering Mathematics for first year, Tata McGraw Hill, New Delhi 2008.
- N.P.Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint 2008.
- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
- M.K.Jain, S.R.K. Iyengar, R.K.Jain, Numerical methods for scientific and engineering computation, Fourth Edition.

Course code	R5MA1002T	**Semester**	I	**Credits**	3	Scheme	2L:1T:0P
Course	Mathematics – I *(Mechanical Engineering/ Production Engineering)*						

Course Outcomes:

After the completion of course, the student should be able to

1. Characterize a linear system in terms of number of solutions, whether it is consistent or not.
2. Compute eigenvalues and eigenvectors of a square Matrix and determine if it is diagonalizable
3. Calculate functional value of some point in a neighborhood using Taylor's series expansion and find the limit of a function at a point or at infinity using L'Hospital's rule.
4. Determine if an infinite series is convergent or not using suitable test.
5. Be familiar with the theorems of differentiability such as mean value theorem and interpret it geometrically.
6. Evaluate partial derivatives and implement/ apply it to find minima and maxima of a multivariate function. Also Find directional derivatives and gradient and illustrate geometric meaning with the help of sketches.
7. Apply definite integration to evaluate surface areas and volumes of revolution and evaluate improper integrals.
8. Evaluate multiple integrals for regions in a plane and find volume, area bounded by the curves, mass, center of gravity of solid geometric figures.
9. Characterize complex functions in terms of analyticity and find harmonic conjugates.

Module	**Content**	**Lectures**
1	**Linear Algebra:** Rank of a matrix, System of linear equations- check for consistency, Eigenvalues & eigenvectors of a matrix, Diagonalization, Cayley-Hamilton theorem, Minimal polynomial, Finding Inverse and Powers of a matrix.	08
2	**Differential Calculus:** Mean value theorem, Rolle's theorem, Indeterminate form, L'Hospital's rule, Taylor's theorem and Truncation error, Partial Derivatives, Chain rule, Total Derivative, Differentiation of an implicit function, Directional Derivative, Gradient, maxima, minima and saddle points of a multivariable function, Lagrange's multipliers method, tangent plane and normal line, Convergence of sequence and series, Tests for convergence -ratio test, root test, p-series test, comparison test, alternating series test, absolute convergence test.	10
3	**Integral Calculus:** Evaluation of definite integration to find surface areas and volumes of revolution, Introduction to Improper Integrals and Gamma functions and its properties, Multiple integrals, change of order of integration in double integrals, Change of variables (Cartesian to polar), Triple integrals	10

	(Cartesian, cylindrical and spherical co-ordinates). Applications: areas and volumes, Center of mass and Gravity (constant and variable densities);	
4	**Complex Variables – Differentiation:** Complex Functions- Limits, Continuity and differentiability, Analytic functions, Cauchy Riemann equations, Harmonic conjugates	05

References:

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & sons, 2006.
- Ramana B. V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
- Veerarajan T., Engineering Mathematics for first year, Tata McGraw Hill, New Delhi 2008.
- N. P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint 2008.
- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
- Susan Jane Colley, Vector Calculus, 4th Edition,2012
- David Poole , Linear Algebra A Modern Introduction, Third Edition
- S. Kumareson, Linear Algebra A Geometric Approach
- John H. Matthews and Russell W. Howell, Complex Analysis for Mathematics and Engineering, Third Edition

Course code	R5MA1003T	**Semester**	I	**Credits**	3	Scheme	2L:1T:0P
Course	Mathematics – I *(Electrical Engineering/ Electronics Engineering/ Electronics and Telecommunication Engineering/ Computer Engineering/ Information Technology)*						

Course Outcomes:

After the completion of course, the student should be able to

1. Characterize a linear system in terms of number of solutions, whether it is consistent or not.
2. Compute eigenvalues and eigenvectors of a square Matrix and determine if it is diagonalizable
3. Demonstrate the concepts of vector spaces, subspaces, span, basis, dimension and their properties with examples and identify their subspaces.
4. Calculate functional value of some point in a neighborhood using Taylor's series expansion and find the limit of a function at a point or at infinity using L'Hospital's rule.
5. Determine if an infinite series is convergent or not using suitable test.
6. Be familiar with the theorems of differentiability such as mean value theorem and interpret it geometrically.
7. Evaluate partial derivatives and apply it to find minima and maxima of a multivariate function. Also Find directional derivatives and gradient and illustrate geometric meaning with the help of sketches.
8. Apply definite integration to evaluate surface areas and volumes of revolution and evaluate improper integrals.
9. Evaluate multiple integrals for regions in a plane and find volume, area bounded by the curves, mass, center of gravity of solid geometric figures.

Module	**Content**	**Lectures**
1	**Linear Algebra:** Rank of a matrix, System of linear equations- check for consistency, Eigenvalues & eigenvectors of a matrix, Diagonalization, Cayley-Hamilton theorem, Minimal polynomial, Finding Inverse and Powers of a matrix, Linear dependence and independence of vectors, Vector spaces, Basis, Dimension, Subspaces, Linear transformations, Rank of a Linear transformation, Orthogonal transformation, Inner product spaces.	15
2	**Differential Calculus:** Mean value theorem, Rolle's theorem, Indeterminate form, L'Hospital's rule, Taylor's theorem and Truncation error, Partial Derivatives, Chain rule, Total Derivative, Differentiation of an implicit function, Directional Derivative, Gradient, maxima, minima and saddle points of a multivariable function, Lagrange's multipliers method, tangent plane and normal line, Convergence of sequence and series, Tests for convergence -ratio test, root test, p-series test, comparison test, alternating series test, absolute convergence test.	09

3	**Integral Calculus:** Evaluation of definite integration to find surface areas and volumes of revolution, Introduction to Improper Integrals and Gamma functions and its properties, Multiple integrals, change of order of integration in double integrals, Change of variables (Cartesian to polar), Triple integrals (Cartesian, cylindrical and spherical co-ordinates). Applications: areas and volumes, Center of mass and Gravity (constant and variable densities).	09

References:

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & sons, 2006.
- Ramana B. V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
- Veerarajan T., Engineering Mathematics for first year, Tata McGraw Hill, New Delhi 2008.
- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
- Susan Jane Colley, Vector Calculus, 4th Edition,2012
- David Poole , Linear Algebra A Modern Introduction, Third Edition
- S. Kumareson, Linear Algebra A Geometric Approach, Fourth Edition

Course code	R5MA1011T	Semester	II	Credits	3	Scheme	2L:1T:0P
Course	Mathematics – II *(Civil Engineering)*						

Course Outcomes:

After the completion of course, the student should be able to

1. Formulate Differential equations from the given physical problems and solve first order Differential equations using different techniques.
2. Find the complete solution of a differential equation with constant coefficients in terms of complementary function and particular integral.
3. Develop better understanding of scalar and vector fields and apply gradient to solve problems involving normal vectors to level surfaces.
4. Apply the integral theorems such as Stoke's theorem, Green's theorem and Gauss divergence theorem to evaluate line, surface and volume integrals and give physical interpretation of curl and divergence of a vector field.
5. Model physical phenomena using partial differential equations such as heat and wave equation and solve them using separation of variables method.
6. Find the Fourier series representation of a periodic function and evaluate the value of a series of real numbers.

Module	Content	Lectures
1	**Ordinary Differential Equations:** Solving First order equations – Exact, linear and Bernoulli's equations, higher order linear differential equations with constant coefficients, Complementary functions and Particular integrals by operator method, method of variation of parameters, Method of Undetermined coefficients, Euler-Cauchy equation; initial and boundary value problems.	12
2	**Partial Differential Equations:** Classification of second order linear PDEs, Method of Separation of variables, Solutions of one-dimensional Heat equation, First and second order wave equation, Two- dimensional Laplace equation,	06
3	**Vector calculus:** Vector functions- Limits, continuity and differentiation, scalar and vector fields, gradient, divergence and curl, Line integrals, Surface integrals, Volume integrals, Stoke's theorem, Gauss' Divergence theorem, Green's theorem	08
4	**Fourier Series:** Definition of Fourier series, Dirichlet's conditions, Evaluation of Fourier series of periodic function of arbitrary period 2l, series of Even and odd Functions, Half range series, Parseval's identity	06

References:

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002
- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & sons, 2006.
- Ramana B. V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
- Veerarajan T., Engineering Mathematics for first year, Tata McGraw Hill, New Delhi 2008.
- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
- Susan Jane Colley, Vector Calculus, 4th Edition,2012

Course code	R5MA1012T	Semester	II	Credits	3	Scheme	2L:1T: 0P
Course	Mathematics – II *(Mechanical Engineering/ Production Engineering)*						

Course Outcomes:

After the completion of course, the student should be able to

1. Formulate Differential equations from the given physical problems and solve first order Differential equations using different techniques.
2. Find the complete solution of a differential equation with constant coefficients in terms of complementary function and particular integral.
3. Study complex power series, classify singularities of a function, evaluate line integrals and apply residue theorem to evaluate real integrals.
4. Develop better understanding of scalar and vector fields and apply gradient to solve problems involving normal vectors to level surfaces.
5. Apply the integral theorems such as Stoke's theorem, Green's theorem and Gauss divergence theorem to evaluate line, surface and volume integrals and give physical interpretation of curl and divergence of a vector field.
6. Model physical phenomena using partial differential equations such as heat and wave equation and solve them using separation of variables method.

Module	Content	Lectures
1	**Ordinary Differential Equations:** First order equations (linear and nonlinear); Bernoulli's equations, higher order linear differential equations with constant coefficients, Complementary functions and Particular integrals by operator method, method of variation of parameters, Method of Undetermined coefficients, Euler-Cauchy equation; initial and boundary value problems.	10
2	**Partial Differential Equations:** Classification of second order linear PDEs, Method of Separation of variables, Solutions of one-dimensional Heat equation, First and second order wave equation, Two- dimensional Laplace equation,	06
3	**Vector calculus:** Vector functions- Limits, continuity and differentiation, scalar and vector fields, gradient, divergence and curl, Line integrals, Surface integrals, Volume integrals, Stoke's theorem, Gauss' Divergence theorem, Green's theorem.	08

4	**Complex Variables – Integration:** Cauchy's Integral theorem and formula, Taylor's series- radius of convergence, Laurent's series, Singularities and Poles, Residue theorem, Evaluation of real integrals using contour integration and concept of residues	08

References:

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
- Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & sons, 2006.
- Ramana B. V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
- Veerarajan T., Engineering Mathematics for first year, Tata McGraw Hill, New Delhi 2008.
- N.P.Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint 2008.
- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
- Susan Jane Colley, Vector Calculus, 4th Edition, 2012.
- John H. Matthews and Russell W. Howell, Complex Analysis for Mathematics and Engineering, Third Edition

Course code	R5MA1013T	**Semester**	II	**Credits**	3	Scheme	2L:1T:0P
Course	Mathematics – II *(Electrical Engineering/ Electronics Engineering/ Electronics and Telecommunication Engineering)*						

Course Outcomes:

After the completion of course, the student should be able to

1. Find the complete solution of a differential equation with constant coefficients in terms of complementary function and particular integral.
2. Formulate Differential equations from the given physical problems and solve first order Differential equations using different techniques.
3. Characterize complex functions in terms of analyticity, find harmonic conjugates and study geometric properties of conformal mappings.
4. Study complex power series, classify singularities of a function, evaluate line integrals and apply residue theorem to evaluate real integrals.
5. Develop better understanding of scalar and vector fields and apply gradient to solve problems involving normal vectors to level surfaces.
6. Apply the integral theorems such as Stokes theorem, Green's theorem and Gauss divergence theorem to evaluate line, surface and volume integrals and give physical interpretation of curl and divergence of a vector field.

Module	**Content**	**Lectures**
1	**Ordinary Differential Equations:** Solving First order equations – Exact, linear and Bernoulli's equations, higher order linear differential equations with constant coefficients, Complementary functions and Particular integrals by operator method, method of variation of parameters, Method of Undetermined coefficients, Euler-Cauchy equation; initial and boundary value problems.	12
2	**Vector calculus:** Vector functions- Limits, continuity and differentiation, scalar and vector fields, gradient, divergence and curl, Line integrals, Surface integrals, Volume integrals, Stoke's theorem, Gauss' Divergence theorem, Green's theorem.	08
3	**Complex Variables – Differentiation:** Complex Functions- Limits, Continuity and differentiability, Analytic functions, Cauchy Riemann equations, Harmonic conjugates, Conformal mappings, Linear fractional transformations and their properties.	07

4.	**Complex Variables – Integration:** Cauchy's Integral theorem and formula, Taylor's series- radius of convergence, Laurent's series, Singularities and Poles, Residue theorem, Evaluation of real integrals using contour integration and concept of residues.	07

References:

- Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & sons, 2006.
- Veerarajan T., Engineering Mathematics for first year, Tata McGraw Hill, New Delhi 2008.
- S. L.Ross, Differential Equations 3rd Edition, Wiley India, 1984.
- E.A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
- Susan Jane Colley, Vector Calculus, 4th Edition,2012

Course code	R5MA1014T	**Semester**	II	**Credits**	3	Scheme	2L:1T:0P
Course	Mathematics – II (*Computer Engineering/ Information Technology*)						

Course Outcomes:

After the completion of course, the student should be able to

1. Formulate Differential equations from the given physical problems and solve first order Differential equations using different techniques.
2. Find the complete solution of a differential equation with constant coefficients in terms of complementary function and particular integral.
3. Express a logical statement in terms of predicates, quantifiers and logical connectives.
4. Construct correct direct and indirect proofs (proofs by contradiction and contraposition), proof by induction, exhaustion and find a counterexample to disprove a proposed statement.
5. Solve counting problems involving the sum rule, multiplication rule, permutations and combinations (with and without repetitions), principle of inclusion- exclusion, and Pigeonhole principle.
6. Use Generating Functions to solve counting problems, recurrence relations and establishing Binomial Identities.
7. Determine properties of relations, identify equivalence and partial order relations and sketch relations.

Module	**Content**	**Lectures**
1	**Ordinary Differential Equations**: Solving First order equations – Exact, linear and Bernoulli's equations, higher order linear differential equations with constant coefficients, Complementary functions and Particular integrals by operator method, method of variation of parameters, Method of Undetermined coefficients, Euler-Cauchy equation; initial and boundary value problems.	10
2	**Logic:** Propositional equivalences, Methods of proof, Tautologies and contradictions, Predicates and Quantifiers, Duality Law.	05
3	**Counting:** The basics of counting, the pigeonhole principle, permutations and combinations with repetition, Binomial coefficients and identities, recurrence relations, solving recurrence relations, generating functions, inclusion - exclusion principle, application of inclusion-exclusion.	12
4	**Relations:** Relations and their properties, n-ary Relations and their applications, Representing Relations, Closure of Relations, Equivalence Relations and classes, Partial Ordering, Total ordering,	07

References:

- Discrete Mathematical Structures with Applications to Computer Science, J. P. Tremblay, R. Manohar, Tata McGraw Hill, 2008
- Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & sons, 2006.
- Kenneth H. Rosen, Discrete Mathematics and its Applications, 7th Edition, Tata McGraw Hill, 2012
- E.A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
- Elements of Discrete Mathematics, C. L. Liu and D. P. Mohapatra 4th Ed., McGraw Hill Edu.(India) Pvt. Ltd.
- B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course code	R5MA1015T	Semester	II	Credits	3	Scheme	2L:1T:0P
Course	Mathematics – II *(Textile Technology)*						

Course Outcomes:

After the completion of course, the student should be able to

1. Examine the different types of data and its interpretation using statistics.
2. Apply the discrete and continuous probability distributions to find probabilities of various events and the expected value of a random variable.
3. Find the relation between two or more phenomena with the help of curve fitting and correlation-regression analysis.
4. Determine the effect of various parameters using ANOVA.
5. Demonstrate the ability of statistical quality control with suitable case studies.
6. Estimate population parameters using sampling and Perform hypothesis testing on population means, variances and proportions.

Module	Content	Lectures
1	**Introduction and need for statistics in Textiles:** Introduction to statistics, Methods of data collection, need for SQC techniques, Classification and graphical representation of data Frequency distribution, Measures of central tendency -concepts of Mean, Median & Mode, Partition values- concept of quartiles, percentile; Measures of dispersion-quartile deviation, Standard Deviation, Coefficient of variation.	06
2	**Correlation & Regression Analysis:** Introduction to bi-variate data, Correlation analysis, Coefficient of correlation and Rank correlation, Regression analysis, curve fitting, method of least squares, Multivariate data analysis.	08
3	**Probability Distributions:** Review of Probability, Conditional probability, Bayes' theorem. Discrete and continuous random variables, Probability density function, Expectation, Variance, Moments, Binomial distribution, Poisson distribution, Normal distribution.	08
4	**Estimation and Testing of Hypothesis:** Concepts of Statistical hypothesis, Null and Alternate hypothesis, Critical region, Two types of errors, Level of significance, Tests of significance based on Large sample theory, Student's t test, F test and Chi-square test; Sampling distribution of sample mean and sample proportion, standard error of estimator, Estimation of parameters- point estimation & interval estimation(confidence intervals), Central Limit Theorem.	12

5	**Analysis of Variance:** Introduction, one way analysis and two way analysis.	03
6	**Statistical Quality Control:** Introduction to Statistical quality control techniques and control charts- Mean chart, R chart, np chart, p chart, C chart.	03

References:

- Statistics for Textile Engineers, Edited by J. R. Nagla, Woodhead Publishing India Pvt. Ltd, 2014, ISBN978-93-80308-37-1
- Principles of Textile testing, J.E.Booth, Heywood books, London, 1961.
- Fundamentals of Mathematical Statistics by V. K. Kapoor and S. C. Gupta, Sultan Chand and Sons, 2020.
- Probability, Statistics and Random Processes by T. Veerarajan, Tata McGraw - Hill Education, Second edition 2002.