DEPARTMENT OF MATHEMATICS

RK VALLEY*NUZVID*** ONGOLE*** SRIKAKULAM**

RGUKT

BOARD OF STUDIES

Held on 22-10-2022: 11.00 AM

Virtual Meeting

MATHEMATICS COURSE STRUCTURE & SYLLABI
FOR
PUC & B.TECH PROGRAM

AGENDA

a) Reframing PUC theory syllabi in accordance to the University guidelines
b) Review of approved syllabus for Mathematics courses which are approved in the previous BoS, conducted on December-2020.
c) Approval for **Probability & Random Variables** course for EEE department E2 Sem1.
d) Approval for **Introduction to Probability and Statistics** course for civil department E2 Sem2.
e) Retaining same syllabi for Minor in Mathematics courses as approved in the previous BoS, conducted on December-2020.
f) For Elective subjective all 4 credit courses can be offered as 3 credit courses also by reducing syllabus accordingly as per the requirement of specific engineering departments.

- **The syllabus scheduled for PUC & Engineering is as per institute guidelines matches with exact allotted Lecture (L), Tutorial (T), Lab (L) contact hours. It excludes examination schedule, exam preparation days, holidays, and others.**

BOS - MEMBERS

S. No	Name of the Member and Designation	Role
1	Prof. S.S.S.V. GOPAL RAJU, Professor, RGUKT-Nuzivid	Chairperson
2	Deans, Academics of constituent Institutes of RGUKT	Academic Member
3	Prof. Y.N.Reddy, Professor, Department of Mathematics, NIT-Warangal	Subject Expert
4	Prof. Sanyasiraju V S Yadida, Professor, Department of Mathematics, IIT- Madras	Subject Expert
5	Prof. D.Bharathi, Department of Mathematics, Sri Venkateswara University, Tirupati.	Subject Expert
6	HoD, Mathematics, RGUKT- RK Valley HoD, Mathematics, RGUKT- Nuzvid HoD, Mathematics, RGUKT- Ongole HoD, Mathematics, RGUKT- Srikakulam	4- Campuses Heads of the Department
7	Sri J. Bhanumurthy, Mentor, RGUKT-RK Valley	MEMBER
8	Sri.B. Sathish Kumar, Assistant Professor(C), RGUKT -Nuzvid	MEMBER
11	K. Yogasree,E3 –EEE,, R.K.Valley, Student representative.	Student
12	Dr MERAM MUNIRATHNAM, Assistant Professor(C), RGUKT –R.K.Valley	Member-Convener

PUC – MATHEMATICS

COURSE STRUCTURE

Course Code	Course Name	Course Category	L – T – P	Credits
PMA201101	MATHEMATICS - I	PUC	5– 2 – 0	5
PMA201201	MATHEMATICS - II	PUC	5– 2 – 0	5
PMA202101	MATHEMATICS - III	PUC	5 – 2 – 0	5
PMA202201	MATHEMATICS – IV	PUC	5 – 2 – 0	5

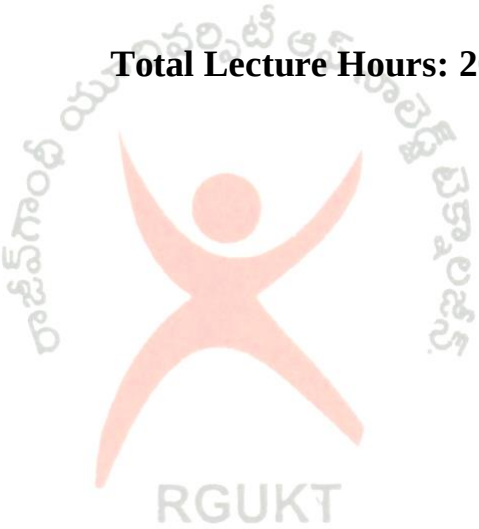
ORIENTATION PROGRAM ON MATHEMATICS

SYLLABUS

(20 Lecture Hours)

- Introduction to the Mathematics content available in RGUKT website
- Orientation on the basic Concepts of Mathematics
- Set concepts
- Set operations
- Algebra of sets
- Cartesian products of sets and relations
- Real Line.
- Position of a point on real line.
- Absolute value of a real number and its properties.
- Distance between two points on a real line and its properties.

Total Lecture Hours: 20



PUC-1 SEM-1

Course Code	Course Name	Course Category	L – T - P	Credits
PMA1101	MATHEMATICS –I	PUC	5-2-0	5

COURSE LEARNING OBJECTIVES

1. To study the basic concepts of straight lines and various forms of straight lines.
2. To study the Concept of Sequences, Series and Progressions.
3. To study the sum of Natural numbers, Principle of Mathematical induction.
4. To study the Concept of Real Line, Functions and Types of Functions.
5. To study the Solutions of linear in equations, linear in equations involving absolute values and the solutions of system of linear in equations.
6. To study the basics of Trigonometric functions and their graphs.

COURSE CONTENT

Unit – I **(10 Lecture Hours)**

STRAIGHT LINES : Cartesian Coordinates, Locus, Slope of a line (Angle between two lines), Various forms of equation of a line, Parallel and perpendicular lines, General equation of a line, Distance of a point from a line(Distance between Parallel lines), Family of lines.

Unit – II **(9 Lecture Hours)**

PROGRESSIONS: Sequences and series, Arithmetic progression, Geometric progression, Harmonic progression.
PRINCIPLE OF MATHEMATICAL INDUCTION: Sums of Natural Numbers, Principle of Mathematical Induction.

Unit - III **(14 Lecture Hours)**

FUNCTIONS: Introduction to functions, Types of functions, Inverse functions, Exponential function, Logarithmic function, Graphs of functions and Exponential equation.

Unit – IV

(9 Lecture Hours)

LINEAR INEQUALITIES: Linear Inequalities in one variable, Inequalities involving Absolute values, System of linear Inequations.

Unit – IV **(10 Lecture Hours)**

TRIGONOMETRIC FUNCTIONS: Angles and coordinate Lines, Trigonometric functions of acute angles, Trigonometric functions of General angles, Graphs of Trigonometric functions, Reductions to Functions of positive acute angles.

Unit-V

TRIGONOMETRIC FUNCTIONS OF MULTIPLE ANGLES: (8 Lecture Hours)

Trigonometric functions of two angles, Trigonometric functions of multiple angles, Trigonometric functions of Sub-Multiple angles, Inverse Trigonometric functions.

LEARNING RESOURCES

TEXT BOOK

George B. Thomas, Jr. Maurice D. Weir, Joel Hass, *THOMAS' CALCULUS OF EARLY TRANSCENDENTALS'*, 12th Edition, Pearson.

REFERENCE BOOKS

i) *'TELUGU ACADEMI MATHEMATICS'*- IA, IB.
ii) *'NCERT MATHEMATICS'* - 11th Grade, 12th Grade (Part-1 and Part-2)
iii) S.L.Loney, *Plane Trigonometry*, University Press 1893, AITBS Publishers, India.
iv) James Stewart, CALCULUS-EARLY TRANSCENDENTALS, 8th Edition, Cengage Learning.

WEB RESOURCES

1. puc1a.rguktrkv.ac.in, puc1a.rguktnuz.ac.in
2. puc1b.rguktrkv.ac.in, puc1b.rguktnuz.ac.in

Total Number of Modules: 34 Total Lecture Hours: 60

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1	Learn the basic concepts of straight lines and various forms of straight lines.
CO 2	Learn the sequences and series, progressions and Induction procedure to prove a given statement.
CO 3	Learn the sums of Natural numbers and able to prove the generalized statements using Principle of Mathematical induction.
CO 4	Learn the basic concepts on real line, functions, Domain and range of a given function and different types of functions.
CO 5	Compute the solutions sets for the given linear inequations and represent of the solutions sets through graphically.
CO 6	Learn the basic definition of the six trigonometric functions and their graphs, values of the trigonometric functions for all types angles.

FOR THEORY COURSES ONLY

Course Nature		**Theory**	
Assessment Method			
Assessment Tool	Monthly Tests	End Semester Test	Total
Weightage %	40%	60 %	100 %

PUC-1 SEM-2

Course Code	Course Name	Course Category	L – T - P	Credits
PMA1201	MATHEMATICS –II	PUC	5-2-0	5

COURSE LEARNING OBJECTIVES

1. To study the Trigonometric Relations and the Solutions of Trigonometric Equations.
2. To study the basic concepts of Complex numbers, De Moivre's Theorem, Quadratic equations, expressions and their solutions, maximum and minimum values of quadratic equations.
3. To study the concept of the limit and formal definition of the limit, and discuss of continuity of various functions.
4. To study the concept of differentiability of a given function on a given interval and higher order derivatives.
5. To study the chain rule in differentiation and to find the derivative implicitly defined functions.
6. To study the strategy of graphing a curve on its domain and optimize a given function.

COURSE CONTENT

Unit- I **(12 Lecture Hours)**

TRIGONOMETRIC RELATIONS: Transformation Formulas, Conditional Trigonometric Identities, Trigonometric Equations, Relation between the Angles and Sides of a triangle, Properties of triangles.

Unit – II **(12 Lecture Hours)**

COMPLEX NUMBERS & QUADRATIC EQUATIONS: Concept of Complex Numbers, Algebra of Complex Numbers, Complex Plane, Polar Form, De Moivre's Theorem, Quadratic equations in one variable, Equations reducible to quadratic equations, Forming quadratic equations with given roots and quadratic expressions.

Unit- III **(16 Lecture Hours)**

LIMITS AND CONTINUITY: Rates of change, Concept of a limit, Rules for finding limit, Formal definition of limit, Extension of the limit concept, Infinite limits, some special limits, Continuity at a point, Rules of continuity, Continuity on intervals, Tangent lines.

Unit - IV **(10 Lecture Hours)**

DIFFERENTIATION: The Derivative of a function, Derivatives and continuity, Differentiation rules – Sums and Differences, Differentiation rules – Products and Quotients, Second and higher order derivatives, Derivatives of trigonometric functions, Continuity of trigonometric functions.

Unit - V **(7 Lecture Hours)**

CHAIN RULE AND IMPLICIT DIFFERENTIATION: The chain rule, Differentiation formulas that include the chain rule, Implicit differentiation, Tangent and normal lines, Rational powers of differentiable functions.

Unit - VI **(18 Lecture Hours)**

APPLICATIONS OF DERIVATIVES: Extreme values of functions, Finding extrema, Rolle's Theorem, Mean value Theorem, Increasing and Decreasing functions, The first Derivative test, Curve Sketching, The second Derivative Test, Strategy for Graphing, Asymptotes, Related rates of change , Optimization, Differentials.

LEARNING RESOURCES

Text book: George B. Thomas, Jr. Maurice D. Weir, Joel Hass, *THOMAS' CALCULUS OF EARLY TRANSCENDENTALS'*, 12th Edition, Pearson.

REFERENCE BOOKS

i. *'TELUGU ACADEMI MATHEMATICS'*- IA, IB
ii. *'NCERT MATHEMATICS'* - 11th Grade, 12th Grade (Part-1 and Part-2)
iii. James Stewart, CALCULUS-EARLY TRANSCENDENTALS, 8th Edition, Cengage Learning.

WEB RESOURCES

1. puc1a.rguktrkv.ac.in, puc1a.rguktnuz.ac.in
2. puc1b.rguktrkv.ac.in, puc1b.rguktnuz.ac.in

Total Number of Modules: 50 **Total Lecture Hours: 75**

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1	Learn the Trigonometric Relations and the Solutions of Trigonometric Equations
CO 2	Learn the complex numbers whose rectangular form and polar form, finding the roots, framing the quadratic equations and their extreme values.
CO 3	Learn the concept of the limit and formal definition of the limit, and discuss of continuity of various functions.
CO 4	Learn the concept of differentiability of a given function on a given interval and higher order derivatives.
CO 5	Learn the chain rule in differentiation and to find the derivative Implicitly defined functions.
CO 6	Learn the strategy of graphing a curve on its domain and optimize a given function.

FOR THEORY COURSES ONLY

Course Nature		**Theory**	
Assessment Method			
Assessment Tool	Monthly Tests	End Semester Test	Total
Weightage %	40%	60 %	100 %

PUC-2 SEM-1

Course Code	Course Name	Course Category	L – T - P	Credits
PMA2101	MATHEMATICS –III	PUC	5-2-0	5

COURSE LEARNING OBJECTIVES

1. To study the basic concepts in indefinite integration, Methods to solve the given indefinite integrals and computing the limit of Riemann Sums.
2. To study the definite integrals as a limit of Riemann sum and learn theorems on definite integrals.
3. To study the area between the given curves, volumes of the solids using different methods, length of a plane curve and areas of surfaces.
4. To study the differentiation and integration of Transcendental Functions.
5. To study the permutations and combinations.
6. To study the concepts on Binomial Theorem and Multinomial Theorem.

COURSE CONTENT

Unit – I **(10 Lecture Hours)**

INDEFINITE INTEGRALS : Indefinite integrals, Integration by substitution, Approximation by finite sums, Average Value of Non-Negative Functions , Algebra of Finite Sums, Limits of Riemann Sums.

Unit – II **(13 Lecture Hours)**

DEFINITE INTEGRALS : Definite Integrals ,Properties of Definite Integrals, Area and Integrals, Mean Value Theorem for Integrals , The Fundamental Theorem, Evaluation of Definite Integrals, Substitution in Definite Integrals, Area between the curves.

Unit - III **(12 Lecture Hours)**

APPLICATIONS OF INTEGRATION : Volumes of Solids by Slicing, Volumes of Solids of Revolution – Disks, Volumes of Solids of Revolution – Washers, Volumes of Solids of Revolution– Shell Method, Length of Plane Curves, Area of Surfaces of Revolution.

Unit – IV **(20 Lecture Hours)**

TRANSCENDENTAL FUNCTIONS : Derivative of Inverse Functions, Natural Logarithms, Logarithmic Differentiation, Exponential Function, General Exponential Function, General Logarithmic Functions, L Hospitals Rule, Relative Rates of Growth, Derivatives of Inverse Trigonometric Functions, Hyperbolic functions, Inverse hyperbolic functions.

Unit - V **(10 Lecture Hours)**

PERMUTATIONS AND COMBINATIONS: Fundamental Principle of counting Distributions, Permutations, Permutations with repetitions, ordered samples, Combinations

Unit - VI **(10 Lecture Hours)**

BINOMIAL THEOREM: Binomial Theorem for Positive Integral Indices, General and Middle Terms, Greatest Coefficient, Binomial Coefficients, Multinomial Coefficients.

LEARNING RESOURCES

TEXT BOOK

George B. Thomas, Jr. Maurice D. Weir, Joel Hass, *THOMAS' CALCULUS OF EARLY TRANSCENDENTALS'*, 12th Edition, Pearson.

REFERENCE BOOKS

i. *'TELUGU ACADEMI MATHEMATICS'*- IIA, IIB
ii. *'NCERT MATHEMATICS'* - 11th Grade, 12th Grade (Part-1 and Part-2)
iii. James Stewart, CALCULUS-EARLY TRANSCENDENTALS, 8th Edition, Cengage Learning.

WEB RESOURCES

1. puc2a.rguktrkv.ac.in, puc2a.rguktnuz.ac.in
2. puc2b.rguktrkv.ac.in, puc2b.rguktnuz.ac.in

Total Number of Modules: 41 **Total Lecture Hours: 75**

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1	Learn the basic concepts in indefinite integration, Methods to solve the given indefinite integrals and computing the limit of Riemann Sums.
CO 2	Learn the definite integrals as a limit of Riemann sum and learn theorems on definite integrals.
CO 3	Learn the area between the given curves, volumes of the solids using different methods, length of a plane curve and areas of surfaces.
CO 4	Learn differentiation and integration of Transcendental Functions.
CO 5	Learn the permutations and combinations.
CO 6	Learn the concepts on Binomial Theorem and Multinomial Theorem.

FOR THEORY COURSES ONLY

Course Nature		**Theory**	
Assessment Method			
Assessment Tool	Monthly Tests	End Semester Test	Total
Weightage %	40%	60 %	100 %

PUC-2 SEM-2

Course Code	Course Name	Course Category	L – T - P	Credits
PMA2201	MATHEMATICS –IV	PUC	5-2-0	5

COURSE LEARNING OBJECTIVES

1. To study the different types of methods to solve the indefinite and definite integrals.
2. To study the different types of conic sections and their properties.
3. To study the parameterization of plane curve, differentiation and integration of the parameterized curves, graphing of polar curves in a polar coordinates, polar equations of conics, areas, lengths and surface areas of polar curves.
4. To study the basic concepts of Matrices, Algebra of matrices, determinants of matrices, inverse and rank of a matrix, and system of linear equations and their consistency.
5. To study the different types of infinite series.
6. To study the 3-D Geometry.

COURSE CONTENT

Unit – I **(14 Lecture Hours)**

METHODS OF INTEGRATION: Basic integration formulas, Integration by parts, Partial Fractions, General descriptions of the method of partial fractions, Trigonometric substitutions, Integral Tables , Reduction formulas.

Unit – II **(12 Lecture Hours)**

CONIC SECTIONS: Circle, Parabola, Ellipse, Hyperbola, Classifying Conic Sections by Eccentricity, Quadratic Equations in two variables.

Unit – III **(18 Lecture Hours)**

PARAMETRIZATION & POLAR COORDINATES: Plane curves, Parameterizations of plane curves, Differentiation with parameterization curves , Integration with parameterized curves, Polar Coordinates, Graphing in Polar Coordinates, Polar Equations for Lines and Circles, Polar Equations for Conic Sections, Area in Polar Coordinates, Length and Surface Area in Polar Coordinates.

Unit - IV **(16 Lecture Hours)**

MATRICES: Fundamental of matrices, Algebra of Matrices, Special Matrices, Determinant of matrix, Evaluation of determinants by properties, Finding inverse of a Matrix, Rank of a matrix, System of Linear Equations and Consistency.

Unit - V **(12 Lecture Hours)**

INFINIE SERIES: Binomial Series, Geometric Series, Arithmetic- Geometric Series, Exponential Number, Exponential Series, Logarithmic Series.

Unit – VI **(12 Lecture Hours)**

3-D GEOMETRY: Lines in Space, Planes in Space, Cylinders, Quadric Surfaces, Cylindrical Coordinates, Spherical Coordinates.

LEARNING RESOURCES

TEXT BOOK

George B. Thomas, Jr. Maurice D. Weir, Joel Hass, *THOMAS' CALCULUS OF EARLY TRANSCENDENTALS'*, 12th Edition,

REFERENCE BOOKS

i. *'TELUGU ACADEMI MATHEMATICS'*- IIA, IIB
ii. *'NCERT MATHEMATICS'* - 11th Grade, 12th Grade (Part-1 and Part-2)
iii. James Stewart, CALCULUS-EARLY TRANSCENDENTALS, 8th Edition, Cengage Learning.

WEB RESOURCES

1. puc2a.rguktrkv.ac.in, puc2a.rguktnuz.ac.in
2. puc2b.rguktrkv.ac.in, puc2b.rguktnuz.ac.in

Total Number of Modules: 43 **Total Lecture Hours: 84**

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1	Learn to solve the indefinite and definite integrals using different types of methods.
CO 2	To study the different types of conic sections and their properties.
CO 3	Learn the parameterization of plane curve, differentiation and integration of the parameterized curves, the polar coordinates, graphing of polar curves in a polar plane, polar equations of conics, areas, lengths and surface areas of polar curves.
CO 4	Learn the concepts of Matrices, rank of a matrix and solving the given system of linear equations.
CO 5	Learn the different types of infinite series.
CO 6	Learn the basic concepts in 3-D Geometry.

For Theory courses only

Course Nature		**Theory**	
Assessment Method			
Assessment Tool	Monthly Tests	End Semester Test	Total
Weightage %	40%	60 %	100 %

ENGINEERING MATHEMATICS

Course Structure

BRANCH	E1 SEM-1	E1 SEM-2	E2 SEM-1	E2 SEM-2
ECE	Differential Equations and Multivariable Calculus **CC: (22MA1101)**	Linear Algebra & Numerical Methods **CC: (22MA1201)**	Probability &Random variables **CC: (22MA2101)**	
EEE	Differential Equations and Multivariable Calculus **CC: (22MA1101)**	Linear Algebra & Numerical Methods **CC: (22MA1201)**	Probability &Random variables **CC: (22MA2101)**	
CSE	Calculus & Algebra **CC: (22MA1102)**	Discrete Mathematics **CC: (22MA1202)**	Probability & Statistics **CC: (22MA2102)**	
CIVIL	Differential Equations and Multivariable Calculus **CC: (22MA1101)**	Linear Algebra & Numerical Methods **CC: (22MA1201)**		Introduction to Probability and Statistics (3 Credits) **CC: (22MA 2201)**
MECHANICAL	Differential Equations and Multivariable Calculus **CC: (22MA1101)**	Linear Algebra & Numerical Methods **CC: (22MA1201)**	Transform Calculus(TC) **CC: (22MA2103)**	Introduction to Probability and Statistics (3 Credits) **CC: (22MA 2201)**
CHEMICAL	Differential Equations and Multivariable Calculus **CC: (22MA1101)**	Linear Algebra & Numerical Methods **CC: (22MA1201)**	Transform Calculus(TC) **CC: (22MA2103)**	
MME	Differential Equations and Multivariable Calculus **CC: (22MA1101)**	Linear Algebra & Numerical Methods **CC: (22MA1201)**	Transform Calculus(TC) (3 Credits) **CC: (22MA2104)**	Open Elective (Probability and statistics)

***CC- Course Code**

E1 SEM-1

Course Code	Course Name	Course Category	L – T - P	Credits
22MA1101	Differential Equations and Multivariable Calculus ECE,EEE,CE,ME,CHE&MME	B.Sc	3-1-0	4

COURSE LEARNING OBJECTIVES

The objectives of this course is to

1. Discuss the Solutions of first order differential equations.
2. Discuss the Solutions of higher order linear differential equations.
3. Understand the convergence of infinite series with different tests.
4. Learn power series representation of functions and its validity.
5. Understand Continuity and differentiability of multi-variable functions and its applications to discuss maximum and minimum.
6. Discuss the convergence Improper integrals and apply Leibnitz rule.

COURSE CONTENT

Unit – I **(10 Contact hours)**

DIFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE: Basic concepts, Variable Separable method, homogeneous differential equations, Exact differential equations, Integrating factor, Differentiable equations Reducible to exact, Linear differential equations, Bernoulli differential equations.

Unit - II **(11 Contact hours)**

LINEAR DIFFERENTIAL EQUATIONS OF HIGHER ORDER: Homogenous differentiable equations, Non-homogeneous linear equations of higher order with constant coefficients with RHS term of the type $e^{ax}, sinax, cosax,$ polynomials in $x, e^{ax}\,V(x), xV(x)$, Methods of Undetermined Coefficients, Method of variation of parameters, Euler Cauchy equation.

Unit - III **(12 Contact hours)**

SEQUENCES AND SERIES: Definition of Sequences and convergence, Convergence of series, Comparison test, Ratio test, Root test, Absolute and Conditional convergence, Alternating series, Power series, Taylor's and Maclaurin's series.

Unit - IV **(12 Contact hours)**

FUNCTIONS OF SEVERAL VARIABLES: Limit, Continuity and Differentiability of functions of several variables, Partial derivatives and their geometrical interpretation, Differentials, Derivatives of Composite and Implicit functions, Chain rule, Jacobians, Derivatives of higher order, Homogeneous functions, Euler's theorem, and Harmonic functions.

Unit – V **(8 Contact hours)**

APPLICATIONS OF FUNCTIONS OF SEVERAL VARIABLES: Taylor's expansion of functions of several variables, Maxima and Minima of functions of several variables - Lagrange's method of multipliers.

Unit – VI **(6 Contact hours)**

BETA AND GAMMA FUNCTION: Beta and Gamma functions - elementary properties, Relation between Beta and gamma functions, Evaluation of Definite integral using Beta and Gamma functions, differentiation under integral sign, and differentiation of integrals with variable limits - Leibnitz rule.

LEARNING RESOURCES

TEXT BOOKS

ERWIN KREYSZIG**, '***Advanced Engineering Mathematics'*, Wiley-India, 9th Edition

REFERENCE BOOKS

i) TOM M. APOSTAL**,'** *Calculus, Volume II'*, Wiley-India, Second Edition,
ii) R. K. JAIN AND S. R. K. IYENGAR,' *Advanced Engineering Mathematics'*, Narosa Publishers, 3rd Edition.
iii) B.S.GREWAL**, '***Higher Engineering Mathematics'*, Khanna Publishers, 42nd Edition.

WEB RESOURCES

1. NPTEL, IIT- Madras, 08-June-2017, Introduction to ordinary differential equations URL: https://nptel.ac.in/courses/111106100/12
2. NPTEL, IIT- Kanpur, 15-March-2016, Differential Calculus of Several Variables URL: https://nptel.ac.in/courses/111104092/11
3. NPTEL, IIT- Roorkee, 22-December-2017, Multivariable Calculus URL:https://nptel.ac.in/courses/111107108/
4. MatheMagician, 24–April-2017, Calculus - sequences and series, URL: https://www.youtube.com/playlist?list=PLJMXXdEk8kMAeBLj14HX0fhe_LypRc4aW
5. RGUKT Course Content

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1	Solve first order differential equations.
CO 2	Solve higher order linear differential equations.
CO 3	Check the convergence of infinite series with different methods
CO 4	Discuss the power series representation of a function at various points.
CO 5	Explain limits and continuity, differentiability and partial derivatives of functions of multivariable and solve the extremum problems subjected to constraints.
CO 6	Apply Leibnitz rule and beta gamma functions to evaluate improper integrals.

FOR THEORY COURSES ONLY

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

CSE

Course code	Course Name	Course Category	L-T-P	Credits
22MA1102	**Calculus and Linear Algebra (CSE)**	**B.Sc**	**3-1-0**	**4**

COURSE LEARNING OBJECTIVES

The objectives of this course is to

1. Discuss the Solutions of first order differential equations.
2. Understand Continuity and differentiability of multi-variable functions
3. Discuss maximum and minimum of functions of several variables.
4. Discuss the linear transformation and its Eigen values and Eigen vectors.
5. Discuss numerical methods to find the roots of polynomial and transcendental equations Interpolating and Fitting the curves for data points.
6. Evaluate integrals by using numerical methods and solving IVP

Unit – I **(10 Contact hours)**

DIFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE: Basic concepts, Variable Separable method, homogeneous differential equations, Exact differential equations, Integrating factor, Differentiable equations Reducible to exact, Linear differential equations, Bernoulli differential equations.

Unit - II **(12 Contact hours)**

FUNCTIONS OF SEVERAL VARIABLES: Limit, Continuity and Differentiability of functions of several variables, Partial derivatives and their geometrical interpretation, Differentials, Derivatives of Composite and Implicit functions, Chain rule, Jacobians, Derivatives of higher order, Homogeneous functions, Euler's theorem, and Harmonic functions.

Unit – III **(8 Contact hours)**

APPLICATIONS OF FUNCTIONS OF SEVERAL VARIABLES: Taylor's expansion of functions of several variables, Maxima and Minima of functions of several variables - Lagrange's method of multipliers.

Unit – IV **(10 Contact hours)**

LINEAR ALGEBRA: Vector Spaces, Linear Combinations of Vectors, Linear dependence and Independence, Basis and Dimension, Linear Transformations, Matrix Representations of Linear transformation,

Unit-V **(10 Contact hours)**

MATRIX ALGEBRA (EIGEN VALUES AND EIGEN VALUES): Solving system of Homogeneous and Non-Homogeneous equations by using Gauss elimination method. Characteristic roots and Characteristic Vectors of a matrix - Cayley-Hamilton Theorem (without proof); Finding inverse and power of a matrix by Cayley-Hamilton Theorem.

Unit - VI **(10 Contact hours)**

NUMERICAL SOLUTION OF TRANSCENDENTAL EQUATIONS, INTERPOLATION: Roots of polynomial and transcendental equations – bisection method, Regula-falsi method and Newton-Raphson Method, Finite differences, Newton's forward and backward interpolation formulae, Gauss central difference Interpolation formulae.

LEARNING RESOURCES

TEXT BOOK

ERWIN KREYSZIG**, '***Advanced Engineering Mathematics'*, Wiley-India,9th Edition

REFERENCE BOOKS

i) TOM M. APOSTAL**,***'Calculus, Volume II'*, Wiley-India,Second Edition,

ii) R. K. JAIN AND S. R. K. IYENGAR,'*Advanced Engineering Mathematics'*, Narosa Publishers,3rd Edition.

iii) B.S.GREWAL, '*Higher Engineering Mathematics'*, Khanna Publishers,42nd Edition.

WEB RESOURCES

1. NPTEL, IIT- Madras,08-June-2017, Introduction to ordinary differential equations
   URL: https://nptel.ac.in/courses/111106100/12
2. NPTEL, IIT- Kanpur,15-March-2016,Differential Calculus of Several Variables
   URL: https://nptel.ac.in/courses/111104092/11
3. NPTEL, IIT- Madras,2015-02-05,Linear Algebra
   URL: https://nptel.ac.in/courses/111/106/111106051/
4. NPTEL, IIT- Delhi, 2009-12-31,Numerical Methods and Computation
   URL: https://nptel.ac.in/courses/122/102/122102009/
5. NPTEL, IIT- Kharagpur, 2012-07-11,Regression Analysis.
   URL: https://nptel.ac.in/courses/111/105/111105042/
6. RGUKT Course Content

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1	Solve first order differential equations.
CO 2	Explain limits and continuity, differentiability and partial derivatives of functions of multivariable and solve the extremum problems subjected to constraints.
CO 3	Find Taylor's series and extreme values for functions of two variables .
CO 4	Finding Eigen values and Eigen vector for a linear transformation.
CO 5	Approximate the roots of polynomial and transcendental equations.
CO 6	Approximate the value at a point by using given discrete data. Solve IVP numerically.

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

E1 SEM-2

Course Code	Course Name	Course Category	L – T - P	Credits
22MA1201	Linear Algebra & Numerical Methods (ECE,EEE,CE,ME,CHE, MME)	B.Sc	3-1-0	4

COURSE LEARNING OBJECTIVES

The objectives of this course is to

1. Introduce vector spaces and linear transformation.
2. Discuss Eigen values and Eigen vectors of a matrix and various properties.
3. Setup double and triple integrals to find volume and surface area.
4. Discuss directional derivatives and application of Green's, Stokes and Gauss theorems.
5. Discuss numerical methods to find the roots of transcendental equations and Interpolation.
6. Evaluate integrals by using numerical methods and solving IVP.

COURSE CONTENT

Unit – I **(12 Contact hours)**

LINEAR ALGEBRA: Vector Spaces, Linear Combinations of Vectors, Linear dependence and Independence, Basis and Dimension, Linear Transformations, Matrix Representations of Linear transformation.

Unit – II **(8 Contact hours)**

EIGEN VALUES AND EIGEN VECTORS: Solving system of Homogeneous and Non-Homogeneous equations by using Gauss elimination method. Characteristic roots and Characteristic Vectors of a matrix - Cayley-Hamilton Theorem (without proof); Finding inverse and power of a matrix by Cayley-Hamilton Theorem.

Unit-III **(10 Contact hours)**

MULTIPLE INTEGRALS: Double and triple integrals, computations of surface and volumes, Jacobeans of transformations, change of variables in double integrals, Change of Order of double integrals, integrals dependant on parameters - applications.

Unit–IV **(12 Contact hours)**

VECTOR CALCULUS: Scalar and vector fields, level surfaces, directional derivative, Gradient, Curl, Divergence, Laplacian, line, surface integrals and Volume integrals, Green, Gauss and Stokes theorems (without Proof) and problems.

Unit – V **(10 Contact hours)**

ROOT FINDING METHODS AND INTERPOLATION: Roots of polynomial and transcendental equations – bisection method, Regula-Falsi method and Newton-Raphson method, Finite differences, Newton's forward and backward interpolation formulae.

Unit – VI **(8 Contact hours)**

NUMERICAL INTEGRATION AND NUMERICAL SOLUTION OF IVP: Trapezoidal rule, Simpson's $1/3^{rd}$ rule and $3/8^{th}$ rule for numerical integration, Solution of IVP by Euler and Runge-Kutta method.

LEARNING RESOURCES

TEXT BOOK

ERWIN KREYSZIG**,** '*Advanced Engineering Mathematics'*, Wiley-India, 9^{th} Edition.

REFERENCE BOOKS

1. R. K. Jain and S. R. K. Iyengar**,** '*Advanced Engineering Mathematics',* Narosa Publishing House, New Delhi, 3rd Edition.
2. B.S.Grewal, '*A Text Book of Higher Engineering Mathematics'*, Khanna Publishers, 43rd Edition.
3. Gilbert Strang , 'Linear Algebra and its Applications*',* CENGAGE Learning 4th Edition.

WEB RESOURCES

1. https://onlinecourses.nptel.ac.in/noc20_ma54/preview
2. https://onlinecourses.nptel.ac.in/noc21_ma11/preview
3. RGUKT content

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1	Write Matrix representation for transformations.
CO 2	Find Eigen values and Eigen vector for a Matrix.
CO 3	Setup and evaluating double and triple integrals.

CO 4	Apply Green's Stokes and Gauss Divergence Theorems.
CO 5	Approximate the roots of polynomial and transcendental equations.
CO 6	Approximate the Integral value by numerical methods and solve IVP using numerical methods.

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

CSE

Course Code	Course Name	Course Category	L – T - P	Credits
22MA1202	**Discrete Mathematics (CSE)**	**B.Sc**	**3-1-0**	**4**

COURSE LEARNING OBJECTIVES

The objective of this course is to

1. Develop mathematical maturity of students to build the ability to understand and create mathematical arguments and to teach them how to think logically and mathematically.
2. Prove theorems and Mathematical arguments by using different methods. Provide the mathematical foundations for many computer science courses including data structures, algorithms, database theory, automata theory, formal languages, compiler theory, computer security and operating systems.
3. Learn the basic properties of sets and how to work with discrete structures, which are abstract mathematical structures used to represent discrete objects and relationship between these objects.
4. Introduce basic techniques of counting so that they develop the ability to enumerate.
5. Learn the concepts of graphs and its properties, solving real world problems by using graphs.
6. Learn the concepts of Euler Paths, graph coloring, trees.

COURSE CONTENT

Unit – I **(10 Contact hours)**

PROPOSITIONAL LOGIC: Propositions and Connectives, well-formed formulas, Logical Equivalence and laws of logic, Normal forms, PCNF, PDNF.

Unit - II **(10 Contact hours)**

PROOF TECHNIQUES: Tautological implications and rules of inferences, Methods of proofs (Forward proof, proof by contradiction, contra positive proofs, proof of necessity and sufficiency, Proof by Mathematical induction).

Unit - III **(12 Contact hours)**

SETS, RELATIONS AND FUNCTIONS: Sets, Relations, Equivalence Relations and compatibility relations, Transitive closure, Posets, Finite and infinite sets, countable and uncountable sets (definitions), Functions.

Unit - IV **(12 Contact hours)**

INTRODUCTION TO COUNTING: Counting Principles, Pigeon-hole Principle, Permutations and Combinations, Recurrence Relations, Linear Recurrence relations, Generating functions.

Unit - V **(9 Contact hours)**

INTRODUCTION TO GRAPH THEORY: Graphs and their basic properties, Special types of graphs and representations of graphs, Isomorphism's, connectivity.

Unit – VI **(7 Contact hours)**

GRAPH THEORY (Continuation): Euler and Hamiltonian Paths, Planar Graphs, Graph coloring, Trees

LEARNING RESOURCES

TEXT BOOK

Kenneth H. Rosen, *'Discrete Mathematics and its Applications'*, Tata McGraw-Hill, 7th Edition.

REFERENCE BOOKS

1. Trembley and Manohar, '*Discrete Mathematical Structures to Computer Science'*, by Mc - Graw Hill (1997).
2. Kolman, Busby and Ross, *'Discrete Mathematical Structures'* PHI (2009), Sixth Edition.
3. Thomas Koshy, '*Discrete Mathematics with Applications'*, Elsevier Academic press.

WEB RESOURCES

1. NPTEL Lectures by Prof. Kamala Krithivasan, Dept of CSE,IIT Madras
   URL**:** https://www.youtube.com/watch?v=xlUFkMKSB3Y&list=PL0862D1A947252D20
2. MIT open course ware: Mathematics for Computer Science, Fall 2010. Instructor: Tom Leighton
   URL 1: **https://www.youtube.com/watch?v=L3LMbpZIKhQ&list=PLB7540DEDD482705B**
   URL 2:http://ocw.mit.edu/6-042JF10
3. Discrete Mathematics for GATE. IIT lecture

URL: https://www.youtube.com/watch?v=E6uhC0pT9J8&list=PLEJxKK7AcSEGD7ty8DB1aU0xVG_P_hs_0

4. RGUKT Course Content

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1	Read, comprehend and construct mathematical argument
CO 2	Prove theorems and mathematical statements in different techniques.
CO 3	Deal with set, relation, countability and functions.
CO 4	Apply permutation, combination, pigeon-hole principle, recurrence relation and generating functions to enumerate objects.
CO 5	Understand and apply concepts of graph in many computer science courses.
CO 6	Deal with Euler paths in graphs and coloring of graphs

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

E2 SEM-1

Course Code	Course Name	Course Category	L – T - P	Credits
22MA2101	Probability and Random variables (ECE,EEE)	B.Sc	2-1-0	3

COURSE LEARNING OBJECTIVES

The objective of this course is to

1. To provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in signal processing and Communication Engineering.
2. To introduce students to the basic methodology of "probabilistic thinking" and to apply it to problems.
3. To understand basic concepts of probability theory and random variables, how to deal with multiple random variables, Conditional probability and conditional expectation, joint distribution and independence, mean square estimation.
4. Understand the difference between time averages and statistical averages.
5. Understand the upper bounds and lower bounds of any probability events and given some probability generating functions.
6. Understand the Convergence of functions of random variables with different techniques.

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COURSE CONTENT

Unit - I **(8 Contact hours)**

PROBABILITY AND THEOREMS IN PROBABILITY:

Probability introduction through Sets and Relative Frequency, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms,

Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Baye's Theorem and Independent Events.

Unit - II **(7 Contact hours)**

RANDOM VARIABLE AND DISTRIBUTION: Definition of random variable, discrete and continuous random variables, independent random variables. Distribution function and its properties, Probability mass function, Probability density function and their properties. Expectation of a random variable and its properties. Variance of a random variable and its properties. Definition of bivariate random variable, discrete and continuous bivariate random variables, distribution function of a bivariate random variable , conditional probability mass function and conditional probability density function.

Unit-III **(10 Contact hours)**

DISCRETE DISTRIBUTIONS: Bernoulli, Binomial, Poisson, Negative Binomial, Geometric and hyper geometric distributions (Find their mean, variance and problems). Continuous distributions: Uniform, Exponential, Normal, Beta and Gamma distributions

Unit-IV **(5 Contact hours)**

FUNCTIONS OF RANDOM VARIABLES: Functions of one Random variable, functions of two independent random variables, Covariance, Correlation coefficient (Karl Pearson), Bi-Variate Normal Distribution.

Unit – V **(7 Contact hours)**

GENERATING FUNCTIONS: Markov's inequality, Chebyshev's inequality and Cauchy-Schwartz's inequality (with proofs). Generating functions: Moment generating function (M.G.F) and its properties, characteristic functions (C.F) and its properties, Cummulant generating function (C.G.F) and its properties, probability generating function (P.G.F) and its properties.

Unit – VI **(8 Contact hours)**

ORDER STATISTICS: Order statistics, Sequence of Random Variables, Convergence of a Sequence of Random Variables, Convergence Theorems: WLLN (weak law of large numbers), SLLN (strong law of large numbers) and Central limit theorem.

LEARNING RESOURCES

TEXT BOOK

Peyton Z. Peebles,'*Probability, Random Variables & Random Signal Principles'*,TMH, 4Ed, 2001.

REFERENCE BOOKS

i) George R. Cooper, Clave D. MC Gillem, '*Probability Methods of Signal and System Analysis',* Oxford,3 Edition,1999.

ii) S.P. Eugene Xavier, '*Statistical Theory of Communication'*, New Age Publications, 1997.

iii) Athanasios Papoulis and S. Unnikrishna Pillai', *Probability, Random Variables and Stochastic Processes*', TMH, 4th Ed.

WEB RESOURCES

1. https://nptel.ac.in/courses/117105085/
2. https://nptel.ac.in/courses/111106112/
3. https://nptel.ac.in/courses/111102111/
4. RGUKT Course Content

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1	Apply Simple probabilities using an appropriate sample space.
CO 2	Apply Simple probabilities and expectations from probability density functions.
CO 3	Apply problem-solving techniques to solving real-world events.
CO 4	Apply selected probability distributions to solve problems.
CO 5	Apply Mean and covariance functions for simple random processes.
CO 6	Interpret and clearly present output from statistical analysis.

For Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

PROBABILITY AND STATISTICS

Course code	**Course Name**	**Course Category**	**L-T-P**	**Credits**
MA2102	**Probability and Statistics (CSE)**	**BSC**	**3-1-0**	**4**

COURSE LEARNING OBJECTIVES

The objective of this course is to

1. Providing students with a formal treatment of probability theory.
2. Equipping students with essential tools for statistical analysis.
3. Fostering understanding through real-world statistical applications.
4. Develop skills in presenting quantitative data using appropriate diagrams, tabulations.
5. Use appropriate statistical methods in the analysis of simple datasets.
6. Instill the belief that Statistics is important for scientific research.

COURSE CONTENT

Unit – I **(8 Contact hours)**

PROBABILITY AND THEOREMS IN PROBABILITY: Probability introduction through Sets and Relative Frequency, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem and Independent Events.

Unit – II **(10 Contact hours)**

PROBABILITY DISTRIBUTIONS: Discrete distributions, Bernoulli, Binomial, Poisson, Negative Binomial, Geometric and hyper geometric distributions (Find their mean, variance and problems). Continuous distributions: Uniform, Exponential, Normal, Beta and Gamma distributions.

Unit – III **(10 Contact hours)**

MOMENT GENERATING FUNCTIONS: Functions of Random Variables, Correlation coefficient and Bivariate Normal Distribution. Probability Inequalities and Generating Functions, Moment Generating Function, Characteristic Function, Cumulant Generating Function, Probability Generating Function.

Unit – IV **(8 Contact hours)**

ORDER STATISTICS AND CENTRAL LIMIT THEOREM: Order Statistics, Convergence of Sequence of Random Variables, Weak Law of Large Numbers, Strong Law of Large Numbers, Central Limit Theorem.

Unit - V **(12 Contact hours)**

SAMPLING THEORY: Definition of population, sampling, statistics and parameters. Types of sampling, Expected values of sample mean and variance, sampling distribution, standard error, sampling distribution of mean and sampling distribution of variance. Sampling -Distributions (t, F and Chi-square), confidence interval and interval estimation.

Unit – VI **(12 Contact hours)**

LARGE SAMPLE TESTS: Definition of Null and alternative hypothesis, critical region. Type I and Type II errors, power of the test, one tail, two tail tests, Tests for the single mean, two means, single proportion and two proportions using Z-test and t-test, t-test and F-test for significance of difference variance.

LEARNING RESOURCES

TEXT BOOK

William W. Hines and Douglas C. Montgomery, '*Probability and Statistics in Engineering'*, Willy Publications, 4th Edition.

REFERENCE BOOKS

1. Sheldon Ross, '*A First Course in Probability'*, Pearson Publications, 9th Edition.
2. Athanasios Papoulis and S. Unnikrishna Pillai, '*Probability, Random Variables and Stochastic Processes'*, TMH, 4th Edition,.

WEB RESOURCES

1. https://nptel.ac.in/courses/117105085/
2. https://nptel.ac.in/courses/111106112/
3. https://nptel.ac.in/courses/111102111/
4. RGUKT Course Content

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1	Apply Probability theory via Bayes Rule.
CO 2	Describe the properties of Discrete and Continuous distributions.
CO 3	Apply problem-solving techniques to solving real-world events.
CO 4	Apply selected probability distributions to solve problems.
CO 5	Develop problem-solving techniques needed to accurately calculate probabilities.
CO 6	Interpret and clearly present output from statistical analysis.

For Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

TRANSFORM CALCULUS

Course code	Course Name	Course Category	L-T-P	Credits
MA2103	**Transform Calculus (ME,CHE)**	**BSC**	**3-1-0**	**4**

COURSE LEARNING OBJECTIVES

The objectives of this course is to

1. Introduce partial differential equations and solutions of first order PDE.
2. Introduces the concept of transforms and their mathematical properties.
3. Apply Laplace transforms to solve the ordinary and partial differential equations which are not solvable by traditional analytical methods.
4. Write Fourier series expansion of periodic and non-periodic functions.
5. Introduce Fourier transforms and their properties.
6. Apply transformation techniques to solve boundary value problems.

COURSE CONTENT

Unit-I **(10 contact hours)**

LAPLACE TRANSFORM: Definition of Laplace Transform, linearity property, conditions for existence of Laplace Transform. First and second shifting properties, Laplace Transform of derivatives and integrals, unit step functions, Dirac delta-function, error function.

Unit-II **(10 contact hours)**

APPLICATION OF LAPLACE TRANSFORMS: Differentiation and integration of transforms, convolution theorem, inversion, periodic functions. Evaluation of integrals by Laplace Transform. Solution of Ordinary differential Equations.

Unit-III **(12 contact hours)**

FOURIER SERIES: Periodic functions, Fourier series representation of a function, Fourier series for Even and Odd functions, half range sine and cosine series, Fourier integral Theorem, Parseval's identity.

Unit-IV **(10 contact hours)**

FOURIER TRANSFORM: Fourier Transform, Fourier sine and cosine transforms. Linearity, scaling, frequency shifting and time shifting properties. Self reciprocity of Fourier Transform, convolution theorem.

Unit-V **(10 contact hours)**

BOUNDARY VALUE PROBLEMS: Relation between Fourier and Laplace Transforms, Solutions of boundary value problems by Fourier Transforms.

Unit – VI **(8 contact hours)**

PARTIAL DIFFERENTIAL EQUATIONS: Introduction to partial differential equations, Formation of PDE, Lagrange's equation, Pp+Qq=R form, Variable separable method.

LEARNING RESOURCES

TEXT BOOK

ERWIN KREYSZIG**, '***Advanced Engineering Mathematics'*, Wiley-India, 9th Edition.

REFERENCE BOOKS

i) M.K. Jain., '*Numerical solutions of differential equations',* Wiley Eastern, 1984, 2nd Edition.

ii) M.K Jain, S.R.K Iyengar, R.K Jain., '*computational methods for PDE*,' Wiley Eastern 1994.
iii) S.D. Conte &Carl de Boor., '*Elementary Numerical analysis an algorithmic approach'*, McGraw Hill, Newyork, 1980, 3rdEdition.
iv) E.Ward Cheney**,** David R. Kindcaid,' *Numerical methods and applications'*, Brooks / Cole, 2008.
v) Butcher, J.C, '*Numerical methods for ordinary differential equations'*, Wiley, NewYork, 2003.

WEB RESOURCES

1. https://onlinecourses.nptel.ac.in/noc19_ma04/preview.
2. RGUKT content.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1	Solve the partial differential equations of first and second order.
CO 2	Solve the ordinary differential equations with discontinuous forcing terms.
CO 3	Able to analyze the solutions with various initial and boundary conditions.
CO 4	Able to write series expansions of periodic functions and their physical significance.
CO 5	Solve the various forms of ODEs and PDEs.
CO 6	Solve the various types of differential equations such as Integro- differential equations, System of differential equations.

For Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

TRANSFORM CALCULUS

Course code	**Course Name**	**Course Category**	**L-T-P**	**Credits**
MA2104	**Transform Calculus (MME)**	**BSC**	**2-1-0**	**3**

COURSE LEARNING OBJECTIVES

The objective of this course is to

1. Introduce partial differential equations and solutions of first order PDE.
2. Introduces the concept of transforms and their mathematical properties.
3. Apply Laplace transforms to solve the ordinary and partial differential equations which are not solvable by traditional analytical methods.
4. Write Fourier series expansion of periodic and non-periodic functions.

5. Introduce Fourier transforms and their properties.
6. Apply transformation techniques to solve boundary value problems.

COURSE CONTENT

Unit-I **(10 Contact hours)**

LAPLACE TRANSFORM: Definition of Laplace Transform, linearity property, conditions for existence of Laplace Transform. First and second shifting properties, Laplace Transform of derivatives and integrals, unit step functions, Dirac delta-function, error function.

Unit-II **(7 Contact hours)**

APPLICATIONS OF LAPLACE TRANSFORMS: Differentiation and integration of transforms, convolution theorem, inversion, periodic functions. Evaluation of integrals by Laplace Transform, solution of Ordinary differential Equations.

Unit-III **(8 Contact hours)**

FOURIER SERIES: Periodic functions, Fourier series representation of a function, Fourier series for Even and Odd functions, half range sine and cosine series, Fourier integral Theorem, Parseval's identity.

Unit-IV **(5 Contact hours)**

FOURIER TRANSFORM: Fourier Transform, Fourier sine and cosine transforms. Linearity, Scaling, frequency shifting and time shifting properties.

Unit-V **(7 Contact hours)**

INVERSE FOURIER TRANSFORM: Inverse Fourier Transforms, Self reciprocity of Fourier Transform, convolution theorem.

Unit-VI **(8 Contact hours)**

BOUNDARY VALUE PROBLEMS: Relation between Fourier and Laplace Transforms, Solutions of boundary value problems by Fourier Transforms.

LEARNING RESOURCES

TEXT BOOK

ERWIN KREYSZIG**, '***Advanced Engineering Mathematics'*, Wiley-India, 9th Edition.

REFERENCE BOOKS

1. M.K. Jain., '*Numerical solutions of differential equations',* Wiley Eastern, 1984, 2nd Edition.
2. M.K Jain, S.R.K Iyengar, R.K Jain., '*computational methods for PDE*,' Wiley Eastern 1994.
3. S.D. Conte &Carl de Boor., '*Elementary Numerical analysis an algorithmic approach',* McGraw Hill, Newyork, 1980, 3rd Edition.
4. E. Ward Cheney**,** David R. Kindcaid.,' *Numerical methods and applications'*, Brooks / Cole, 2008.
5. Butcher, J.C, '*Numerical methods for ordinary differential equations'*, Wiley, Newyork, 2003.

WEB RESOURCES

1. https://onlinecourses.nptel.ac.in/noc19_ma04/preview.
2. RGUKT content.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1	Solve the partial differential equations of first and second order.
CO 2	Solve the ordinary differential equations with discontinuous forcing terms.
CO 3	Able to analyze the solutions with various initial and boundary conditions.
CO 4	Able to write series expansions of periodic functions and their physical significance.
CO 5	Solve the various forms of ODEs and PDEs.
CO 6	Solve the various types of differential equations such as Integro- differential equations, System of differential equations.

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

PROBABILITY AND STATISTICS

Course code	Course Name	Course Category	L-T-P	Credits
MA2201	**Introduction to Probability and Statistics (ME & CIVIL)**	**BSC**	**2-1-0**	**3**

COURSE LEARNING OBJECTIVES

The objectives of this course are

1. Providing students with a formal treatment of probability theory.
2. Equipping students with essential tools for statistical analysis.
3. Fostering understanding through real-world statistical applications.
4. Develop skills in presenting quantitative data using appropriate diagrams, tabulations.

5. Use appropriate statistical methods in the analysis of simple datasets.
6. Instill the belief that Statistics is important for scientific research.

COURSE CONTENT

Unit – I **(7 Contact hours)**

PROBABILITY: Probability introduction through Sets and Relative Frequency, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint probability, Conditional Probability, Total Probability, Bayes' Theorem and Independent Events.

Unit – II **(6 Contact hours)**

RANDOM VARIABLE : Definition of random variable, discrete and continuous random variables, Probability mass function and density function. Bivariate random variable, Joint probability mass function and joint probability density function. independent random variables.

Unit-III **( )**

Mathematical Expectation: Mathematical expectation of a random variable. Mean, variance, correlations coefficient its properties. Moment generating function its properties. Chebyshev's inequality Markov's inequality.

Unit-IV **(10 Contact hours)**

SPECIAL PROBABILITY DISTRIBUTIONS: Bernoulli, Binomial, Poisson, Negative Binomial, Geometric and hyper geometric distributions (Find their mean, variance and problems). Continuous distributions: Uniform, Exponential, Normal, Beta and Gamma distributions. Central limit theorem.

Unit – V **(8 Contact hours)**

SAMPLING THEORY: Definition of population, sampling, statistics and parameters. Types of sampling, sampling distributions (student-t distribution, chi-square distribution and F-distribution). Sampling distribution of sample mean, difference of mean, proportion and difference of proportion, variance and comparison of variance.

Unit-VI **(6 Contact hours)**

Theory Estimation: Point estimator and interval estimator for population mean, difference of mean, proportion and difference of proportion, variance and comparison of variance.

LEARNING RESOURCES

TEXT BOOK

William W. Hines and Douglas C. Montgomery, '*Probability and Statistics in Engineering'*, Willy Publications, 4th Edition.

REFERENCE BOOKS

i) Sheldon Ross, '*A First Course in Probability'*, Pearson Publications, 9th Edition.

ii) Athanasios Papoulis and S. Unnikrishna Pillai, '*Probability, Random Variables and Stochastic Processes'*, TMH, 4th Edition,.

WEB RESOURCES

1. https://nptel.ac.in/courses/117105085/
2. https://nptel.ac.in/courses/111106112/
3. https://nptel.ac.in/courses/111102111/
4. RGUKT Course Content

COURSE OUTCOMES: At the end of the course, the student will be able to

CO 1	Apply Probability theory via Baye's Rule.
CO 2	Describe the properties of Discrete and Continuous distributions.
CO 3	Apply problem-solving techniques to solving real-world events.
CO 4	Apply selected probability distributions to solve problems.
CO 5	Develop problem-solving techniques needed to accurately calculate probabilities.
CO 6	Interpret and clearly present output from statistical analysis.

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

MINOR IN MATHEMATICS

COMPULSORY COURSES

S.No.	Subject Name	**L-T-P**	**Credits**
1	REAL ANALYSIS	3-1-0	4
2	ABSTRACT ALGEBRA	3-1-0	4
3	Matrix Algebra	3-1-0	4

ELECTIVE COURSES

S.NO.	SUBJECT NAME	L-T-P	CREDITS	BRANCHES
1.	METRIC SPACES	3-1-0	4	All Branches
2.	Discrete Structures	3-1-0	4	All except CSE
3.	Number theory	3-1-0	4	All Branches
4.	Complex Analysis	3-1-0	4	All Branches
5.	Applied Linear Algebra	3-1-0	4	All Branches
6.	Calculus & Linear Algebra	3-1-0	4	All Branches
7.	Discrete Mathematics & Graph Theory	3-1-0	4	All except CSE

8.	Numerical Analysis & Optimization	3-1-0	4	All Branches
9.	Partial Differential Equations	3-1-0	4	All Branches
10.	Transform Calculus	3-1-0	4	ECE,EEE,CSE &CE
11.	Probability and Statistics	3-1-0	4	All except CSE
12.	Probability and Stochastic Process	3-1-0	4	All Branches
13.	Integral Transforms and their applications	3-1-0	4	ECE,EEE,CSE &CE
14.	Essential Mathematics for Machine Learning	3-1-0	4	All Branches
15.	Introduction to R software	3-1-0	4	All Branches
16.	Numerical Methods for Engineering	3-1-0	4	All Branches
17.	Computational Mathematics with Python	3-1-0	4	All Branches

REAL ANALYSIS

Unit-1 **(9 Contact hours)**

NUMBER SYSTEM: Dedekind's definition of real numbers, Cantor's definition of real numbers, field and order axioms, countable and uncountable sets. Supremum and infimum of sets of real numbers, bounds and limit points of a set, Bolzano Weierstrass theorem, open and closed sets.

Unit-2 **(11 Contact Hours)**

SEQUENCES AND SERIES: Limit inferior, limit superior and limit of sequence. Bounded and monotonic sequences, Cauchy sequence and Cauchy's general principle of convergence. Product and quotient of limits, Cantor's theorem on nested interval and its applications. Compact sets.

Unit-3 **(8 Contact Hours)**

CONTINUITY AND UNIFORM CONTINUITY: Heine-Borel theorem. Limit, limit superior, limit inferior of real functions, limit theorems. Continuity and uniform continuity of real functions, properties of continuous functions, continuity and compactness.

Unit-4 **(12 Contact Hours)**

DIFFERENTIABILITY OF REAL FUNCTIONS: Differentiability of real functions, Taylor's and Maclaurin's theorems. Riemann integration, conditions for integrability, properties of integrable functions, indefinite integral and their properties, fundamental theorem of integral calculus, mean value theorems, improper integrals and convergence at infinity, absolute and conditional convergence.

Unit-5 **(10 Contact Hours)**

SEQUENCES AND SERIES: Sequences and series of functions, uniform convergence of sequences and series of functions.

Unit-6 **(10 Contact Hours)**

METRIC SPACES: Metric space, Definition, real line as an example of a metric space.

LEARNING RESOURCES

TEXT BOOK

Introduction to Real Analysis Bartle and Sherbert,(Third Edition), Wiley-India (2007)

REFERENCE BOOKS

1. Elements of Real Analysis by Shanti Narayana and M.D. Raisinghania, S. Chand & Company Ltd, Revised Edition (2011).
2. R.R. Goldberg, Methods of Real Analysis ,Wiley (1976)
3. Principles of Mathematical Analysis by Walter Rudin,(Third edition),Mc-Graw Hill,(1976)

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

ABSTRACT ALGEBRA

Unit-I: Number Theoretic Algorithms (8 contact hours)

Divisibility and divisors, Prime and composite numbers, Division theorem, remainders, modular equivalence, unique factorization, GCD recursion theorem, Euclid's Algorithm, extended form of Euclid's algorithm.

Unit-II: Groups (12 contact hours)

Integer Equivalence Classes and Symmetries, Groups, subgroups, order of an element, subgroups generated by an element, solving modular linear equations, Chinese remainder theorem, Euler's theorem, Fermat's theorem, Discrete logarithm theorem, Primality testing(Pseudoprimality testing, Miller-Rabin randomized primality test)

Unit-III: Cosets and Lagrange's theorem (10 contact hours)

Cyclic groups, Permutation groups, Normalizer of an element, Center of the group, conjugate class an element, cosets, Lagrange theorem, Normal subgroup, factor group and Simple groups

Unit-IV: Isomorphism (8 contact hours)

Homomorphism, Isomorphism and Isomorphism theorems, Automorphism, Cayley's theorem

Unit-V: Structure of Groups (10 contact hours)

Finite Abelian Groups, Solvable groups, Groups Acting on Sets, Class equation, P-group, Syllow's theorems ,Number of non-isomorphic finite order groups(Non Abelian, Abelian & Cyclic)

Unit-VI: Rings and Fields (12 contact hours)

Rings, Integral domain, skew-Field, Fields, ideals (Principle, prime, Maximal), Factor rings, polynomial rings, Factorization of polynomials, Fields, Extension fields, Finite fields, Introduction to Galois group .

Text Books

1.*Dummit, D. S. and Foote, R. M.*, "**Abstract Algebra**", John Wiley & Sons (3rd Edition)
2. *Bhattacharya, P. B., Jain, S. K. and Nagpaul, S. R.,* "**Basic Abstract Algebra**", Cambridge University Press (2nd Edition.)
3. *Joseph A Gallian*, **"Contemporary Abstract Algebra",**(7th Edition).

Assessment Method for Theory courses only

Course Nature	Theory			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

Abstract Algebra

Credits:3	Total Hours:45

Unit-I: Groups (8 contact hours)

Integer Equivalence Classes and Symmetries, Groups, subgroups, order of an element, subgroups generated by an element.

Unit-II: Cosets and Lagrange's theorem (10 contact hours)

Cyclic groups, Permutation groups, Normalizer of an element, Center of the group, conjugate class an element, cosets, Lagrange theorem, Normal subgroup, factor group and Simple groups

Unit-III: Isomorphism (8 contact hours)

Homomorphism, Isomorphism and Isomorphism theorems, Automorphism, Cayley's theorem

Unit-IV: Structure of Groups (7 contact hours)

Finite Abelian Groups, P-group, Syllow's theorems ,Number of non-isomorphic finite order groups(Non Abelian, Abelian & Cyclic)

Unit-V: Rings (6 contact hours)

Rings, Integral domain, skew-Field, Fields, ideals (Principle, prime, Maximal), Factor rings, polynomial rings.

Unit-VI: Fields (6 contact hours)

Factorization of polynomials, Fields, Extension fields, Finite fields.

Text Books

1.*Dummit, D. S. and Foote, R. M.*, "**Abstract Algebra**", John Wiley & Sons (3rd Edition)
2. *Bhattacharya, P. B., Jain, S. K. and Nagpaul, S. R.,* "**Basic Abstract Algebra**", Cambridge University Press (2nd Edition.)
3. *Joseph A Gallian*, **"Contemporary Abstract Algebra",**(7th Edition)

Assessment Method for Theory courses only

Course Nature	Theory			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

MATRIX ALGEBRA

Course code	Course Name	Course Category	L-T-P	Credits

MAXX01	Matrix Algebra	BSC	3-1-0	4

Detailed syllabus:

Unit – I (7 Contact hours)

Vector Spaces, Subspaces, Bases and Dimension, Ordered basis and coordinates. Linear transformations, Matrix representation of linear transformations, Rank-Nullity Theorem.

Unit - II (7 Contact hours)

Symmetric, skew-symmetric, Hermitian, Skew – Hermitian, Orthogonal, Unitary matrices and their properties.

Unit - III (8 Contact hours)

Idempotent matrix, Row and column spaces, rank and trace and their properties.

Unit - IV (8 Contact hours)

Quadratic forms, positive definite and their properties, Reduction of quadratic forms to canonical form using Lagrange method and orthogonal reduction.

Unit - V (8 Contact hours)

Matrix Diagonalization: QR, LD and singular value decomposition.

Unit - VI (7 Contact hours)

Iterative methods to solve AX=B using Jacobi, Gauss- Seidel, SOR Methods.

Text Books:

1. Advanced Engineering Mathematics by Erwin Kreyszig, 8th Edition, Wiley India Pvt. Ltd

2. Introduction to Linear Algebra by Gilbert Strang, South Asian Edition, Wellesley Cambridge Press.

3. Matrix and Linear Algebra by Kanti Bhushan Datta, Second Edition, PHI.

4. Elementary Linear Algebra Applications Version, 9th Edition, by Howard Anton, Chris Rorres, Wiley Indian Pvt. Ltd.

5. Schaum's Outlines of Matrix Operations by Richard Bronson, McGraw Hill

Reference Books:

1. Linear Algebra by Kenneth Hoffman and Ray Kunze, 2nd Edition, PHI.

2. Assessment Method for Theory courses only

Course Nature	Theory			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

ELECTIVE COURSES

METRIC SPACES

Course Objectives: The course aims at providing the basic knowledge pertaining to metric spaces such as open and closed balls, neighborhood, interior, closure, subspace, continuity, compactness, connectedness etc.

Course Contents:

Unit 1: Basic Concepts: (8 Contact Hours)

Metric spaces: Definition and examples, Sequences in metric spaces, Cauchy sequences, Complete metric space.

Unit 2: Topology of Metric Spaces (10Contact Hours)

Open and closed ball, Neighborhood, Open set, Interior of a set, limit point of a set, derived set, closed set, closure of a set, diameter of a set, Cantor's theorem, Subspaces, Dense set.

Unit 3: Continuity & Uniform Continuity: (12Contact Hours)

Continuous mappings, Sequential criterion and other characterizations of continuity, Uniform continuity, Homeomorphism, Contraction mapping, Banach fixed point theorem.

Unit 4: Connectedness and Compactness (12 Contact Hours)

Connectedness, Connected subsets of , Connectedness and continuous mappings, Compactness, Compactness and boundedness, Continuous functions on compact spaces and in terms of the Heine–Borel property.

Unit-5: Iteration (8 Contact Hours)

Iteration as a method to solve problems. Examples in $\mathbf{R}$, $\mathbf{R}^2$. Fixed points of iterations. Discussion of what should be required to guarantee convergence of iterative procedures to fixed points.

Unit-6: Contraction: (10 Contact Hours)

Contractions. Examples. The Contraction Mapping Principle. An application to linear algebra. A differential criterion for a function to be a contraction. Functions with the property that repeated

application gives a contraction. Application to existence of solution of differential equations. Examples.

Text Books:

Shirali, Satish & Vasudeva, H. L. (2009). Metric Spaces, Springer, First Indian Print.

Reference:

1. Kumaresan, S. (2014). Topology of Metric Spaces (2nd ed.). Narosa Publishing House. New Delhi.

2. Simmons, G. F. (2004). Introduction to Topology and Modern Analysis. Tata McGraw Hill. New Delhi.

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

22MAXXXX	**Matrix algebra**	**BSC**	**2-1-0**	**3**

Unit – I **(7 Contact hours)**

Matrices introduction, Operations with matrices, Matrix Multiplication as a linear combination of rows and columns, The laws of Matrix Algebra, Determinant and Inverse of Matrices, Symmetric and Skew-symmetric matrices, Hermitian and Skew-Hermitian matrices.

Unit - II **(8 Contact hours)**

Vector spaces, Introduction to Inner Product and inner product spaces, Orthogonal and Ortho-normal sets, Orthogonal Matrices, Unitary Matrices, Row Space and Column Space, Null Space.

Unit - III **(7 Contact hours)**

Rank and Nullity of matrices, Properties of rank of a matrix, Linear Systems, Projection Matrices, Least Square Approximations.

Unit –IV **(8 Contact hours)**

Eigenvalues and eigenvectors, Cayley-Hamilton theorem, Eignevalues and eigenvectors of all types of matrices, Trace of a Matrix, Diagonalization of a matrix.

Unit –V **(8 Contact hours)**

Generalized inverses, The Moore-Penrose inverse, Orthogonal Sets and the Gram-Schmidt Process, Quadratic forms, Reduction of quadratic forms to canonical forms,Matrix Differentiation.

Unit-VI **(7 Contact hours)**

LU, LDU, UDU and Cholesky Decomposition, QR decomposition, Singular Value Decomposition. Applications of SVD.

Learning resources

Text book:

1. "Introduction to Linear Algebra" by Gilbert Strang, South Asian Edition, Wellesley Cambridge Press
2. Course content: enngg2a.nuz.rgukt.in >>> sem2 >>> ece >>> matrix algebra.

Reference Books:

1. "Linear Algebra", Second Edition, by P.Ramachadra Rao and P. Bhimashankaram. Hindustan Book Agency.

2. "Elementary Linear Algebra Applications Version", 9th Edition, by Howard Anton, Chiris Rorres, Wiley Indian Pvt. Ltd.

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

DISCRETE STRUCTURES

Course code	Course Name	Course Category	L-T-P	Credits
22MAXX02	Integral Transforms and their applications	BSC	3-1-0	4

Unit-1: Propositional logic: (8 Contact hours)

Syntax, semantics, valid, Satisfiable and Unsatisfiable formulas, encoding and examining the validity of some logical arguments.

Unit-2: Proof techniques: (8 contact hours)

Forward proof, proof by contradiction, contra positive proofs, proof of necessity and sufficiency.

Unit-3: Sets, relations and functions: (12 contact hours)

Operations on sets, relations and functions, binary relations, partial ordering relations, equivalence relations, princ iples of mathematical induction, Finite and infinite sets, countable and uncountable sets, Cantor's diagonal argument and the power set theorem.

Unit-4: Introduction to counting: (10 contact hours)

Basic counting techniques, inclusion and exclusion, pigeon-hole principle, permutation, combination, summations. Introduction to recurrence relation and generating function.

Unit-5: Introduction to graphs: (10 contact hours)

Graphs and their basic properties, degree, path, cycle, subgraphs, isomorp hism, Eulerian and Hamiltonian walks, graph coloring, planar graphs, trees.

Unit-6:Algebraic structures and Morphisms: (12 contact hours)

Algebraic structures with one binary operation and semi groups, monoids and groups, congruence relation and quotient structures. Free and cyclic monoids and groups, permutation groups, substructures, normal subgroups. Algebraic structures with two binary operations and rings, integral domains and fields. Boolean algebra and Boolean ring.

Text Books:

1. Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw-Hill.

2. Discrete Mathematical Structures to Computer Science by Trembley and Manohar, Mc - Graw Hill (1997)

3. Discrete Mathematical Structures by Kolman, Busby and Ross, Sixth Edition, PHI (2009).

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

NUMBER THEORY

Course code	Course Name	Course Category	L-T-P	Credits
22MAXX03	Number Theory	BSC	3-1-0	4

Course Objectives:

In number theory there are challenging open problems which are comprehensible at undergraduate level, this course is intended to build a micro aptitude of understanding aesthetic aspect of mathematical instructions and gear young minds to ponder upon such problems. Also, another

objective is to make the students familiar with simple number theoretic techniques, to be used in data security.

Course Contents:

Unit 1: Distribution of Primes and Theory of Congruencies (6 contact hours)

Linear Diophantine equation, Prime counting function, Prime number theorem, Goldbach conjecture, Fermat and Mersenne primes,

Unit-2: Congruences & Residues: (14 contact hours)

Congruence relation and its properties, Linear congruence and Chinese remainder theorem, Fermat's little theorem, Wilson's theorem. Quadratic residues, quadratic reciprocity, Jacobi symbol, greatest integer function, arithmetic functions, the Mobius inversion formula.

Unit 3: Number Theoretic Functions: (12contact hours)

Number theoretic functions for sum and number of divisors, Multiplicative function, The Mobius inversion formula, The greatest integer function. Euler's phi-function and properties, Euler's theorem.

Unit 4: Primitive Roots : (12 contact hours)

The order of an integer modulo n, Primitive roots for primes, Composite numbers having primitive roots; Definition of quadratic residue of an odd prime, and Euler's criterion.

Unit 5: Quadratic Reciprocity Law (8 contact hours)

The Legendre symbol and its properties, Quadratic reciprocity, Quadratic congruencies with composite moduli;

Unit-6: Public Key Encryption : (8 contact hours)

Public key encryption, RSA encryption and decryption.

Course Learning Outcomes: This course will enable the students to learn:

i) Some of the open problems related to prime numbers, viz., Goldbach conjecture etc.
ii) About number theoretic functions and modular arithmetic.
iii) Public crypto systems, in particular, RSA.

References:

1. Burton, David M. (2007). Elementary Number Theory (7th ed.). Tata Mc-Graw Hill Edition, Indian Reprint. 2. Jones, G. A., &Jones, J. Mary. (2005).
2. Elementary Number Theory. Undergraduate Mathematics Series (SUMS). First Indian Print. Additional Reading: 1. Neville Robinns. (2007).
3. Beginning Number Theory (2nd ed.). Narosa Publishing House Pvt. Limited, Delhi.

Assessment Method for Theory courses only

Course Nature	Theory			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

NUMBER THEORY

Course code	Course Name	Course Category	L-T-P	Credits
22MAXX03	Number Theory	BSC	2-1-0	3

Course Objectives:

In number theory there are challenging open problems which are comprehensible at undergraduate level,
this course is intended to build a micro aptitude of understanding aesthetic aspect of mathematical
instructions and gear young minds to ponder upon such problems. Also, another objective is to make the
students familiar with simple number theoretic techniques, to be used in data security.

Course Contents:

Unit 1: Distribution of Primes and Theory of Congruencies (6 contact hours)
Linear Diophantine equation, Prime counting function, Prime number theorem, Goldbach conjecture, Fermat and Mersenne primes,

Unit-2: Congruences and Congruences with a Prime-Power Modulus (10contact hours)
Modular arithmetic, Linear congruences, Simultaneous linear congruences, Chinese Remainder Theorem, An extension of Chinese Remainder Theorem (with non-coprime moduli),Arithmetic modulo p, Fermat's little theorem, Wilson's theorem, Pseudo-primes and Carmichael numbers, Solving congruences modulo prime powers.

Unit-3: Residues: (10 contact hours)
Quadratic residues, quadratic reciprocity, Jacobi symbol, greatest integer function, arithmetic functions, the Mobius inversion formula.

Unit 4: Number Theoretic Functions: (10 contact hours)
Number theoretic functions for sum and number of divisors, Multiplicative function, The Mobius inversion formula, The greatest integer function. Euler's phi-function and properties, Euler's theorem.

Unit 5: Primitive Roots : (8 contact hours)
The order of an integer modulo n, Primitive roots for primes, Composite numbers having primitive roots; Definition of quadratic residue of an odd prime, and Euler's criterion.

Unit 6: Quadratic Reciprocity Law (8 contact hours)
The Legendre symbol and its properties, Quadratic reciprocity, Quadratic congruencies with composite moduli.

References:

1. Burton, David M. (2007). Elementary Number Theory (7th ed.). Tata Mc-Graw Hill Edition, Indian Reprint. 2. Jones, G. A., &Jones, J. Mary. (2005).
2. Elementary Number Theory. Undergraduate Mathematics Series (SUMS). First Indian Print. Additional Reading: 1. Neville Robinns. (2007).
3. Beginning Number Theory (2nd ed.). Narosa Publishing House Pvt. Limited, Delhi.

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

Complex Analysis

Course code	**Course Name**	**Course Category**	**L-T-P**	**Credits**
22MA XX04	**COMPLEX ANALYSIS**	**BSC**	**3-1-0**	**4**

Course objectives:

1)To enable the students to understand the mathematical concepts of the complex variables and their applications in science and engineering

2) To understand and apply the concepts of the limit, continuity, differentiability of the complex functions

3) To identify curves, region and domain of the complex functions

4) To describe basic properties of complex integration and having the ability to accomplish such integrals

5) To evaluate the integrals using residues

UNIT1:

Complex Numbers And Functions (10 Contact hours)

Definition and properties of the complex numbers- geometrical representations-Polar forms – functions of a complex variables-Conversion of Cartesian equations into complex variables-Domain and region of the complex functions-univalent and multivalent complex functions

UNIT2:

Limits and Continuity (10 Contact hours)

Limits-Continuity-Differentiability-Analyticity-Properties- Derivatives of the analytical functions -Cauchy-Rieman equations in Cartesian and polar coordinates –Harmonic and Conjugate harmonic conjugate functions – Construction of analytical functions -Milne-Thomson method

UNIT3:

Complex Transformations (10 Contact hours)

Conformal mappings-Transformation of e^z ,lnz,z^2, sinz, cosz, -images under Transformation - Bilinear Transformation- Translation, rotation, magnification and inversion –Fixed points-Cross ratio-Determination of Bilinear Transformation

UNIT4:

Complex Integration (10 Contact hours)

Complex integration –line integrals in the plane -evaluation of the line integral along a path and independence of the paths ,existence of indefinite integration –Cauchy's integral theorem - Cauchy's integral formula –Generalised integral formula and related problems.

Unit5:

Singularities (10 Contact hours)

Complex power series -Radius of the convergence-Expansion in Taylor series - Maclaurin's series-Laurent series –singular points- Isolated singular points-pole of order m-essential singular points

UNIT6:

Residue Theorem (10 Contact hours)

Residue –Evaluation of residues by the formula and by the Laurent series-Residue theorem-applications -Evaluation of integrals of the type a) improper real integral $\int_{-\infty}^{\infty} f(x)dx$ b)$\int_0^{\frac{\pi}{2}} f(sin\theta, cos\theta)d\theta$ c) $\int_{-\infty}^{\infty} e^{imx} f(x)dx.$

Learning resoures

Text Book:

Erwin Kreyszig ' Advanced Engineering Mathematics" Wiley -india 9th edition

Reference Books :

1. R.K.Jain and S.R.K .Iyengar "Advanced Engineering Mathematics" Narosa Publishing House , New Delhi .4th Edition

2. Erwin Kreyszig ' Advanced Engineering Mathematics" Wiley -india 9th edition
3. B.S.Grewal " A Text Book of Higher Engineering Mathematics " Wiley –india , 44th Edition
4. Mathematics by T.K.V .Iyengar, B.KrishnaGanghi ,S .Ranganatham and M.V.S.S .N.Prasad , S.Chand Publication
5. Engineering Mathematics Volume –II E.Rukmangadachari,E.KesavaReddy, Pearson Publication

Web resources:

1. https://mathworld.wolfram.com/ComplexAnalysis.html
2. https://ntpel.ac.in/courses/15101003/downloads/modu21/lecture23.pdf.
3. RGUKT Course Content

Assessment Method for Theory courses only

Course Nature	Theory			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

APPLIED LINEAR ALGEBRA

Course code	Course Name	Course Category	L-T-P	Credits
22MAXX05	Integral Transforms and their applications	BSC	3-1-0	4

Course Objectives:

1. Understanding basic concepts of linear algebra to illustrate its power and utility through applications to computer science and Engineering.

2. apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.

3. solve problems in cryptography, computer graphics and wavelet transforms

Course Contents:

Unit:1 System of Linear Equations: (8 Contact Hours)

Gaussian elimination and Gauss Jordan methods - Elementary matrices- permutation matrix - inverse matrices - System of linear equations - - LU factorizations.

Unit:2 Vector Spaces (12 Contact Hours)

vector space- subspace –linear combination-span-linearly dependent-independent- bases - dimensions-finite dimensional vector space. Subspace Properties, Row and column spaces -Rank and nullity – Bases for subspace – invertibility- Application in interpolation.

Unit:3 Linear Transformations and applications (10 Contact Hours)

Linear transformations – Basic properties-invertible linear transformation - matrices of linear transformations - vector space of linear transformations – change of bases – similarity

Unit:4: Inner Product Spaces: (10 Contact Hours)

Dot products and inner products – the lengths and angles of vectors – matrix representations of inner products- Gram-Schmidt orthogonalisation .

Unit-5: Applications of Inner Product Spaces: (10 Contact Hours)

QR factorization- Projection - orthogonal projections – relations of fundamental subspaces – Least Square solutions in Computer Codes

Unit:6 Applications of Linear equations : (10 Contact Hours)

An Introduction to coding - Classical Cryptosystems –Plain Text, Cipher Text, Encryption, Decryption and Introduction to Wavelets (only approx. of Wavelet from Raw data)

Text Book(s)

1. Linear Algebra, Jin Ho Kwak and Sungpyo Hong, Second edition Springer(2004). (Topics in the Chapters 1,3,4 &5)

2. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R. Hill, 9th Edition Pearson Education, 2011.

Reference Books

1. Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition, Academic Press(2016)

2. Applied Abstract Algebra, Rudolf Lidl, Guter Pilz, 2nd Edition, Springer 2004.

3. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003

4. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).

Assessment Method for Theory courses only

Course Nature	Theory
Assessment Method	

Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

Calculus & Linear Algebra

Course code	Course Name	Course Category	L-T-P	Credits
22MAXX06	Integral Transforms and their applications	BSC	3-1-0	4

Unit – I **(10 Contact hours)**

Differential equations of first order and first degree:

Basic concepts, Variable Separable method, homogeneous differential equations, Exact differential equations, Integrating factor, Differentiable equations Reducible to exact, Linear differential equations, Bernoulli differential equations

Unit - II **(12 Contact hours)**

Functions of several variables:

Limit, Continuity and Differentiability of functions of several variables, Partial derivatives and their geometrical interpretation, Differentials, Derivatives of Composite and Implicit functions, Chain rule, Jacobians, Derivatives of higher order, Homogeneous functions, Euler's theorem, and Harmonic functions.

Unit - III

Applications of Functions of several Variable: (8 Contact hours)

Taylor's expansion of functions of several variables, Maxima and Minima of functions of several variables - Lagrange's method of multipliers.

Unit – I V

Linear Algebra: (10 Contact hours)

Vector Spaces, Linear Combinations of Vectors, Linear dependence and Independence, Basis and Dimension, Linear Transformations, Matrix Representations of Linear transformation,

Unit-V **(10 Contact hours)**

Matrix Algebra (Eigen Values and Eigen Values):

Elementary of transformations of Matrices, Rank and Inverse of a matrix using Gauss Jordan Elimination, Eigen values and Eigen Vectors. Properties for various types of matrices (i.e symmetric, skew-symmetric, Hermitian, Skew - Hermitian, Orthogonal, Unitary matrices and Idempotent matrix).

Unit - VI **(10 Contact hours)**

Numerical solution of transcendental equations, Interpolation and Curve fitting:

Roots of polynomial and transcendental equations – bisection method, Regula-falsi method and Newton-Raphson method, Finite differences, Newton's forward and backward interpolation formulae, Gauss central difference Interpolation formulae, Curve fitting by Least square method [(i) straight line (ii) Parabola].

Text Book(s)

1. Linear Algebra, Jin Ho Kwak and Sungpyo Hong, Second edition Springer(2004). (Topics in the Chapters 1,3,4 &5)

2. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R. Hill, 9th Edition Pearson Education, 2011.

Reference Books

1. Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition, Academic Press(2016)

2. Applied Abstract Algebra, Rudolf Lidl, Guter Pilz, 2nd Edition, Springer 2004.

3. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003

4. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

Discrete Mathematics and Graph Theory

Course code	Course Name	Course Category	L-T-P	Credits
22MAXX07	**Integral Transforms and their applications**	**BSC**	**3-1-0**	**4**

Course Objectives:

1. To address the challenge of the relevance of lattice theory, coding theory and algebraic structures to computer science and engineering problems.

2. To use number theory, in particular congruence theory to cryptography and computer science problems.
3. To understand the concepts of graph theory and related algorithm concepts

Course Syllabus:

Unit:1 Mathematical Logic and Statement Calculus (8 contact hours)

Introduction-Statements and Notation-Connectives–Tautologies–Two State Devices and Statement logic -Equivalence - Implications–Normal forms - The Theory of Inference for the Statement Calculus.

Unit:2 Predicate Calculus (12 contact hours)

The Predicate Calculus - Inference Theory of the Predicate Calculus. Algebraic Structures 5 hours Semigroups and Monoids - Groups – Subgroups – Lagrange's Theorem Homomorphism – Properties-Group Codes.

Unit:3: Lattices (8 contact hours)

Partially Ordered Relations -Lattices as Posets – Hasse Digram – Properties of Lattices.

Unit:4 Boolean algebra (8 contact hours)

Boolean algebra - Boolean Functions-Representation and Minimization of Boolean Functions – Karnaugh map – McCluskey algorithm.

Unit:5 Fundamentals of Graphs (12 contact hours)

Basic Concepts of Graph Theory – Planar and Complete graph - Matrix representation of Graphs – Graph Isomorphism – Connectivity–Cut sets-Euler and Hamilton Paths–Shortest Path algorithms.

Unit:6 Trees, Fundamental circuits , Cut sets: (12 contact hours)

Graph colouring, covering, Partitioning Trees – properties of trees – distance and centres in tree –Spanning trees – Spanning tree algorithmsTree traversals-Fundamental circuits and cut-sets. Bipartite graphs - Chromatic number – Chromatic partitioning – Chromatic polynomial - matching – Covering– Four Colour problem.

Text Book(s) :

1. Discrete Mathematical Structures with Applications to Computer Science, J .P. Trembley and R. Manohar, Tata McGraw Hill-35th reprint, 2017.

2. Graph theory with application to Engineering and Computer Science, Narasing Deo, Prentice Hall India 2016.

Reference Books:

1. Discrete Mathematics and its applications, Kenneth H. Rosen, 8th Edition, Tata McGraw Hill, 2019.

2. Discrete Mathematical Structures, Kolman, R.C.Busby and S.C.Ross, 6th Edition, PHI, 2018.

3. Discrete Mathematics, Richard Johnsonbaugh, 8th Edition, Prentice Hall, 2017. 4. Discrete Mathematics, S. Lipschutz and M. Lipson, McGraw Hill Education (India) 2017.

5. Elements of Discrete Mathematics–A Computer Oriented Approach, C.L.Liu, Tata McGraw Hill, Special Indian Edition, 2017.

6. Introduction to Graph Theory, D. B. West, 3rd Edition, Prentice-Hall, Englewood Cliffs, NJ, 2015.

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

Numerical Analysis & Optimization

Course code	**Course Name**	**Course Category**	**L-T-P**	**Credits**
22MAXX08	**Numerical Analysis & Optimization**	**BSC**	**3-1-0**	**4**

Unit-1 :Interpolation: **(10 Contact hours)**

Finite Differences, Difference table, Divided Difference, Newton'sGregory forward & Backward Interpolation, Gauss forward & backward difference formula, Stirling's formula, Bessel's formula, Interpolation with unequal interval, Lagrange's interpolation, Newton's Divided Difference formula

Unit-2 Numerical Integration & Differentiation: (10 Contact hours)

Numerical differentiation, Formula for Derivative, Maxima & Minima of tabulated function, Newton Cote's Quadrature formula, Trapezoidal rule, Simpsons 1/3 & 3/8 rule, Weddle's rule.

Unit 3 Solution of Algebraic & Transcendental Equation: (8 Contact hours)

Bisection Method, Iteration Method, Regula Falsi Method, Newton Raphson Method, Errors & Convergence.

Unit-4 Solution of Differential Equation: (10 Contact hours)

Picard's Method, Euler's Method, Euler's Modified Method, Taylor's Method, Runga Kutta Method, Predictor Corrector Methods.

Unit-5 Optimization: (10 Contact hours)

The Linear Programming problem, Problem formulation, Linear programming in matrix notation, Graphical solution of linear programming problem.

Unit-6: (12 Contact hours)

Some Basic properties of convex sets, convex functions & concave functions, Theory & application of the simplex method of solution of a linear programming problem.

Text Books:

1. C.E. Froberg, Introduction to Numerical Analysis, Addison-Wesley

Reference:

1. James B. Scarborough, Numerical Mathematical Analysis, Oxford & IBH Publishing Co. Pvt. Ltd.
2. Melvin J. Maron, Numerical Analysis A Practical Approach, Macmillan Publishing Co. Inc. New York
3. M.K.Jain, S.R.K.Iyengar, R.K.Jain, Numerical Methods Problems & Solutions, New Age International Ltd.
4. M.K.Jain, S.R.K.Iyengar, R.K.Jain, Numerical Methods for Scientific & Engineering Computation, New Age International Ltd.
5. Kanti Swaroop, P.K.Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi

Assessment Method for Theory courses only

Course Nature	Theory			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

PARTIAL DIFFERENTIAL EQUATIONS

Course code	Course Name	Course Category	L-T-P	Credits
22MAXX09	Partial Differential Equations	BSC	3-1-0	4

Course Contents:

Unit 1: **(6 Contact hours)**

Review of power series solution of ODE, Frobenius series, Bessel functions and Legendre polynomials.

Unit-2:

First Order PDE and Method of Characteristics **(6 Contact hours)**

Introduction to partial differential equations, linear and quasi-linear equations of first order. Classification of integrals. Lagrange's Method of solution and its geometrical interpretation, compatibility condition.

Unit-3:

Non Linear First Order PDE: **(8 Contact hours)**

Charpit's method, special types of first order equations,Canonical form of first order PDE, Method of separation of variables for first order PDE.

Unit4 : Mathematical Models and Classification of 2nd Order Linear PDE

(12Contact hours)

Gravitational potential, Conservation laws and Burger's equations, Classification of second order PDE, Reduction to canonical forms, Equations with constant coefficients, General solution.

Unit 5: The Cauchy Problem and Wave Equations (14 Contact hours)

Mathematical modeling of vibrating string, vibrating membrane. Cauchy problem for second order PDE, Homogeneous wave equation, Initial boundary value problems, Non-homogeneous boundary conditions, Finite strings with fixed ends, Non-homogeneous wave equation, Goursat problem.

Unit 6: Method of Separation of Variables (14Contact hours)

Method of separation of variables for second order PDE, Vibrating string problem, Existence and uniqueness of solution of vibrating string problem, Heat conduction problem, Existence and uniqueness of solution of heat conduction problem, Non-homogeneous problem.

Text Books:

1. E. Kreyszig Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons (1999)

2. Ian N. Sneddon, Elements of Partial Differential Equations, Dover publication (2006)

References:

1. Myint-U, Tyn & Debnath, Lokenath. (2007). Linear Partial Differential Equation for Scientists and Engineers (4th ed.). Springer, Third Indian Reprint, 2013.

2. Stavroulakis, Ioannis P & Tersian, Stepan A. (2004). Partial Differential Equations: An Introduction with Mathematica and MAPLE (2nd ed.). World Scientific.

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

TRANSFORM CALCULUS

Course code	Course Name	Course Category	L-T-P	Credits
MAXX10	Transform Calculus	BSC	3-1-0	4

Detailed syllabus:

UNIT-I

Laplace Transform: **(10 contact hours)**

Definition of Laplace Transform, linearity property, conditions for existence of Laplace Transform. First and second shifting properties, Laplace Transform of derivatives and integrals, unit step functions, Dirac delta-function, error function.

UNIT-II

Application of Laplace transforms: **(10 contact hours)**

Differentiation and integration of transforms, convolution theorem, inversion, periodic functions. Evaluation of integrals by Laplace Transform. Solution of Ordinary differential Equations.

UNIT-III

Fourier Series: **(12 contact hours)**

Periodic functions, Fourier series representation of a function, Fourier series for Even and Odd functions, half range sine and cosine series, Fourier integral Theorem, Parseval's identity.

UNIT-IV

Fourier Transform: **(10 contact hours)**

Fourier Transform, Fourier sine and cosine transforms. Linearity, scaling, frequency shifting and time shifting properties. Self reciprocity of Fourier Transform, convolution theorem.

UNIT-V

Boundary Value Problems: **(8 contact hours)**

Relation between Fourier and Laplace Transforms, Solutions of boundary value problems by Fourier Transforms.

Unit – VI

Partial Differential Equations: (10 contact hours)

Introduction to partial differential equations, Formation of PDE, Lagrange's equation, Pp+Qq=R form, Variable separable method, solutions of one-dimensional heat and wave equations, Solutions of Partial Differential equations by Laplace Transforms.

Text Books:

1. Jain. R.K. Iyengar. S.R.K., Advanced Engineering Mathematics, 3rd Edition, Narosa.

2. Churchill. R.V. Brown. J.W., Fourier series and boundary value problems, Mc Graw. Hill.

Reference Books:

1. E. Kreyszig Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons (1999)

2. H.Dym and H.P Mc Kean, Fourier series and integrals, Academic press, Newyork (1972)

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

Probability and Statistics

Course code	**Course Name**	**Course Category**	**L-T-P**	**Credits**
22MAXX11	**Probability and Statistics**	**BSC**	**3-1-0**	**4**

Course Learning Objectives:

1. Providing students with a formal treatment of probability theory.
2. Equipping students with essential tools for statistical analysis.
3. Fostering understanding through real-world statistical applications.
4. Develop skills in presenting quantitative data using appropriate diagrams, tabulations.
5. Use appropriate statistical methods in the analysis of simple datasets.
6. Instill the belief that Statistics is important for scientific research.

Course Content:

Unit – I

Probability and theorems in Probability (8 Contact hours)

Probability introduction through Sets and Relative Frequency, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem and Independent Events.

Unit – II

Probability Distributions: (10 Contact hours)

Discrete distributions: Bernoulli, Binomial, Poisson, Negative Binomial, Geometric and hyper geometric distributions (Find their mean, variance and problems). Continuous distributions: Uniform, Exponential, Normal, Beta and Gamma distributions.

Unit – III

Moment Generating functions (10 Contact hours)

Functions of Random Variables, Correlation coefficient and Bivariate Normal Distribution. Probability Inequalities and Generating Functions, Moment Generating Function, Characteristic Function, Cumulant Generating Function, Probability Generating Function.

Unit – IV

Order Statistics and Central Limit theorem (08 Contact hours)

Order Statistics, Convergence of Sequence of Random Variables, Weak Law of Large Numbers, Strong Law of Large Numbers, Central Limit Theorem.

Unit - V

Sampling Theory: (12 Contact hours)

Definition of population, sampling, statistics and parameters. Types of sampling, Expected values of sample mean and variance, sampling distribution, standard error, sampling distribution of mean and sampling distribution of variance. Sampling -Distributions (t, F and Chi-square), confidence interval and interval estimation.

Unit – VI

Large Sample Tests: (12 Contact hours)

Definition of Null and alternative hypothesis, critical region. Type I and Type II errors, power of the test, one tail, two tail tests, Tests for the single mean, two means, single proportion and two proportions using Z-test and t-test, t-test and F-test for significance of difference variance.

Learning resources

Text book:

1 William W. Hines and Douglas C. Montgomery, '*Probability and Statistics in Engineering'*, Willy Publications, 4th Edition.

Reference Books:

1. Sheldon Ross, '*A First Course in Probability'*, Pearson Publications, 9th Edition.

2. Athanasios Papoulis and S. Unnikrishna Pillai, '*Probability, Random Variables and Stochastic Processes'*, TMH, 4th Edition,.

Web resources:

1. https://nptel.ac.in/courses/117105085/
2. https://nptel.ac.in/courses/111106112/
3. https://nptel.ac.in/courses/111102111/
4. RGUKT Course Content

Course outcomes: At the end of the course, the student will be able to

CO 1	Apply Probability theory via Bayes Rule.
CO 2	Describe the properties of Discrete and Continuous distributions.
CO 3	Apply problem-solving techniques to solving real-world events.
CO 4	Apply selected probability distributions to solve problems.
CO 5	Develop problem-solving techniques needed to accurately calculate probabilities.
CO 6	Interpret and clearly present output from statistical analysis.

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

Probability and Stochastic Process

Course Learning Objectives:

1. To provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in signal processing and Communication Engineering
2. To introduce students to the basic methodology of "probabilistic thinking" and to apply it to problems.
3. To understand basic concepts of probability theory and random variables, how to deal with multiple random variables, Conditional probability and conditional expectation, joint distribution and independence, mean square estimation.
4 To understand the difference between time averages and statistical averages.

5. Analysis of random process and application to the signal processing in the communication system.
6. To teach students Ergodic Processes, Gaussian Random Processes.

Course Content:

Unit – I:

Probabilty and Theorems in Probability (08 Contact hours)

Permutations and Combinations, Probability introduction through Sets and Relative Frequency, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem and Independent Events.

Unit – II:

Random Varibles (12 Contact hours)

Definition of random variable, Expectation of a random variable and its properties. Variance of a random variable and its properties. Bi-Variate random variable, Discrete distributions: Continuous distributions: Uniform, Exponential, Normal, Beta and Gamma distributions. Covariance, Correlation coefficient (Karl Pearson), Functions of Random variables**.**

Unit –III

Probability Generating Functions (10 Contact hours)

Markov's inequality, Chebyshev's inequality and Cauchy-Schwartz's inequality (with proofs). Generating functions: Moment generating function (M.G.F) and its properties, characteristic functions (C.F) and its properties, Cumulant generating function (C.G.F) and its properties, probability generating function (P.G.F) and its properties.

Unit – IV

Sequence of Random Variables (08 Contact hours)

Order statistics, Sequence of Random Variables, Convergence of a Sequence of Random Variables, Convergence Theorems: WLLN (weak law of large numbers), SLLN (strong law of large numbers) and Central limit theorem.

Unit-V

Stochastic Process-I: **(12 Contact hours)**

Independent Random Variables N- Functions of M-Random Variables and their Distribution Functions Sequence of Random Variables, (Convergence of a Sequence of Random Variables, Convergence Theorems Stochastic Processes and their Characterization).

Unit-VI

Stochastic Process-II: **(10 Contact hours)**

Mean, Auto Correlation Function, Auto Covariance Function, Strictly Stationary, Wide Sense Stationary and Ergodic Processes, Gaussian Random Processes

.Learning resources

Text book:

1. Peyton Z. Peebles,'*Probability, Random Variables & Random Signal Principles'*,TMH, 4Edition, 2001.

Reference Books:

1. George R. Cooper, Clave D. MC Gillem, '*Probability Methods of Signal and System Analysis',* Oxford,3 Edition,1999 .

2. S.P. Eugene Xavier, '*Statistical Theory of Communication'*, New Age Publications, 1997.

3. Athanasios Papoulis and S. Unnikrishna Pillai', *Probability, Random Variables and Stochastic Processes*', TMH, 4th Edition,.

Web resources:

1. https://nptel.ac.in/courses/117105085/
2. https://nptel.ac.in/courses/111106112/
3. https://nptel.ac.in/courses/111102111/
4. RGUKT Course Content

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

INTEGRAL TRANSFORMS AND THEIR APPLICATIONS

Course code	Course Name	Course Category	L-T-P	Credits
22MAXX13	Integral Transforms and their applications	BSC	3-1-0	4

Course Learning Objectives: The objective of this course is to

1. Discuss the properties of Laplace transforms and also Laplace transforms of Special functions.
2. Discuss the Applications Laplace transforms.
3. Discuss the properties of Fourier transforms
4. Discuss the Applications Fourier transforms and also joint Fourier-Laplace transform
5. Discuss the properties of Henkel transforms, Mellin Transforms, Generalized Mellin transforms with applications.
6. Discuss Z-transforms, Hilbert Transforms, Stieltjes Transform, Radon transforms.

Course Content:

UNIT-I

Laplace Transform: (10 contact hours)

Definition of Laplace Transform, linearity property, conditions for existence of Laplace Transform. First and second shifting properties, Laplace Transform of derivatives and integrals, unit step functions, Dirac delta-function, error function.

UNIT-II

Application of Laplace transforms: (10 contact hours)

Differentiation and integration of transforms, convolution theorem, inversion, periodic functions. Evaluation of integrals by Laplace Transform. Solution of Ordinary differential Equations.

UNIT-III

Fourier Transform: (10 contact hours)

Fourier Transform, Fourier sine and cosine transforms. Linearity, scaling, frequency shifting and time shifting properties. Self reciprocity of Fourier Transform, convolution theorem.

UNIT-IV:

Applications of Fourier Transform (10 contact hours)

Applications of Fourier Transforms to solutions of ODEs, PDEs and Integral Equations, Applications of joint Fourier-Laplace transform.

UNIT-V:

Henkel and Mellin Transforms (10 contact hours)

Hankel Transforms: Introduction, properties and applications to PDE, Mellin transforms: Introduction, Properties, Applications; Generalized Mellin transforms

Unit – VI:

Z-Transforms (10 contact hours)

Hilbert Transforms ,Stieltjes Transform , Z - Transforms ,Radon transforms with examples.

Learning resources

Text book:

1. ERWIN KREYSZIG**, '***Advanced Engineering Mathematics',* Wiley-India, 9th Edition.

Reference Books:

1. M.K. Jain., '*Numerical solutions of differential equations',* Wiley Eastern, 1984, 2nd Edition.

2.M.K Jain, S.R.K Iyengar, R.K Jain., '*computational methods for PDE*,' Wiley Eastern 1994.

3.S.D. Conte &Carl de Boor., '*Elementary Numerical analysis an algorithmic approach'*, McGraw Hill, Newyork, 1980, 3rdEdition.

4.E. Ward Cheney**,** David R. Kindcaid.,' *Numerical methods and applications'*, Brooks / Cole, 2008.

5.Butcher, J.C, '*Numerical methods for ordinary differential equations'*, Wi- ley, Newyork, 2003.

Web resources:

1. https://nptel.ac.in/courses/111/102/111102129/
2. RGUKT content.

Assessment Method for Theory courses only

Course Nature		Theory		
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

ESSENTIAL MATHEMATICS FOR MACHINE LEARNING

Course code	Course Name	Course Category	L-T-P	Credits
22MAXX14	Essential Mathematics For Machine Learning	BSC	3-1-0	4

COURSE OUTLINE : Machine learning (ML) is one of the most popular topics of nowadays research. This particular topic is having applications in all the areas of engineering and sciences. Various tools of machine learning are having a rich mathematical theory. Therefore, in order to develop new algorithms of machine/deep learning, it is necessary to have knowledge of all such mathematical concepts. In this course, we will introduce these basic mathematical concepts related to the machine/deep learning. In particular, we will focus on topics from matrix algebra, calculus, optimization, and probability theory those are having strong linkage with machine learning. Applications of these topics will be introduced in ML with help of some real-life examples.

SYLLUBUS:

UNIT-1:

Vector Spaces **(10 Contact hours)**

Linear Independence and dependence of vectors, Basis, Vector Space and Subspaces,Linear Maps, Matrix Representation .

UNIT-2:

Eigenvalues and Eigenvectors **(10 Contact hours)**

Eigenvalues and Eigenvectors, Least Square approximation, Minimum normed solution, Singular Value Decomposition, Dimensionality Reduction Algorithms

UNIT- 3:

Manifolds **(10 Contact hours)**

Manifold Learning algorithms, Computations with Large and Sparse Matrices in Machine Learning

UNIT- 4:

Calculus in Matrices: **(10 Contact hours)**

Gradients, Jacobian, Hessian Matrix, Conditions for extremum, Convexity Numerical Optimization in Machine Learning, Gradient Descent and other optimization algorithms in machine learning.

UNIT-5:

Mathematical Optimization **(10 Contact hours)**

Lagrangian Multiplier method, dual problems and other mathematical Optimization related topics in Support Vector Machines and other Linear Classifiers

UNIT-6:

Introduction to Probability **(10 Contact hours)**

Conditional probability, chain rule, Bayes theorem, Random Variables and introduction to distributions

Text Books:

1. J. Nocedal and S. J. Wright, Numerical Optimization. New York: Springer Science+Business Media, 2006.

References:

1. W. Cheney, Analysis for Applied Mathematics. New York: Springer Science+Business Medias, 2001.

2. S. Axler, Linear Algebra Done Right (Third Edition). Springer International Publishing, 2015.

3. J. S. Rosenthal, A First Look at Rigorous Probability Theory (Second Edition). Singapore: World Scientific Publishing, 2006.

Web resources:
https://nptel.ac.in/courses/111/107/111107137/#

Assessment Method for Theory courses only

Course Nature	Theory			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

INTRODUCTION TO R SOFTWARE

Course code	Course Name	Course Category	L-T-P	Credits
22MAXX15	Introduction To R Software	BSC	3-1-0	4

COURSE OUTLINE: Any scientific task without the knowledge of software is difficult to imagine and complete in the current scenario. R is a free software that is capable of handling mathematical and statistical manipulations. It has its own programming language as well as built in functions to perform any specialized task. We intend to learn the basics of R software in this course.

Syllabus:

Unit-1:

Basic Essentials in R (10 Contact hours)

Basic fundamentals, installation and use of software, data editing, use of R as a calculator, functions and assignments.

Unit-2:

Functions and Matrices (10 Contact hours)

Use of R as a calculator, functions and matrix operations, missing data and logical operators.

Unit-3:

Loops and Sequences (10 Contact hours)

Conditional executions and loops, data management with sequences, Data management with repeats, sorting, ordering, and lists.

Unit-4:

Vectors and Strings **(10 Contact hours)**

Vector indexing, factors, Data management with strings, display and formatting, Data management with display paste, split, nd and replacement, manipulations with alphabets, evaluation of strings, data frames.

Unit-5:

Data Frames **(10 Contact hours)**

Data frames, import of external data in various le formats, statistical functions, compilation of data.

Unit-6:

Graphics and plots **(10 Contact hours)**

Graphics and plots, statistical functions for central tendency, variation, skewness and kurtosis, handling of bivarite data through graphics, correlations, programming and illustration with examples.

Text Books:

1. Introduction to Statistics and Data Analysis - With Exercises, Solutions and Applications in R By Christian Heumann, Michael Schomaker and Shalabh, Springer, 2016
2. The R Software-Fundamentals of Programming and Statistical Analysis - Pierre Lafaye de Micheaux, Rémy Drouilhet, Benoit Liquet, Springer 2013
3. A Beginner's Guide to R (Use R) By Alain F. Zuur, Elena N. Ieno, Erik H.W.G. Meesters, Springer 2009

Online Source:

https://nptel.ac.in/courses/111/104/111104100/

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

16. Numerical Methods for Engineers

Course code	Course Name	Course Category	L-T-P	Credits
22MA XX16	Numerical Methods for Engineers	BSC	3-1-0	4

Course Learning Objectives:

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

Course Content:

UNIT-I: (10 Contact hours)

Introduction to Numerical Methods in Engineering: Importance of numerical methods in engineering - sources of errors in numerical methods - number representations - fixed- and floating-point numbers - significant digits - round off errors

UNIT-II: (10 Contact hours)

Solution of Equations and Eigenvalue Problems: Solution of algebraic and transcendental equations – Newton Raphson method – Solution of linear system of equations – Gauss elimination method –-Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT-III: (10 Contact hours)

Interpolation and Approximation: Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines – Difference operators and relations – Interpolation with equal intervals – Newton's forward and backward difference formulae.

UNIT-IV: (10 Contact hours)

Numerical Differentiation and Integration: Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method – Two point and three-point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT V: (10 Contact hours)

Initial Value Problems for Ordinary Differential Equations: Single step methods – Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge – Kutta method for solving first order equations – Multi step methods – Milne's and Adams – Bash forth predictor corrector methods for solving first order equations.

UNITVI: (10 Contact hours)

Boundary Value Problems in Ordinary and Partial Differential Equations: Finite difference methods for solving second order two – point linear boundary value problems -Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

Learning Resources:

Text Books:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

Reference Books:

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, NewDelhi, 2007.
2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6thEdition, New Delhi, 2006.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition,Prentice Hall, 1992.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition,2015.

Web Resources:

1. IIT Kharagpur, '*Lecture series on Numerical Methods in Civil Engineering'*.

URL: https://nptel.ac.in/courses/105/105/105105043/

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

17.Computational Mathematics with Python

Credits:4	**Total Hours:60**

Unit-I: INTRODUCTION TO PYTHON PROGRAMMING (8 hours)

Introduction of Python, Installing Python IDES – Python IDLE and Anaconda, Data-types in Python, Variables in Python – Declaration and Use, Typecasting in Python, Operators in Python – Assignment, Logical, Arithmetic etc, Taking User Input (Console), Conditional Statements – If else and Nested If else and elif, Python Collections (Arrays) – List, Tuple, Sets and Dictionary, Loops in Python – For Loop, While Loop & Nested Loops String Manipulation – Basic Operations, Slicing & Functions and Methods, User Defined Functions – Defining, Calling, Types of Functions, Arguments, Importing Modules-Math Module, Object-Oriented Programming in Python

Unit-II: NUMERICAL METHODS WITH PYTHON (8 hours)

Solutions to Systems of Linear Equations, Eigen values and Eigenvectors, Least Squares Regression Interpolation, Taylor Series, Root Finding, Numerical Differentiation, Numerical Integration, Ordinary Differential Equations (ODEs) Initial-Value Problems, Boundary-Value Problems for Ordinary Differential Equations (ODEs), Fourier Transform.

Unit-III: AUTOMATIC DIFFERENTIATION (10 hours)

Single variable functions, Multi variable functions-Gradient, Jacobian, Solving Differential equations, Solving 2-dimensional Laplace equation in a rectangle strip.

Unit-IV: RECURSION (12 Hours)

Recursion, Dynamic Programming-1D DP,2D DP, 3D DP, Memoization, top-down, bottom-up(Tabulation)

Unit-V: TREES (10 Hours)

Traversals-preorder, postorder, inorder, level order , Introduction to BST

Unit-VI: PUZZLE SOLVING WITH AID OF GRAPH THEORY THROUGH PYTHON

(12 Hours)

DFS, BFS, Detecting cycles, Topological sort, Bipartite graph, Bridges

Text Books:

1. *Michael Dawson "* **Python Programming for the Absolute Beginner**", 3rd Edition
2. *Mark Lutz* ."**Learning Python**", 5th Edition

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%

Computational Mathematics with Python

Credits:3	**Total Hours:45**

Unit-I: OBJECT ORIENTED PROGRAMMING IN PYTHON (4 Hours)
Basics of Object Oriented Programming, Creating Class and Object, Constructors in Python Parameterized and Non-parameterized, Inheritance in Python, In built class methods and attributes Multi-Level and Multiple Inheritance, Method Overriding and Data Abstraction, Encapsulation and Polymorphism

Unit-II: NUMERICAL METHODS WITH PYTHON (6 Hours)
Solutions to Systems of Linear Equations, Eigen values and Eigenvectors, Least Squares Regression, Root Finding, Numerical Differentiation, Numerical Integration, Ordinary Differential Equations (ODEs) Initial-Value Problems, Boundary-Value Problems for Ordinary Differential Equations (ODEs), Fourier Transform

Unit-III: AUTOMATIC DIFFERENTIATION (6 Hours)

Single variable functions, Multi variable functions-Gradient, Jacobian, Solving Differential equations,.

Unit-IV: RECURSION (10 Hours)

Recursion, Dynamic Programming-1D DP,2D DP, Memoization, top-down, bottom-up(Tabulation)

Unit-V: TREES (10 Hours)

Traversals-preorder, postorder, inorder, level order , Introduction to BST

Unit-VI: PUZZLE SOLVING WITH AID OF GRAPH THEORY THROUGH PYTHON

(9 Hours)

DFS, BFS, Detecting cycles, Topological sort, Bipartite graph, Bridges

Text Books:

1. *Michael Dawson "* **Python Programming for the Absolute Beginner**", 3rd Edition
2. *Mark Lutz* ."**Learning Python**", 5th Edition

Assessment Method for Theory courses only

Course Nature	**Theory**			
Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%