Veer Surendra Sai University of Technology, Burla, Odisha

B. Tech Course Structure

Department of Mathematics

1st Year

First Semester				Second Semester			
Course Code	Subject	L-T-P	CR	Course Code	Subject	L-T-P	CR
UBS19	Mathematics- I (Calculus and Linear Algebra)	3-1-0	4	UBS19	Mathematics-II(Differential Equations and Complex Variables	3-1-0	4

2nd Year

Third Semester				Fourth Semester			
Course Code	Subject	L-T-P	CR	Course Code	Subject	L-T-P	CR
UBS19	Mathematics-III (Transforms, Probability & Statistics and Multivariate Analysis)	3-1-0	4	UBS19	Mathematics-IV (Numerical Methods/ Discrete Mathematics)	3-1-0	4

VISION

To develop research and application of Mathematics to enable students to deliver services to the society and improve the standard of life by training them.

MISSION

- To transform young people to competent and motivated professionals.
- To produce students with strong foundation to join research or serve in academics.
- To cater to the development of Nation for research and training.

Programme Educational Objectives (PEO)

- P1: VSSUT Department of Mathematics provides a post graduate course and Mathematics at B.Tech level suitable for students of high ability, combining and relating mathematics, science and technology.
- P2: VSSUT Department of Mathematics prepares students for further study, and research particularly in areas requiring the applications of mathematics.
- P3: VSSUT Department of Mathematics provides students with knowledge of mathematics, its research potential and the interaction between them.

Programme Outcomes (PO)

The Program Outcomes of Mathematics at B.Tech level are:

At the end of the programme, the students will be able to:

- Apply knowledge of Mathematics in different fields of science and technology.
- To formulate and develop mathematical arguments.
- To acquire knowledge and understanding in advanced areas of mathematics, chosen by the student from the courses.
- Understand, formulate and use mathematical models arising in science, technology and other areas.

DETAILS SYLLABI

B. Tech.: Mathematics-I (Calculusand Linear Algebra) [3-1-0]

Module 1: Calculus (8 Lectures)

Rolle's theorem, Mean value theorems(statements only) and applications. Introduction to improper integrals. Beta and Gamma functions and their properties.

Module 2: Calculus (8 Lectures)

Convergenceof sequence and series, tests of convergence.Fourier series, arbitrary period, even and odd function, half range series.

Module3: Calculus (8 Lectures)

Limit,continuity and partial derivatives (two variables), maxima and minima. Vector and scalar point functions and fields, gradient of a scalar field, directional derivative, divergence of a vector field, curl of a vector field and applications

Module 4:* Linear Algebra*(8 Lectures)

Linear systems of equations, Gauss elimination, linear independence, rank of a matrix, Gauss-Jordan elimination. Vector Space; basis and dimension'

Module 5:* Linear Algebra*(8 Lectures)

Eigenvalues, eigenvectors, some applications of eigenvalue problems, symmetric, skew-symmetric and orthogonal matrices, diagonalization, quadratic forms, complex matrices and forms.

Text Book:

1) Erwin Kreyszig, Advanced Engineering Mathematics (9^{th} Edition), Wiley India Pvt. Ltd
2) S.C. Malik and S. Arora, Mathematical Analysis, New Age International

Reference Books:

1) George B. Thomas, Jr. and Ross L. Finney, Calculus and Analytic Geometry, Addison Wesley Publishing Company
2) B.V. Ramana, Higher Engineering Mathematics, McGraw Hill
3) A. Stroud, Advanced Engineering Mathematics, Industrial Press
4) S.K. Paikray,Text book of Matrix Algebra, Kalyani Publisher

COURSE OUTCOMES:

CO1:To acquire basic knowledge ofdifferential calculus and improper integral,and have a basic understandingof Beta and Gamma functions useful in various fields

CO2: To develop a tool of Fourier series understanding the periodic phenomenon for learning advanced Engineering mathematics.

CO3: To deal with functions of several variables that is essential in most of the branches of engineering.

CO4: To understandGausselimination method and rank of a matrix in solvinglinear equations.

CO5: To experience the knowledgeof eigenvalues and eigenvectorsin a comprehensive manner.

Mathematics-II (Differential Equations andComplex Variables) [3-1-0]

Module 1: **Differential Equations*(8 Lectures)***

Exact ODEs, integrating factors, linear ODEs, Bernoulli equation, homogeneous linear odes of second order, homogeneous linear ODEs with constant coefficients, Euler-Cauchy equations,non-homogeneous ODEs, Applications Of ODEs to electric circuits

Module 2: **Power Series Solution of Differential Equations*(8 Lectures)***

Series solution of differential equation (excluding Frobenius method), Legendre'sequation, Legendre polynomials. Bessel's Equation, properties of Bessel's functions, Bessel Functions of the first and Second Kind.

Module 3: **Complex Variables** ***(8 Lectures)***

Complex valued function, differentiation, analytic function, Cauchy-Riemann equations, harmonic and conjugate harmonic functions, exponential function, trigonometric and hyperbolic functions, logarithm, general power

Module 4: **Complex Variables** ***(8 Lectures)***

Lineintegral in the complex plane,Cauchy's integral theorem, cauchy's integral formula, power series, radius of convergence, Taylor and Maclaurin series, singularities and zeros, Laurent series, Cauchy residue theorem(statement only) and applications.

Module 5: **Elementary Numerical Methods*(8 Lectures)***

Solution of algebraic and transcedental equations by Newton-Raphson and secant method.
Interpolation: Lagrange's method, divided difference method, Newton's forward and backward method. Numerical Integration: Trapezoidal and Simpson's Rule. Numerical solutions of differential equations: Euler's method and improved Euler's method.

Text Book:

1) Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd, 9th edition.

Reference Books:

1) K.A. Stroud, Advanced Engineering Mathematics, Industrial Press
2) Milton Abramowitz and Irene A. Stegun, *Handbook of Mathematical Functions*, National Bureau of Standards, Applied Mathematics Series - 55
3) J. Sinha Roy and S. Padhy, Ordinary and Partial Differential Equation, Kalyani Publisher.
4) B.V. Ramana, Higher Engineering Mathematics, McGraw Hill

COURSE OUTCOMES:

CO1:To gain adequate knowledge of the effective mathematical tools for the solutions of differential equations thatmodelsvarious physical processes.
CO2: To understand the basic knowledge ofpower series solution of differential equations.
CO3: To learnfundamental idea of analytic functions and applications ofCauchy-Riemann equations.
CO4: To apply the tools of integration of complex valued functions, and able to get Taylor and Laurent series expansions of functions that isuseful in various fields of engineering problems.
CO5: To learn the techniques of extract of roots of algebraic and transcendental equations, and also able to evaluate the integrals by Trapezoidal and Simson's rules.

Mathematics-III (Transforms,Probability and Statistics and Multi variate Analysis) [3-1-0]

Module 1:*LaplaceTransforms *(10 Lectures)
Laplace transforms, inverse transforms, linearity, shifting, transforms of derivatives and integrals, solution of ODEs, unit step function, Dirac's delta function, differentiation and integration of transforms, convolution, integral equations.

Module 2:* Fourier Transforms*(8 Lectures)
Basic concept of Fourier integral, Fourier sine and cosine integral, condition of convergence, Fourier transformation, Fourier sine transform, Fourier cosine transform, properties.

Module 3:*Probability *(6 Lectures)
Random variables, probability distributions, mean and variance, Binomial, Poisson and hyper-geometric distributions, Normal distribution.

Module 4:* Statistics*(8 Lectures)
Random sampling, point estimation of parameters, maximum likelihood estimation, confidence intervals, testing of hypotheses for mean and variance, correlation and regression.

Module 5:* Multi-variate Analysis*(8 Lectures)
Line integrals, double integrals, change of order, Green's theorem(statements only), surface integrals, triple integrals, Divergence theorem of Gauss(statements only), Stoke's theorem(statements only) and applications.

Text Book:
Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd, 9^{th} edition

Reference Books:
1) B.V. Ramana, Higher Engineering Mathematics, McGraw Hill
2) K.A. Stroud, Advanced Engineering Mathematics, Industrial Press

COURSE OUTCOMES:

CO1:To acquire basic knowledge of Laplaceand Fourier transforms, and ableto solve differential equations by using Laplace transforms.

CO2: To developknowledge of different methods of proofs forlearning advanced Engineering Mathematics.

CO3:To apply Binomial, Poisson and Normal distributions in probabilistic models.

CO4: To get adequate knowledge of randomsampling and estimation of parameters.

CO5: Toexperience the mathematical tools useful in evaluating multiple integrals and applications.

MathematicsIV- Discrete Mathematics (Only for CSE & IT)4 Credits [3-1-0]

Module I:*Propositional Logic and Counting*(8 Lectures)
Logic:Propositional equivalence, predicates and quantifiers, methods of proofs, proof strategy, mathematical induction, strong induction
Counting: The basics of counting, the pigeonhole principle, principle of inclusion and exclusion and its applications

Module II:* Relations and Recurrence relations*(8 Lectures)
Relations: Relations and their properties, *n*-array relations and their applications, representing relations, closure of relations, equivalence of relations,partial orderings.
recurrence relations, solving homogeneous and non-homogeneous recurrence relations, generating functions.

Module III:* Graph theory*(8 Lectures)

Graph theory: Introduction to graphs, graph terminology, representinggraphs and graph isomorphism, connectivity, Euler and Hamilton paths, planar graphs, graph coloring,

Module IV:* Algebraic Structure and Group theory *(8 Lectures)
Group theory: Algebraic Structure, groups, subgroups, generators and evaluation of powers, cosets and Lagrange's theorem, group homomorphism, isomorphism, automorphism, normal subgroups.

Module V:* Lattices and Boolean Algebra *(8 Lectures)
Lattice theory: Lattices and algebraic systems, principles of duality, basicproperties of algebraic systems defined by lattices, distributive and complimented lattices, Boolean lattices and Boolean algebras, uniqueness of finite Boolean expressions

Text Books:

1) *K.H. Rosen: Discrete Mathematics and its application, 5th edition, Tata McGraw Hill.*
2) *C.L. Liu, D. P. Mohapatra, Elements of Discrete Mathematics, Tata McGraw-Hill Publishing*

COURSE OUTCOME
CO1: To apply recursive definitions and structural induction.
CO2: To familiar with equivalence of relations, recurrence relations and generating functions
CO3: To use Euler and Hamilton paths, Planar graphs, Graph coloring.
CO4: To introduce Group structure, homomorphism, isomorphism and automorphism,
CO5: To introduceLattice theory and Boolean algebras

MATHEMATICS-IV (Numerical Methods) 4 Credits [3-1-0]

Module I: **Errors and Root Extraction** ***(8 Lectures)***
Definition and sources of error, Propagation of errors, finding roots of algebraic and transcendental equations by Bisection method, Newton's method, Secant method, fixed point iteration method.

Module I: **Interpolation*****(8 Lectures)***
Interpolation, Lagrange's interpolation, Newton's divided differences, Forward differences, Backward differences, Central differences, Interpolation error.

Module I: **Numerical integration** ***(8 Lectures)***
Numerical integration: Newton-Cotes Integration formula (without derivation), Trapezoidal rule, Simpson's rule, Gaussian quadrature, Errors in Numerical Integration.

Module I: **Numerical Solution of Differentianal Equations** ***(8 Lectures)***
Solution of ODE's: Euler's method, Improved Euler's method, Runge-Kutta Methods of order-2 and 4.

Module I: **Numerical Solution of system of linear equations*****(8 Lectures)***
Numerical Solution of system of linear equations, Gauss Elimination method, LU decomposition, Gauss-Jordan Elimination method, Gauss Jacobi and Gauss-seidal iteration methods

Text Books:

1. An introduction to numerical analysis, Jain, Iyengar and Jain, New Age International
2. Numerical Analysis, B. S. Grewal, Khanna Publishers

Course Outcomes:

Students will be able to:

CO 1: find the roots of algebraic and transcendental equations
CO 2: compute an interpolating polynomial for a given set of data
CO 3: apply numerical integration methods for computing definite integrals
CO 4: solve ordinary differential equations (IVP) by using numerical methods
CO 5: find approximate solutions for system of linear equations

B. Arch (1st Semester): Applied Mathematics [3-1-0]

Module I: Geometry and Measurements ***(8 Lectures)***

Proportion, golden ratio, Euclidean geometry: methods to calculate areas of various regular geometrical shapes, surface areas of solids and volumes (cube, sphere, cone, cylinder)

Module 2: Numerical Methods***(8 Lectures)***

Finding roots of equations: Bisection method, Newton's method, Secant method.

Numerical integration: Newton-Cotes Integration formula (without derivation), Trapezoidal rule, Simpson's rule, Gaussian quadrature

Module 3: Calculus & Applications ***(8 Lectures)***

Calculus of one variable: Maxima and Minima for a function of one variable, Rolle's theorem, mean value theorem (statement only), Fundamental theorem of calculus, Calculation of areas using integrals: Area bounded by curve, Arc length of curve.

Module 4: Matrices & Basics of Linear Programming***(8 Lectures)***

Elementary rows & column transformation, Gauss elimination & solution of System of equations, Inverse matrix.

Formulation of Linear Programming, Graphical solution, Simplex method.

Module 5: Statistics***(8 Lectures)***

Measures of central tendency, Mean/ Median mode, measures of dispersion (Mean derivation/ Standard Derivation, Variance), Co-relation and Regression.

Course Outcomes:

Students will be able to:

CO 1: acquire basic mathematical techniques required to support architectural and engineering concepts, and in particular get adequate knowledge of finding areas and volumes of various regular geometrical shapes
CO 2: find the roots of algebraic and transcendental equations
CO 3: gain basic knowledge of calculus of one variable, and also able to find areas bounded by the using integrals
CO 4: understand Gauss elimination method and rank of a matrix in solving linear equations
CO 5: learn the central tendency and measures of dispersion of a given sample

Reference Books:

1. Grewal B.S., Higher Engineering Mathematics, 35th edition, Khanna Publishers.
2. Kapoor, V. K. and Gupta, S. C., Fundamentals of Mathematical Statistics, Sultan & Sons
3. Kalavathy, S., Operations Research, Vikas Publishing House Pvt. Ltd., 2009
4. Boucher, J. S., Mensuration, Plane and Solid, Longman, Brown, Green, Longmans and Robert, London.
5. K.H. Rosen: Discrete Mathematics and its application, 5th edition, Tata McGraw Hill.