Course Outline for Semester VI (Batch 2024)

S. No.	Category	Course Code	Course Title	Credits	L	T	P	S	Hours per week
1	Major	MTHS355MJ	Numerical Methods	4	3	x	2	0	5
		MTHS356MJ	Insurance Mathematics	4	3	0	2	0	5
		MTHS357MJ	Probability Distributions	4	4	0	0	0	4
		MTHS358MJ	Geometry	4	4	0	0	0	4
2	Minor 5		Students to choose	4					
3	Internship	DOMS350IN	Internship	4					

Note: Students have to choose one subject from the Major Category — either **Probability distributions** (**MTHS357MJ)** or **Geometry (MTHS358MJ)**.

Course Title: Numerical Methods	**L**	**T**	**P**	**S**	**Semester: 6th**
Course Code: MTHS355MJ	**3**	**x**	**2**	**x**	**Max Marks**: 100
Credits: 4					

Course Objective: Introduces students the analysis of numerical methods as well as the design and use of algorithms for scientific computing.
Course Outcome: After completion of this course student will be able to

Understand the applications of numerical methods in a large number of engineering subjects which require solutions of linear systems, finding eigen values, eigenvectors, interpolation and applications, solving ODEs, PDEs

Unit 1: Numerical Computing, Importance of numerical methods in mathematics and science, Limitations of analytical methods. Types of Errors: Round-off, truncation, and absolute/relative errors. Root-Finding Methods: Bisection method, Regula-Falsi method, Newton-Raphson method, Secant method, Order of convergence and stability

Unit II: Polynomial Interpolation: Lagrange interpolation, Newton's divided difference interpolation. Spline Interpolation: Linear and cubic splines, Numerical Differentiation: Finite difference approximations (forward, backward, central)

Unit III: Numerical Integration (Quadrature): Trapezoidal rule, Simpson's 1/3 and 3/8 rules. Ordinary Differential Equations (ODEs): Euler's method, Picard's Method, Modified Euler Method, Runge-Kutta methods (2nd & 4th order)

Unit IV: Direct Methods for Linear Systems: Gaussian elimination, LU decomposition, Iterative Methods: Jacobi, Gauss-Seidel. Eigenvalue Problems: Power method for dominant eigenvalues

TextBooks / Refrences

1. Introduction to numerical Analysis by C.E. Froberg
2. Numerical Analysis – A Practical Approach by M. Maron
3. Numerical Methods by Burda and Faires. Thomson Brooks/Cole
4. Introductory Methods of Numerical Analysis, **S.S. Sastry,** PHI Learning / Prentice-Hall of India
5. Numerical Methods for Scientific and Engineering Computation Jain, Iyengar, & Jain, New Age International

Course Title: : Insurance Mathematics	**L**	**T**	**P**	**S**	**Semester: 6th**
Course Code: MTHS356MJ	**3**	**x**	**2**	**x**	**Max Marks**: 100
Credits: 4					

Course Objectives: To make the student conversant with Construction and use of a life table, various types of life assurance contracts, various types of life annuity contracts and Calculation of Net premiums and reserves

Course Outcomes: On completion of the course the students will be able to

1. Define the different life table function and how to use it
2. Define simple assurance and annuity contracts, and develop formulae for the means and variances of the present values of the payments under these contracts, assuming constant deterministic interest.
3. Describe practical methods of evaluating expected values and variances of the simple contracts defined in objective.
4. Describe and calculate, using ultimate or select mortality, net premiums and net premium reserves of simple insurance contracts.
5. Describe the calculation, using ultimate or select mortality, of net premiums and net premium reserves for increasing and decreasing benefits and annuities.

Unit I: The Life Table : The life table-Constructing a life table-Using the life table-The pattern of human mortality-Life table functions at non-integer ages-uniform distribution of deaths (UDD)-constant force of mortality (CFM)-The general pattern of mortality-Select mortality-Constructing select and ultimate life tables

Unit II: Life Assurance Contracts: Life assurance contracts: Pricing of life insurance contracts, Whole life assurance contracts, Term assurance contracts, Pure endowment contracts, Endowment assurance contracts, Critical illness assurance contracts, Deferred assurance benefits, Mean and Variance of the present value random variable Claim acceleration approximation.

Unit III: Life Annuity Contract: Life annuity contracts: Whole life annuities payable annually in arrears, Whole life annuities payable annually in advance, Temporary annuities payable annually in arrear, Temporary annuities payable annually in advance, Deferred annuities, Deferred annuities-due, Continuous annuities, Immediate annuity, Mean and Variance of the present value random variable approximations.

Unit IV: Net Premiums And Reserves: Net premiums and reserves-The basis-The net premium-The insurer's loss random variable-Reserves- Prospective reserve-Retrospective reserves-Conditions for equality of prospective and retrospective reserves-Net premium reserves-Recursive calculation of reserves.

TextBooks / References:

1. B H Smith "Contingencies of Value", Harvard University Press, 1988.
2. Alistair Neil "Life Contingencies", Butterworth-Heinemann Ltd; illustrated edition (1977).
3. Griffith Davis "Table of Life Contingencies", Longman & Co, 1825: University of California Library.
4. Micheal M Parmenter, "Theory of Interest and Life contingencies with Pension", 3rd Edition.
5. Bowers, Newton L et al. – "Actuarial mathematics". 2nd Edition – Society of Actuaries, 1997.

Course Title: : Probability Distributions	**L**	**T**	**P**	**S**	**Semester: 6th**
Course Code: MTHS357MJ	**4**	**x**	**x**	**x**	**Max Marks**: 100
Credits: 4					

Course Objective: The main objective is to integrate the foundational concepts of discrete and continuous probability distributions by exploring their properties, key differences, and practical applications.

Course Outcomes: After completion of this course student will able to

1. Demonstrate a comprehensive understanding of discrete and continuous probability distributions and their structural properties.
2. To examine the role of probability models in predicting outcomes, understanding relationships and approximation cases.
3. Understand the concept of Compound, truncated, mixture and sampling distributions
4. Analyze real-world problems by formulating and solving them using appropriate probability models.

Unit –I: Discrete Probability Distributions: Binomial, Poisson, Geometric, Negative Binomial, Hyper-geometric and Multinomial distributions along with their characteristic properties and limiting/approximation cases. Solving real-world problems through the formulation and application of suitable discrete probability models.

Unit –II: Continuous Probability Distributions: Uniform, exponential, Normal, Gamma, Beta, Weibull, Lognormal, Cauchy and, Laplace distributions along with their characteristic properties and limiting/approximation cases. Application of these continuous probability models to handle real world problems.

Unit III: Functions of random variables and their distributions using Jacobian of transformation and other tools. Concept of a sampling distribution. Sampling distributions of t, $\chi 2$ and F (both central and non-central), their properties and applications.

Unit –IV: Compound, truncated and mixture probabilistic models, bivariate normal and bivariate exponential distributions with properties and applications, generalized exponential distributions with structural properties and applications to handle real world problems.

Text Books /References:

1. Rohatgi V.K & A.K. MD. Ehsanes Saleh (2001): An Introduction to Probability Theory and Statistics, 2nd. John Wiley and Sons.
2. Rohatgi,V.K.(1990) : An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd.
3. Johnson, N.L. and Kotz, S. (1969): Distributions in Statistics; Discrete distributions. John Wiley and Sons, New York.
4. Hogg, R.V. and Craig ,A.T.(1989) : Introduction to Mathematical Statistics, Macmillan Publishing Company
5. Johnson, N.L., Kotz, S. and Balakrishnan, N (1994): Continuous Univariate Distributions-1, 2nd Edition John Wiley and Sons, New York.

Course Title: Geometry	**L**	**T**	**P**	**S**	**Semester:** 6th
Course Code: MTHS358MJ	**4**	**x**	**x**	**x**	**Max Marks**: 100
Credits: 4					

Course Objectives: To provide idea about the basic applications of the analytical plane and solid geometry.

Course Outcomes: After the completion of the paper, the student is expected to

1. Handle 2D and 3D geometrical concepts.
2. Understand the nature of Hyperbolic functions.
3. Trace standard curves in Cartesian coordinates and polar coordinates.

Unit I: Parabola, tangents and normals, pole and polar, pair of tangents from a point, equation of a chord of a parabola in terms of its middle point, parametric equations of a parabola.

Unit II: Ellipse, tangents and normal**,** pole and polar, parametric equations of ellipse**,** Diameters, conjugate diameters and their properties**,** General second-degree equation in x and y, Conditions under which a general second degree equation represents a conic**,** Determination of equation of the corresponding conic.

Unit III: Sphere, radical plane, coaxial system, simplified form of the equation of two spheres, Cone, vertex, guiding curve, generator, equation of cone with vertex as origin or a given vertex and guiding curve**,** Condition that the general quation of the second degree should represent a cone, Necessary and sufficient conditions for a cone to have three mutually perpendicular generators.

Unit IV: Cylinder, equation of the cylinder whose generators intersect a given conic and are parallel to given line, enveloping cylinder of a given sphere, types of conicoids, tangent and tangent planes.

Text Books/ References:

1. P. Balasubrahamanyam, K.G. Subramanian and G. R. Venkataraman, Coordinate Geometry of two and three Dimensions, Tata McGraw Hill, 1994.
2. Shanti Narayan, Analytical Solid Geometry, S. Chand and Company, 2007.
3. R.J.T. Bill, Elementary Treatise on Coordinate Geometry of Three Dimensions, McMillan India Ltd., 1994.
4. S.L. Loney, The Elements of Coordinate Geometry, McMillan and Company, London.
5. S.Pirzada and T.A.Chishti, Analytical Solid Geometry, Universities Press, Orient Blackswan