VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM&SYLLABUS (DRAFT) OF

B.Sc. (HONOURS / HONOURS WITH RESEARCH)

MAJOR IN MATHEMATICS

4-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023& NEP, 2020

VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE (HONOURS/ HONOURS WITH RESEARCH) MAJOR IN MATHEMATICS
(under CCFUP, 2023)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. (Hons./ Hons. with Research)	4th	VII			**SEMESTER-VII**					
			Major-14	MATHMJ14	T: Measure Theory and Complex Analysis	4	3-1-0	15	60	75
			Major-15	MATHMJ15	T: Classical Mechanics and Continuum Mechanics	4	3-1-0	15	60	75
			CRM	MATHCRM	T: Research Methodology and Ethics	4	3-1-0	15	60	75
			Major Elective-03	MATHDSE03	Elective-1: Data Science & Graph Theory Elective-II: Ordinary Differential Equations Elective-III: Differential Geometry & Manifold Theory	4	3-1-0	15	60	75
			Minor-07 (Disc.-I)	MATMIN07	T: Probability and Statistics *(To be taken by the other Discipline)*	4	3-1-0	15	60	75
					Semester-VII Total	20				375

MJ = Major, MI = Minor Course, DSE = Discipline Specific Elective Course, CRM= Compulsory Research Methodology, CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical

SEMESTER-VII

MAJOR (MJ)

Major – 14

Major 14: Measure Theory & Complex Analysis **Credit 4, Full Marks 75**

Group-A: Measure Theory (Credit 2)

Course Outcomes (COs):
Upon successful completion of this course, the students will learn the following:
CO1: Understand the concepts of measurable sets, measures, Borel sets, and measurable functions, including their fundamental properties.
CO2: Apply the theory of simple functions and the Lebesgue integral to study integration of bounded and general measurable functions.
CO3: Analyze convergence theorems such as Fatou's lemma, Dominated Convergence Theorem, and Monotone Convergence Theorem, and compare Lebesgue and Riemann integrals.

Syllabus:
Unit 1: Measurable sets; measure and simple properties; sets of measure zero; Cantor set.

Unit 2: Borel sets and their measurability; measurable functions; continuity and measurability; Borel measurable functions; sequences of measurable functions.

Unit 3: Simple functions and properties; integral of nonnegative measurable functions; Lebesgue integral on a measurable set – definition and basic properties.

Unit 4: Lebesgue integral of a bounded function over a set of finite measure; simple properties; comparison of Lebesgue and Riemann integrals; Lebesgue criterion of Riemann integrability.

Unit 5: General Lebesgue integral; bounded convergence theorem; Fatou's lemma; classical Lebesgue dominated convergence theorem; monotone convergence theorem (statement only).

Reference Books:

1. W. Rudin, Real and Complex Analysis, International Student Edition, McGraw-Hill.
2. Inder K. Rana, An Introduction to Measure and Integration (2nd ed.), Narosa Publishing House, New Delhi.
3. P.R. Halmos, Measure Theory, Graduate Text in Mathematics, Springer-Verlag.
4. H.L. Royden, Real Analysis, 3rd ed., Macmillan.

Group-B: Complex Analysis (Credit 2)

Course Outcomes (COs):
Upon successful completion of this course, the students will learn the following:
CO1: What is a multivalued function, and what is the difference from a single-real valued function?
CO2: Apply complex integration techniques and analyze singularities to solve problems using advanced theorems of complex analysis.

CO3: Employ complex analytic methods, including residues, Jordan's lemma, and branch cut analysis, to solve problems in applied mathematics such as Fourier integrals and Laplace transforms.

Syllabus:

Unit 1: Review of basic complex analysis – Cauchy's theorem, primitives of analytic functions, Fundamental Theorem of Algebra, Cauchy's integral formula, Morera's theorem, Liouville's theorem, Taylor's series, Laurent's series, maximum modulus principle.

Unit 2: Definition of homotopy, homotopy version of Cauchy's theorem, extension of Cauchy's theorem to multiply-connected regions.

Unit 3: Multiple valued functions – definition, branch point and branch cut.

Unit 4: Residues and poles – isolated singular points, residues, Cauchy's Residue Theorem, residue at infinity, types of isolated singular points, residues at poles, zeros of analytic functions, zeros and poles, behavior of functions near isolated singularities, Riemann's theorem, Schwarz's lemma, Casorati–Weierstrass theorem.

Unit 5: Applications of residues – evaluation of improper integrals, improper integrals from Fourier analysis, Jordan's Lemma, indented paths, indentation around a branch point, integration along a branch cut, definite integrals involving sines and cosines, other contour integrations, estimation of infinite sums.

Unit 6: Winding number, counting zeros, argument principle, Rouche's theorem, inverse Laplace transforms.

Reference Books:

1. Complex Variable and Applications, J. W. Brown and R. V. Churchill, 8th Edition, McGraw-Hill.
2. Foundations of Complex Analysis, S. Ponnusamy, Narosa, 1995.
3. Functions of one Complex Variable, J. B. Conway, 2nd edition, Narosa, 1997.
4. A Text Book of Complex Analysis, P.K.Nayek and M.R.Seikh, Universities Press, 2018

Major – 15

Major 15: Classical Mechanics & Continuum Mechanics **Credit 4, Full Marks 75**

Group-A: Classical Mechanics (Credit 2)

Course Outcomes (COs):
Upon successful completion of this course, students will be able to:
CO1: Understand motion of a system of particles; constraints; generalized coordinates; holonomic and non-holonomic systems; principle of virtual work; D'Alembert's principle; Lagrange's and Hamilton's equations.
CO2: Apply principles of stationary action; principle of least action; Hamilton's principle; variational principle; brachistochrone problem; derive Lagrange's equations from Hamilton's principle; understand invariance and canonical transformations; conservation laws; Liouville's theorem; Poisson bracket.
CO3: Understand special theory of relativity; postulates of relativity; Lorentz transformation; consequences; force and energy equations; applications in mechanics.

Syllabus:

Unit 1: Motion of a system of particles; constraints; generalized coordinates; holonomic and non-holonomic systems; principle of virtual work; D'Alembert's principle.

Unit 2: Lagrange's equations; Hamiltonian; Hamilton's equations; cyclic coordinates; Routhian equation.

Unit 3: Principle of stationary action; principle of least action; Hamilton's principle; variational principle; brachistochrone problem; Lagrange's equations from Hamilton's principle.

Unit 4: Invariance transformations; conservation laws; space-time transformations; canonical transformations; Liouville's theorem.

Unit 5: Poisson bracket.

Unit 6: Special theory of relativity – postulates of special relativity; Lorentz transformation; consequences of Lorentz transformation; force and energy equations.

Reference Books:

1. Goldstein, H. (1950) Classical Mechanics, Addison-Wesley, Cambridge.
2. Pal, M. (2009). A Course on Classical Mechanics. Narosa, New Delhi, & Alpha Science, Oxford, London.
3. Gupta, A.S. (2005) Calculus of Variations with Applications, Prentice-Hall of India, New Delhi.
4. Gupta, B.D. and Prakash, S. (1985) Classical Mechanics, Kedar Nath Ram Nath, Meerut.
5. Kibble, T.W.B. (1985) Classical Mechanics, Orient Longman, London.
6. Rana, N.C. and Joag, P.S. (2004) Classical Mechanics, Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Symon, K.R. (1971) Mechanics, Addison-Wesley Publ. Co., Inc., Massachusetts.
8. Takwale, R.G. and Puranik, S. (1980) Introduction to Classical Mechanics, Tata McGraw-Hill Publ. Co. Ltd., New Delhi.

Group-B: Continuum Mechanics (Credit 2)

Course Outcomes (COs):

Upon successful completion of this course, students will be able to:

CO1: Understand deformation gradients; displacement gradient; deformation tensor; finite and infinitesimal strain tensors; linear rotation tensor; principal strains; strain invariants; cubical dilatation; compatibility equation for linear strain.

CO2: Analyze stress at a point; body and surface forces; Cauchy's stress principle; stress vector–stress tensor relationship; force and moment equilibrium; stress tensor symmetry; stress quadric; stress transformation; principal stress; stress invariants; stress ellipsoid.

CO3: Comprehend the concept of elasticity in terms of strain and stress; relate stress and strain for elastic materials.

Syllabus:

Unit 1: Deformation gradients; displacement gradient; deformation tensor; finite strain tensors; small deformation theory – infinitesimal strain tensor; relative displacement; linear rotation tensor; interpretation of linear strain tensors; strength ratio; finite strain interpretation; principal strains; strain invariants; cubical dilatation; compatibility equation for linear strain.

Unit 2: Body force; surface forces; Cauchy's stress principle; stress vector; state of stress at a point; stress tensor; stress vector–stress tensor relationship; force and moment equilibrium; stress tensor symmetry; stress quadric of Cauchy; stress transformation laws; principal stress; stress invariants; stress ellipsoid.

Unit 3: Concept of elasticity in terms of strain and stress.

Reference Books:

1. R.N.Chatterjee, Mathematical Theory of Continuum Mechanics, Narosa Publishing House.
2. A.J.M. Spencer, Continuum Mechanics, Longman, 1980.
3. T.J.Chung, Continuum Mechanics, Prentice – Hall.
4. Gedrge R. Mase, Continuum Mechanics: Schaum's Outline of Theory and Problem of Continuum Mechanics, McGraw Hill.

COMPULSORY RESEARCH METHODOLOGY (CRM)

[for both Hons. and Hons. with Research students]

CRM: Research Methodology and Ethics **Credit 4, Full Marks 75**

Course Outcomes (COs):
CO1: Understand the fundamentals of research methodology, including problem formulation, hypothesis, research design, and data collection techniques.
CO2: Apply appropriate sampling methods, data analysis, and proposal writing skills to conduct and present systematic research.
CO3: Develop critical awareness of ethical principles in research, including responsibilities towards academic integrity, confidentiality, and avoidance of misconduct.
CO4: Evaluate publication ethics, authorship issues, conflict of interest, and roles of editors, reviewers, and publishers in ensuring quality research.
CO5: Analyze and interpret research impact using standard metrics such as impact factor, h-index, g-index, i10-index, and altmetrics.

Syllabus:

Unit 1: Definition, importance, and characteristics of research; distinction between method and methodology; types of research – basic, applied, qualitative, quantitative, descriptive, analytical, experimental.

Unit 2: Identification and formulation of research problem; research questions and objectives; survey of literature – importance, sources, and research gaps.

Unit 3: Hypothesis – meaning, role, and types (null, alternative, simple, complex, directional, causal); research process – steps from problem identification to report writing.

Unit 4: Research design – meaning, significance, and types (exploratory, descriptive, analytical, experimental); developing a research plan – statement of problem, objectives, methodology, data plan, timeline, budget.

Unit 5: Types of data – primary and secondary; sources of data; methods of data collection – observation, interview, questionnaire, case study, experiment, content analysis.

Unit 6: Concept of sampling; probability sampling – simple random, stratified, cluster, systematic; non-probability sampling – purposive, convenience, quota, snowball.

Unit 7: Reviewing articles – analysis of objectives, methodology, findings; writing a research proposal – title, abstract, problem statement, literature review, methodology, outcomes, references.

Unit 8: Case discussions and practice on research problems, article reviews, and proposals; recap and integration of the research process.

Unit 9: Definition, nature, and scope of ethics; different branches of ethics; importance of ethics in research and academic life.

Unit 10: Meaning and significance of research ethics; responsibilities of researchers towards fellow researchers, public, and academic community; concept of academic integrity.

Unit 11: Ethical judgments in research; scientific misconduct – falsification, fabrication, plagiarism; redundant, duplicate, and overlapping publications; salami slicing; selective reporting; misrepresentation of data.

Unit 12: Concepts of privacy, autonomy, confidentiality, and anonymity in research; ethical handling of sensitive data.

Unit 13: Definition and importance of publication ethics; publication misconduct; conflict of interest; authorship issues; responsibilities of editors, reviewers, and publishers.

Unit 14: Overview of research metrics; impact factor, h-index, g-index, i10-index; altmetrics and their role in evaluating research impact.

Reference Books:

Research methodology

1. Kothari, C. R., & Garg, G. (2019). *Research Methodology: Methods and Techniques* (4th ed.). New Age International Publishers.
2. Kumar, R. (2019). *Research Methodology: A Step-by-Step Guide for Beginners* (5th ed.). Sage Publications.
3. Creswell, J. W., & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). Sage Publications.
4. Saunders, M., Lewis, P., & Thornhill, A. (2019). *Research Methods for Business Students* (8th ed.). Pearson Education.
5. Sekaran, U., & Bougie, R. (2019). *Research Methods for Business: A Skill-Building Approach* (8th ed.). Wiley.
6. Walliman, N. (2017). *Research Methods: The Basics* (2nd ed.). Routledge.
7. Punch, K. F. (2014). *Introduction to Social Research: Quantitative and Qualitative Approaches* (3rd ed.). Sage Publications.

Research ethics

1. Resnik, D. B. (2020). *The Ethics of Research with Human Subjects: Protecting People, Advancing Science, Promoting Trust*. Springer.
2. Shamoo, A. E., & Resnik, D. B. (2015). *Responsible Conduct of Research* (3rd ed.). Oxford University Press.
3. Beauchamp, T. L., & Childress, J. F. (2019). *Principles of Biomedical Ethics* (8th ed.). Oxford University Press.
4. COPE (Committee on Publication Ethics). (2017). *Code of Conduct and Best Practice Guidelines for Journal Editors*. Retrieved from https://publicationethics.org
5. American Psychological Association. (2020). *Publication Manual of the American Psychological Association* (7th ed.). APA.
6. Steneck, N. H. (2007). *ORI Introduction to the Responsible Conduct of Research*. Office of Research Integrity, U.S. Department of Health & Human Services.
7. Wager, E., & Kleinert, S. (2011). *Responsible Research Publication: International Standards for*

Authors. In Mayer, T., & Steneck, N. (Eds.), *Promoting Research Integrity in a Global Environment* (pp. 309–316). World Scientific.
8. Sugimoto, C. R., & Larivière, V. (2018). *Measuring Research: What Everyone Needs to Know*. Oxford University Press.

MAJOR ELECTIVE (DSE)

Major Elective – 03:

(Any one to be chosen)

Elective -1: Data Science & Graph Theory **Credit 4, Full Marks 75**
Elective -II: Ordinary Differential Equations **Credit 4, Full Marks 75**
Elective -III: Differential Geometry & Manifold Theory **Credit 4, Full Marks 75**

Elective-I: Data Science & Graph Theory **Credit 4, Full Marks 75**

Group-A: Data Science (Credit 2)

CO1: Develop a strong understanding of the foundational concepts in data science, including data topology, distance measures, quadratic functions, and dimensionality reduction techniques such as Principal Component Analysis.
CO2: Apply statistical and probabilistic methods—including distributions, sample statistics, regression, and hypothesis testing—to analyze, visualize, and interpret data using appropriate graphical tools and summary measures.
CO3: Implement classification algorithms such as LDA, QDA, and k-NN using Python and Scikit-learn, and utilize modern data science tools (Python, R, Pandas, NumPy) for data processing, modelling, and visualization.

Syllabus:

Unit 1:
Data Science – Introduction, Brief history of data science, Data science life cycle, Topology of data, Distance function, Euclidean space, Euclidean Norm, Distance
between two points in 2D, 3D, and extension to n dimensions.
Quadratic function, Maxima, minima, Saddle points, vertex, slope, Principal Component Analysis and Dimension Reduction.

Unit 2:
Basic concept of probability, Bayes' theorem, Distributions: Uniform, Gaussian,
Student's t, Chi–square.
Sample statistics such as mean, median, mode, variance, standard deviations,
correlation, regression, parametric and non-parametric tests.
Frequency plot, box plots, concepts of quartile, whisker, outlier, parity plot, normal
probability plot.

Unit 3:
Classification: Metrics, Bayes' Rule, Linear and Quadratic Discriminant Analysis,
K-Nearest Neighbours, Classification with Scikit–learn.
Data visualization techniques: Plotting Qualitative and Quantitative Variables, Data
visualization in a Bivariate Setting.

Unit 4:
Data Science Tools: Python, R, Pandas, NumPy

Reference Books:

1. James, G., Witten, D., Hastie, T., & Tibshirani, R. *An Introduction to Statistical Learning with Applications in R*. Springer.
2. Rajaraman, A., & Ullman, J. D. *Mining of Massive Datasets*. Cambridge University Press.
3. Hastie, T., Tibshirani, R., & Friedman, J. *The Elements of Statistical Learning*. Springer. McKinney, W. *Python for Data Analysis*. O'Reilly Media.

Group-B: Graph Theory (Credit 2)

Course Outcomes (COs):

CO1: Understand fundamental concepts of graphs, including paths, cycles, connectivity, trees, and spanning subgraphs.

CO2: Apply graph-theoretical techniques such as colouring, matching, planarity, and matrix representation to analyze different types of graphs.

CO3: Develop problem-solving skills through algorithms for shortest paths, spanning trees, traveling salesman problem, and applications of intersection graphs.

Syllabus:

Unit 1: Basic graph theoretical concepts; paths and cycles.

Unit 2: Connectivity; trees; spanning subgraphs; bipartite graphs; Hamiltonian and Euler cycles.

Unit 3: Distance and centre; cut sets and cut vertices.

Unit 4: Colouring and matching; four colour theorem (statement only); chromatic polynomial.

Unit 5: Planar graphs; dual graph; directed graphs and weighted graphs.

Unit 6: Matrix representation of graphs.

Unit 7: Algorithms for shortest path and spanning trees; applications of graphs in the travelling salesman problem.

Unit 8: Intersection graph.

Reference Books:

1. Deo, N. (2017). Graph theory with applications to engineering and computer science. PHI Limited, New Delhi, 1979.
2. West, D. B. (2001). Introduction to graph theory, Upper Saddle River: Prentice hall.
3. Chartrand, G. (2006). Introduction to graph theory. Tata McGraw-Hill Education.
4. Gross, J. L., & Yellen, J. (2005). Graph theory and its applications. CRC press.

OR

Elective-II: Ordinary Differential Equations Credit 4, Full Marks 75

Course Outcomes (COs):

CO1: Understand Sturm–Liouville problems, eigenvalues, eigenfunctions, and their applications to boundary value problems.
CO2: Apply Green's function methods to solve ordinary differential equations and boundary value problems effectively.
CO3: Analyze systems of linear differential equations, determine existence and uniqueness of solutions, and use Wronskian techniques for studying vector functions.
CO4: Solve linear differential equations near singular points using Frobenius method, and study properties of hypergeometric and confluent hypergeometric functions.
CO5: Explore special functions including Legendre and Bessel functions, understanding their generating functions, recurrence relations, orthogonality, asymptotic expansions, and integral representations.

Syllabus:

Unit 1: Ordinary differential equations of the Sturm–Liouville type; properties of Sturm–Liouville type; application to boundary value problems; eigenvalues and eigenfunctions; orthogonality theorem; expansion theorem.

Unit 2: Green's function and its properties; Green's function for ordinary differential equations; application to boundary value problems.

Unit 3: Systems of first-order equations and the matrix form; representation of nth-order equations as a system; existence and uniqueness of solutions of systems of equations; Wronskian of vector functions.

Unit 4: Homogeneous linear differential equations; fundamental system of integrals; singularity of a linear differential equation; solution in the neighborhood of a singularity; regular integral; equation of Fuchsian type; series solution by Frobenius method.

Unit 5: Hypergeometric equation; hypergeometric functions; series solution near zero, one, and infinity; integral formula for the hypergeometric function; differentiation of hypergeometric function; the confluent hypergeometric function; integral representation of confluent hypergeometric function.

Unit 6: Legendre equation; Legendre functions; generating function; Legendre functions of first kind and second kind; Laplace integral; orthogonal properties of Legendre polynomials; Rodrigue's formula; Schläfli's integral.

Unit 7: Bessel equation; Bessel function; series solution of Bessel equation; generating function; integral representations of Bessel's functions; Hankel functions; recurrence relations; asymptotic expansion of Bessel functions.

Reference Books:

1. G.F. Simmons: Differential Equations, TMH Edition, New Delhi, 1974.
2. S.L. Ross: Differential Equations (3rd edition), John Wiley & Sons, New York, 1984.
3. M.S.P. Eastham: Theory of Ordinary Differential Equations, Van Nostrand, London, 1970.
4. M. Braun: Differential Equations and Their Applications; An Introduction to Applied Mathematics, 3rd Edition, Springer-Verlag.
5. E.D. Rainville and P.E. Bedient: Elementary Differential Equations, McGraw Hill, NewYork, 1969.
6. E.A. Coddington and N. Levinson: Theory of ordinary differential equations, McGraw Hill, 1955.

OR

Elective-III: Differential Geometry & Manifold Theory **Credit 4, Full Marks 75**

Group-A: Differential Geometry (Credit 2)

Course Outcomes (COs):
CO1: Understand fundamental concepts of curves and surfaces, including arc-length, reparameterization, fundamental forms, and curvature properties.
CO2: Apply affine connections, covariant differentiation, and parallel transport to study torsion and curvature tensor fields.
CO3: Analyze Riemannian manifolds through curvature tensors, Bianchi identity, Ricci and scalar curvature, and explore applications in Einstein manifolds and conformal geometry.

Syllabus:

Unit 1: Curves in plane and space; arc-length; reparameterization; closed curves; simple closed curve; Four Vertex Theorem.

Unit 2: Regular surface; tangents and normals; orientability; the first fundamental form; developable surface; the second fundamental form; Gauss's formula; Weingarten formula; Gauss and Codazzi equations; different curvatures.

Unit 3: Affine connection (Koszul); torsion and curvature tensor field; covariant differential; parallel transport.

Unit 4: Riemannian manifold; Riemannian connection; Riemann curvature tensor; Bianchi identity; Ricci tensor; scalar curvature; Einstein manifold; semi-symmetric metric connection; Weyl conformal curvature tensor; conformally symmetric Riemannian manifold and its consequences; geodesic.

Reference Books:

1. A. Pressley, Elementary Differential Geometry, Springer, 2nd Volume, 2010.
2. W.M. Boothby, An Introduction to Differentiable Manifolds and Riemannian Geometry, Academic Press, Revised 2003.
3. S. Kumaresan, A Course in Differential Geometry and Lie Groups, Hindustan Book Agency.

Group-B: Manifold Theory (Credit 2)

Course Outcomes (COs):
CO1: Understand the concepts of topological and differentiable manifolds, smooth maps, diffeomorphisms, and submanifolds.
CO2: Apply vector field theory including tangent vectors, push-forward mappings, integral curves, immersions, submersions, and transformation groups.
CO3: Analyze differential forms through cotangent spaces, exterior products, exterior differentiation, and pull-back operations in the study of manifolds.

Syllabus:

Unit 1: Topological manifolds; differentiable manifolds; smooth maps and diffeomorphisms.

Unit 2: Curves in a manifold; tangent vector; vector fields; integral curves of a vector field; push-forward mapping; f-related vector field.

Unit 3: Immersion and submersion; submanifolds; 4-parameter group of transformations (local and global); complete vector field.

Unit 4: Cotangent space; r-form; exterior product; exterior differentiation; pull-back differential form.

Reference Books:

1. L.W. Tu, An Introduction to Manifolds, Springer, 2007.
2. J.M. Lee, Introduction to Smooth Manifolds, Springer, 2003.
3. S. Lang, Introduction to Differential Manifolds, John Wiley & Sons, New York, 1962

MINOR (MI)

Minor-07

Probability & Statistics **Credit 4, Full Marks 75**

Course Outcomes (COs):

Upon successful completion of this course, students will be able to:

CO1: Understand sample space; probability axioms; discrete and continuous random variables; cumulative distribution functions; probability mass and density functions.

CO2: Compute mathematical expectation; moments; moment generating function; characteristic function; analyze discrete distributions: uniform, binomial, Poisson, geometric, negative binomial; and continuous distributions: uniform, normal, exponential.

CO3: Analyze bivariate distributions; compute correlation coefficient; apply linear regression for two variables.

CO4: Understand random samples; types of samples; sampling distributions; estimate parameters using sample data.

CO5: Perform hypothesis testing; identify Type I and Type II errors; solve simple hypothesis testing examples.

Syllabus:

Unit 1: Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function, discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

Unit 2: Bivariate distribution, correlation coefficient, linear regression for two variables.

Unit 3: Random samples, type of sample, sampling distributions, estimation of parameters.

Unit 4: Testing of hypothesis, Type I & II errors, simple examples.

Reference Books:

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, Introduction to Mathematical Statistics, Pearson Education, Asia, 2007.
2. Irwin Miller and Marylees Miller, John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006.
3. Sheldon Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007.
4. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, Introduction to the Theory of Statistics, 3rd Ed., Tata McGraw- Hill, Reprint 2007
5. Gupta, Ground work of Mathematical Probability and Statistics, Academic publishers.