Department of Mathematics

(For Students admitted from 2024-2025)

Vision:

Providing an environment where students can learn, research and transform their mathematical skills to achieve high standards of excellence in generating and propagating knowledge in Mathematics.

Mission:

- To develop analytical skills and logical acumen for problem solving
- To provide excellent knowledge of Mathematical Science for suitable career and groom them for National recognition
- To provide students with a wide spectrum of valuable courses with rigorous training that enables them to pursue their future

Programme Educational Objectives:

PEO1: To create and strengthen women leaders through disciplinary knowledge, professional skills and ethical sensitivity

PEO2: To transform students as successful entrepreneurs to face the modern challenges

PEO3: To nurture the students to invent, innovate and create solutions for current moral, ecological and economic issues

Programme Outcomes:

PO 1: Disciplinary Knowledge: Acquiring knowledge of different dimensions in the related areas of study and identifying the assumptions that frame thinking and actions

PO 2: Effective Communication: Ability to share thoughts, Ideas and applied skills of communications in its various perspectives

PO 3: Research Skill and Critical Thinking: Ability to plan, execute and report the results of an experiment and to draw conclusions from evidences and the capability to apply analytical thought by following scientific approach to knowledge development

PO 4: Moral Ethical Awareness / Reasoning: Ability to embrace moral / ethical values in conducting one's life, about an ethical issues from multiple perspectives, and use ethical practices in all works and appreciating environmental and sustainability issues; and adopting unbiased and truthful actions in all aspects of work

PO 5: Information / Digital Literacy: Capability to use ICT in case of need and the ability to access, evaluate and use the relevant information

PO 6: Problem Solving: Ability to apply their competence to solve non-familiar everyday problems in real life situations

PO 7: Self – directed and Lifelong Learning: Acquire the ability to engage in independent and lifelong learning through self-paced and self-directed learning to meet out the change in life

M Sc MATHEMATICS

[Two Year Regular Programme]

(For Students Admitted from 2024-25)

Programme Specific Outcomes:

PSO 1: Acquire strong foundation knowledge which will help them to become a good academician

PSO 2: Investigate mathematical problems and solutions in a variety of contexts related to science, technology, business and industry, and illustrate these solutions using symbolic, numeric, or graphical methods

PSO 3: Prepare students for pursuing research or careers in mathematical sciences, industry and allied fields

PSO 4: Understand the impact of solutions in ethical, societal and environmental contexts and demonstrate the knowledge and need for sustainable development

PSO 5: Function as an individual, member or a leader in diverse teams and in Multidisciplinary settings. Become an entrepreneur by acquiring technical, communicative, problem solving and intellectual skills

PSO 6: Investigate, design and apply appropriate methods to solve problems in science, mathematics, technology and/or engineering

PSO 7: Technological advancements in computing and engage in life-long self-learning for personal development in the context of interdisciplinary nature of future endeavors

PREAMBLE

1. Modified for the core course "Topology" (II Semester).
2. Modified for the core courses "Analysis I" (I Semester) and "Analysis II" (II Semester).
3. The core course "Numerical Methods" (II Semester) has been renamed as "Numerical Analysis" (II Semester).

PROGRAMME STRUCTURE, Program Code: PMX

Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	CIA	ESE	Total Marks
I	HMMXC111	Core I	Linear Algebra	6	5	25	75	100
	HMMXC121	Core II	Analysis-I	6	5	25	75	100
	HMMXC131	Core III	Ordinary Differential Equations	6	5	25	75	100
	HMMXC141	Core IV	o Number Theory	6	5	25	75	100
	HMMXE11A/ HMMXE11B	DSE I	Graph Theory/ Stochastic Process	6	5	25	75	100
	HMMXX1/ HMMXX1O	Extra credit	Fuzzy Sets and Relations / * Online Course		2		100	100
		Total		**30**	**25+2**	**125**	**375+100**	**500+100**

II	HMMXC211	Core V	Algebra-I	6	5	25	75	100
	HMMXC221	Core VI	Analysis-II	6	5	25	75	100
	HMMXC232	Core VII	Topology	6	5	25	75	100
	HMMXC241	Core VIII	Partial Differential Equation	6	5	25	75	100
	HMMXE22A/HMMXE2BP	DSE II	Numerical Analysis/#Web Designing Lab	6	5	25	75	100
	HMMXX2P/ HMMXX2O	Extra credit	Village Placement Programme / * Online Course		2		100	100
		Total		**30**	**25+2**	**125**	**375+100**	**500+100**
III	HMMXC311	Core IX	Algebra-II	6	5	25	75	100
	HMMXC321	Core X	Complex Analysis	6	5	25	75	100
	HMMXC331	Core XI	o Measure and Integration	6	5	25	75	100
	HMMXC341	Core XII	Mathematical Statistics	6	5	25	75	100
	HMMXE3AP/ HMMXE31B	DSE III	Statistics through R Tool Lab/ Optimization Techniques	6	5	25	75	100
	HMESX3/ HMMXX3O	Extra credit	Employability Skills/ * Online Course		2	100		100
		Total		**30**	**25+2**	**125+ 100**	**375**	**500+100**
IV	HMMXC41	Core XIII	Differential geometry	6	5	25	75	100
	HMMXC421	Core XIV	Functional Analysis	6	5	25	75	100
	HMMXC43PW	Core XV	Project	18	5	100	100	200
	HMMXX4/ HMMXX4O	Extra credit	Communication Skills/ * Online Course		2		100	100
	Total			**30**	**15+2**	**150**	**250+100**	**400+100**
	Grand total			**120**	**90+8**	**525+ 100**	**1375+ 300**	**1900+ 400**

* For Online certification credit alone will be assigned on submission of certificate obtained through appearing for Online Examination from EDX, Spoken Tutorial, NPTEL or Coursera.

o Integrated Course

\# Internship Training

DSE COURSE FOR OTHER PG PROGRAMME FOR M Sc IT

Sem	SubjectCode	Course	SubjectTitle	Hours / Week	Credits	CIA	ESE	Total
II	HMITE2A	DSE II	Probability and Applied Statistics	6	5	25	75	100

DSE - Discipline Specific Elective

DSE COURSE FOR OTHER PG PROGRAMME FOR MCA

Sem	SubjectCode	Course	SubjectTitle	Hours / Week	Credits	CIA	ESE	Total
II	IMCAE2A	DSE II	Probability and Applied Statistics	6	5	25	75	100

DSE - Discipline Specific Elective

Core I – Linear Algebra

(For Students Admitted from 2024-2025)

Semester: I **Hours / week: 6**
Subject Code: HMMXC111 **Credit: 5**

Course Objectives:

1. To know the fundamental notions of vector spaces viz linear dependence, basis and dimension and linear transformations on these spaces have to be studied thoroughly.
2. To learn how the subject encompasses the isomorphic theory of matrices and comprehend the key ideas involved in the study of the structure theory of linear maps.

Unit-I **(18 hours)**

Vector spaces - Subspaces - Linear Combinations and Systems of Linear Equations- Linear Dependence and Linear Independence - Bases and Dimension - Maximal Linearly Independent Subsets.

Unit-II **(18 hours)**

Linear Transformations, Null Spaces, and Ranges - The Matrix Representation of a Linear Transformation - Composition of Linear Transformations and Matrix Multiplication - Invertibility and Isomorphism - The Change of Coordinate Matrix.

Unit-III **(18 hours)**

Elementary Matrix Operations and Elementary Matrices - The Rank of a Matrix and Matrix Inverses - System of Linear Equations - Theoretical Aspects and computational Aspects - Determinants of Order 2 - Determinants of Order n - Properties of Determinants - Summary - Important Facts about Determinants.

Unit-IV **(18 hours)**

Eigenvalues and Eigenvectors - Diagonalizability – Invariant Subspaces and Cayley Hamilton Theorem

Unit-V **(18 hours)**

The Jordan Canonical Form 1 - The Jordan Canonical Form 2 - The Minimal polynomial.

Course Outcomes:

After Successful completion of this course, student will be able to

CO1: Analyze the concept of Vector spaces, Subspaces, Bases and Dimension

CO2 : Explore the concept of Linear Transformation

CO3: Compute the solution of system of linear Equations

CO4: To find the solutions of Eigen value and Eigen Vectors, Diagonalization of matrices.

CO5: To find the Jordan canonical forms of various linear transformations and thereby able to solve various problems.

Text Book:

1. Stephen H. Friedberg, Arnold J. Insel and Lawrence E. Spence, *Linear Algebra*, FourthEdition, PHI Learning Private Limited, New Delhi, 2014.

Unit I: Chapters 1
Unit II: Chapter 2 (Sections 2.1 to 2.5)
Unit III: Chapter 3 & Chapter 4 (Sections 4.1 to 4.4)
Unit IV: Chapter 5(Sections 5.1 5.2 and 5.4)
Unit V: Chapter 7 (Sections 7.1 to 7.3)

Reference Books:

1. S. Kumaresan, *Linear Algebra*, Prentice-Hall of India Ltd, 2000.
2. K. Hoffman and R. Kunze, *Linear Algebra*, Second Edition, Pearson, 2015.
3. M. Artin, Algebra, Pearson, 2015.

E-Resources:

1. https://www.youtube.com/watch?v=zvRdbPMEMUI
2. https://youtu.be/JYRzEOh1mPU
3. https://mandal.ku.edu/math790/canonForms.pdf
4. https://www.youtube.com/watch?v=uJNQPgYjlQc

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	9	9	**45**
CO2	3	9	9	3	3	3	9	**39**
CO3	3	3	3	3	3	1	9	**25**
CO4	3	3	9	3	3	3	9	**33**
CO5	3	1	3	1	3	1	9	**21**
Total	**21**	**19**	**33**	**13**	**15**	**17**	**45**	**163**

Low-1 **Medium-3** **High-9**

Core II – Analysis – I

(For Students Admitted from 2024-25)

Semester: I **Hours / week: 6**

Subject Code: HMMXC121 **Credit: 5**

Course Objectives:

1. To know the genuine differences that appear when we pass from real functions to vector value functions
2. To understand the theory of sequences and series, continuity, differentiation and integration

Unit I **(18 hours)**

Sets and Functions, Mathematical Induction, Finite and Infinite sets. Real Number system: Algebraic and Order properties: Infimum, Supremum, LUE Axiom. Countable and uncountable Spaces.

Unit II **(18 hours)**

Metric spaces - Definition and examples - open balls and open sets.

Unit III **(18 hours)**

Sequences and Series of real numbers - limit theorems - monotone sequences - Cauchy criterion - limsup, liminf - Convergent sequences in metric spaces - limit and cluster points - Cauchy sequences - Bounded sets - Dense sets. Infinity.

Unit IV **(18 hours)**

Continuous functions - Equivalent Definitions of Continuity - Uniform Continuity - Limit of a function - Discontinuities of a Real Valued function - Compact spaces and their properties - Continuous functions on Compact spaces- Characterization of Compact Metric spaces.

Unit V **(18 hours)**

Connectedness: Connected spaces - Complete metric spaces - Examples- Baire Category Theorem - Banach Contraction Principle.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Gain mastery in the fundamental concepts such as sets and functions, Induction principle, Finite and Infinite sets. In real number system they would get insight in algebraic and order properties in a top down approach.

CO2: Understand the basic concepts in metric spaces geometrically and with rigor.

CO3: Realize the key idea convergence of sequences and the quantitative inequality estimates. Here numerous examples would have demonstrated the role of inequalities.

CO4: Learn the crucial concept of continuity of functions and uniform continuity and will be able to work on problems emphasizing these ideas of real analysis.

CO 5: Study thoroughly the metric topology and discuss the ideas connecting compactness and continuity and connectedness and continuity.

Text Book:

1. R.G. Bartle and D.R. Sherbert, *Introduction to Real Analysis,* 4th Edition, Wiley India Edition, 2014.
2. S. Kumaresan, *Topology of Metric Spaces*, 2nd Edition, Narosa Publishing House, New Delhi, 2011.

Unit I: Chapters 1 and 2 from [1]

Unit II: Chapter 1 from [2]

Unit III: Chapter 3 from [1] and Chapter 2 sections 2.1 to 2.5 from [2]

Unit IV: Chapter 3, Chapter 4 from [2] (sections 3.3 and 3.6 omitted) and Chapter 5 from [1]

Unit V: Chapter 5 Section 5.1 and Chapter 6 sections 6.1, 6.3 and 6.4 (section 6.2, 6.3.16 and 6.3.17 omitted) from [2]

Reference Books:

1. S.C. Malik, *Principles of Real Analysis,* New Age International Private Limited, Second Edition, 2018.
2. Walter Rudin, *Principles of Mathematical Analysis*, Third Edition, Mcgraw Hill, 2017.
3. Apostol, *Mathematical Analysis*, Narosa Publising House, Second Edition, 2002.
4. V.Ganapathy Iyer, *Mathematical Analysis*, Tata McGraw Hill1985.

E-Resources:

1. https://www.google.co.in/books/edition/Introduction_to_Analysis/lZm8AQAAQBAJ?hl=en&gbpv=1&dq=Analysis+Mathematics&printsec=frontcover
2. https://www.youtube.com/watch?v=kOa6qhgYrI0
3. https://www.youtube.com/watch?v=fh1AQkR_4yU
4. https://www.youtube.com/watch?v=LUKfrjpDHTk

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	1	1	3	3	9	**23**
CO2	3	3	1	1	1	3	9	**21**
CO3	9	9	3	1	3	9	9	**43**
CO4	9	9	3	1	1	3	9	**35**
CO5	9	9	9	1	9	9	9	**55**
Total	**33**	**33**	**17**	**5**	**17**	**27**	**45**	**177**

Low-1 Medium-3 High-9

Core III - Ordinary Differential Equations

(For Students Admitted from 2024-2025)

Semester: I **Hour / week: 6**

Subject Code: HMMXC131 **Credit: 5**

Course Objectives:

1. To analyze the solutions of different types of Ordinary Differential Equations
2. To promote critical thinking and problem solving abilities in Ordinary Differential Equations

Unit-I **(18 hours)**

The general solution of the homogeneous equation - The use of one known solution to find another - The method of variation of parameters - Power Series solutions. A review of power series - Series solutions of first order equations - Second order linear equations; Ordinary points.

Unit II **(18 hours)**

Regular Singular Points - Gauss's hyper geometric equation - The Point at infinity-Legendre Polynomials - Bessel functions.

Unit III **(18 hours)**

Linear Systems of First Order Equations - Homogeneous Equations with constant coefficients - The Existence and Uniqueness Solutions - The Method of Successive approximations and Picard's Theorem.

Unit IV **(18 hours)**

Qualitative Properties of Solutions – Oscillations and Strum separation Theorem- Sturm Comparison Theorems

Unit V **(18 hours)**

Nonlinear equations: Autonomous Systems; the phase plane and its phenomena- Types of critical points; Stability - critical points and stability for linear systems - Stability by Liapunov's direct method - Simple critical points of nonlinear systems.

Course Outcomes:

After completion of this course, student will be able to

CO 1: Find the solutions of differential equations with homogeneous and nonhomogeneous equations

CO 2: Classify the regular singular point, Euler equation and Bessel equation

CO 3: Solve the Initial value problems for first order ordinary differential equation using the method of solutions of successive approximation and Picard's theorem

CO 4: Evaluate the qualitative properties of solutions using Strum comparison theorem

CO 5: Solve the non-linear equations, critical point and stability for linear systems using Liapunov's direct method

Text Books:

1. G.F. Simmons, *Differential Equations with Applications and Historical Notes*, 3rd Edition McGraw Hill, 2017.

Unit I : Chapter 3 (Sections 15, 16 & 19) and Chapter 5(Sections 26 to 28)

Unit II : Chapter 5(Sections 29 to 32) and Chapter 8 (Sections 44 to 46)

Unit III : Chapter 10 (Sections 55 & 56) and Chapter 13 (Sections 69 & 70)

Unit IV : Chapter 4 (Sections 24 to 25)

Unit V : Chapter 11(Sections 58 to 62)

Reference Books:

1. Earl A. Coddington, *An Introduction to Ordinary Differential Equations*, Prentice Hall of India Private Limited, 2001.
2. Ian Sneddon, *Elements of Partial Differential Equations*, McGraw Hill International Edition, 2006.

E-Resources:

1. https://www.youtube.com/watch?v=AWVCi5kgovM
2. https://www.youtube.com/watch?v=oFQXNfHNdqU
3. https://www.youtube.com/watch?v=oKlI_TIFNPU
4. https://www.youtube.com/watch?v=BVKyaEu1FWk
5. https://www.youtube.com/watch?v=XUmw9KZwg4M

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	1	3	9	9	**31**
CO2	3	3	3	1	3	3	3	**19**
CO3	9	9	3	3	9	9	9	**51**
CO4	9	9	3	3	9	9	9	**51**
CO5	9	9	3	3	9	9	9	**51**
Total	**33**	**33**	**15**	**11**	**33**	**39**	**39**	**203**

Low-1 Medium-3 High-9

Core IV –Number Theory

(For Students Admitted from 2024-2025)

Semester: I **Hour / week: 6**
Subject Code: HMMXC141 **Credit: 5**

Course Objectives:

1. To know basic concepts such as divisibility, primes, congruences and its solutions
2. To analyses the solutions of Quadratic Residues, Mobius inversion Formula and the Diophantine equations and their solutions have to be introduced.

Unit I **(18 hours)**

Introduction - Divisibility - Primes - The Binomial Theorem.

Unit II **(18 hours)**

Congruences - Solutions of congruences - The Chinese Remainder theorem - Prime power Moduli - Primitive roots and Power Residues - Number theory from an algebraic view point - Groups, rings and fields.

Unit III **(18 hours)**

Quadratic Residues - Quadratic Reciprocity - The Jacobi Symbol – Binary Quadratic forms- Equivalence and reduction of Binary Quadratic forms - sum of two squares.

Unit IV **(18 Hours)**

Greatest integer Function - Arithmetic Functions - The Mobius Inversion formula Recurrence Functions - Combinatorial number theory.

Unit V **(18 Hours)**

Diophantine Equations - The equation ax + by = c - Simultaneous Linear Equations - Pythagorean Triangles - Assorted examples.

Course Outcomes:

After completion of this course, student will be able to

CO1: Solve congruences as application of Chinese remainder Theorem

CO2: Know the concepts of Primitive roots and Power Residue

CO3: Evaluate the Quadratic residue and Jacobi symbol and work on sum of two squares problems.

CO4: Know the fundamentals of greatest integer function and recurrence functions

CO5: Solve simple simultaneous linear Diophantine equations.

Text book:

1. Ivan Niven, Herbert S, Zuckerman and Hugh L, Montgomery, *An Introduction to the Theoryof Numbers*, Fifth edition., John Wiley & Sons Inc, 2008.
   Unit I : Chapter 1
   Unit II: Chapter 2 (Sections 2.1 to 2.3, 2.6, 2.8, 2.10, and 2.11)
   Unit III: Chapter 3 (Sections 3.1 to 3.6)
   Unit IV: Chapter 4 (Sections 4.1 to 4.5)
   Unit V: Chapter 5(Sections 5.1 to 5.4)

Reference Books:

1. Gareth A. Jones and J. Mary Jones, *Elementary Number Theory*, Springer Verlag,Indian Reprint, 2005.
2. David M. Burton, *Elementary Number Theory*, 6th edition, McGraw Hill, 2007.
3. George Andrews, *Theory of Numbers*, Saunders, 1971.
4. William, *Fundamentals of Number Theory*, Leveque, Addison-Wesley Publishing Company, Phillipines, 1977

E-Resources:

1. https://en.wikipedia.org/wiki/Euler%27s_theorem
2. https://math.oxford.emory.edu/site/math125/legendresSymbol/
3. https://sites.millersville.edu/bikenaga/number-theory/quadratic-residues/quadratic-residues.pdf
4. https://www.cuemath.com/algebra/greatest-integer-function/
5. https://en.wikipedia.org/wiki/Diophantine_equation

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	3	9	3	3	9	9	**45**
CO2	3	9	9	3	3	3	9	**39**
CO3	3	3	3	3	3	1	9	**25**
CO4	3	3	9	3	3	3	9	**33**
CO5	3	1	3	1	3	1	9	**21**
Total	**21**	**19**	**33**	**13**	**15**	**17**	**45**	**163**

Low-1 Medium-3 High-9

DSE I - Graph Theory

(For Students Admitted from 2024-2025)

Semester: I **Hours / week: 6**
Subject Code: HMMXE11A **Credit: 5**

Course Objectives:

1. To know the basic concept of Graph Theory and have an idea of matching in graphs and study the applications of matching in day to day life problems
2. To apply theoretical knowledge acquired to solve realistic problems in real life

Unit I **(18 Hours)**

Graphs, Sub graphs: Graphs and Simple Graphs – Graph Isomorphism – The Incidence and Adjacency Matrices – Sub graphs – Vertex Degrees – Paths and Connection Cycles. Trees- Cut Edges and Bonds – Cut Vertices – Cayley's Formula.

Unit II **(18 Hours)**

Connectivity, Euler Tours and Hamilton Cycles: Connectivity – Blocks - Euler tours – Hamilton cycles.

Unit III **(18 hours)**

Matching : Matching – Matching Coverings in Bipartite Graphs – Perfect Matching Edge Colourings - Edge Chromatic Number – Vizing's Theorem.

Unit IV **(18 hours)**

Independent Sets, Cliques: Independent Sets- Ramsey's Theorem Vertex Colourings: Chromatic Number – Brook's Theorem – Hajo's Conjecture – Chromatic Polynomials – Girth and Chromatic Number.

Unit V **(18 hours)**

Planar Graphs: Plane and Planar Graphs – Dual Graphs – Euler"s Formula- Bridges – Kuratowski's Theorem (Proof Omitted) – The Five Colour Theorem and The Four Colour Conjecture – Non Hamiltonian Planar Graphs – Directed Graphs: Directed Graphs – Directed Paths – Directed Cycle.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: To understand the basic concept of Graph Theory
CO 2: Apply the concept of path to Euler tour, connectivity, Blocks and Hamilton cycles in the real life.
CO 3: To know the concepts of Matching and perfect matching
CO 4: Prove the theorems in Independent Set
CO 5: Apply the concept of Planner Graphs in real life situations.

Text Book:

1. J.A. Bondy and U.S.R. Murthy, *Graph Theory with applications*, The Macmillan PressLtd, Fifth Printing, 1982.

Unit I : Chapter 1 (Sections 1.1 - 1.7) & Chapter 2(Sections 2.1 - 2.4)
Unit II: Chapter 3 (Sections 3.1 - 3.2) & Chapter 4 (Sections 4.1 - 4.2)
Unit III: Chapter 5(Sections 5.1 - 5.3) & Chapter 6(Sections 6.1 - 6.2)
Unit IV: Chapter 7(Sections 7.1 -7.2) & Chapter 8 (Sections 8.1 to 8.5)
Unit V: Chapter 9(Sections 9.1 –9.7) & Chapter 10 (Sections 10.1 to 10.3)

Reference Books:

1. R R. Balakrishnan, K. Ranganathan, *A Textbook of Graph Theory*, Springer International Edition, First Indian Reprint2008.
2. John Clark & Derek Allan Holtan, *A First Look at Graph theory*, Allied Publishers Limited,1995.
3. S.A.Choudum, *A First Course in Graph Theory*, Macmillan India Limited, First Edition, 1987.

E-Resources:

1. https://www.csa.iisc.ac.in/~arpita/DS14/Turan.pdf
2. https://www.youtube.com/watch?v=T BYNkgvnU2s
3. https://nptel.ac.in/courses/111/106/111106050/

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	9	9	9	9	**63**
CO2	9	3	9	3	9	3	3	**39**
CO3	3	3	9	9	9	3	3	**39**
CO4	3	3	3	3	9	3	3	**27**
CO5	9	9	9	9	9	9	9	**63**
Total	**33**	**27**	**39**	**33**	**45**	**27**	**27**	**231**
			Low-1		**Medium-3**		**High-9**	

DSE I - Stochastic Process

(For Students Admitted from 2024-2025)

Semester: I **Hours / week: 6**
Subject Code: HMMXE11B **Credit: 5**

Course Objectives:

1. To understand the stochastic models for many real life probabilistic situations
2. To know about the models like birth- death to reorient their knowledge to stochastic analysis

Unit I **(18 hours)**

Random Variables and Stochastic Processes: Generating Functions - Laplace Transform - Laplace Transform of a probability distribution or of a random variable.

Unit II **(18 hours)**

Stochastic Process: An Introduction - Specification of Stochastic Process – **Markov Chains:** Definition and Examples - Higher Transition probabilities.

Unit III **(18 hours)**

Markov Chains: Classification of States and Chains - Determination of Higher Transition Probabilities - Stability of a Markov System - Markov Chain with Denumerable Number of States.

Unit IV **(18 hours)**

Markov Process with Discrete State Space: Poisson Process and Related Distributions - Generalisation of Poisson Process - Birth and Death Process.

Unit V **(18 hours)**

Applications in Stochastic Models: Queueing Systems and Models - Birth and DeathProcess in Queueing Theory - Reliability Models.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Apply the concepts of Laplace transform of a probability distribution
CO 2: Find the solution of the problems in Markov Chains using stochastic process
CO 3: Discover the most important classification of States and Chains
CO 4: Examine the applications of Poisson process and Related Distributions
CO 5: Analyze the concept of birth and death process in queuing theory

Text Book:

1. J. Medhi, *Stochastic Processes*, New Age International Private Limited, Publishers, Third Edition, 2011.

Unit I: Chapter 1 (Pg. No: 1 - 42)
Unit II: Chapter 1, 2 (Pg. No: 49 -50 & 62 -73)
Unit III: Chapter 2 (Pg. No: 78 -99 & 101 -102)
Unit IV: Chapter 3 (Pg. No: 150 -170)
Unit V: Chapter 10 (Pg. No: 388 - 395 & 402 - 415)

Reference Books:

1. Arnold O.Allen, *Probability, Statistics, and Queueing Theory with Computer Science Applications*, Elsevier, a division of Reed Elsevier India Private Limited,2005.
2. U.N.Bhat, *Elements of Applied Stochastic Process*, John wiley and Sons Limited, Second Edition, 1984.
3. D.R.Cox and H.D.Miller, *Theory of stochastic process*, Methuen, London, 1965.

E-Resources:

1. https://www.google.co.in/books/edition/Probability_Statistics
2. https://www.google.co.in/books/edition/Theory_of_Stochastic_Processes
3. https://youtu.be/n2y7n6jw5d0
4. https://youtu.be/54yLcoHIAEA

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	3	3	3	9	3	**33**
CO2	3	3	3	3	3	9	3	**27**
CO3	3	3	1	3	1	1	3	**15**
CO4	9	9	9	3	9	3	9	**51**
CO5	9	9	9	3	9	9	9	**57**
Total	**27**	**33**	**25**	**15**	**25**	**31**	**27**	**183**

Low-1 Medium-3 High-9

Extra credit - Fuzzy Sets and Relations

(For Students Admitted from 2024-2025)

Semester: I
Subject Code: HMMXX1 **Credit: 2**

Course Objectives:

1. To introduce the concept of fuzzy set theory and their basic operations
2. To understand the concepts and properties of fuzzy relations and fuzzy graphs

Unit I

Crisp Sets and Fuzzy Sets: Introduction - Crisp Sets: An overview - The Notion of Fuzzy Sets.

Unit II

Crisp Sets and Fuzzy Sets: Basic Concepts of Fuzzy Sets - Classical Logic: An overview -Fuzzy Logic.

Unit III

Operations on Fuzzy Sets: General Discussion - Fuzzy Complement - Fuzzy Union.

Unit IV

Operations on Fuzzy Sets: Fuzzy Intersection - Combinations of Operations - General Aggregation Operations.

Unit V

Operations on Fuzzy Sets: Fuzzy Relations - Crisp and Fuzzy Relations - Binary Relations - Binary Relations on a Single Set.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Categorize the Crisp sets and fuzzy sets
CO 2: Apply the Basic Concepts of fuzzy logic in fuzzy sets
CO 3: Analyze the application of fuzzy logic to real time systems
CO 4: Make use of operations on fuzzy sets
CO 5: Compute fuzzy relations on a single set

Text Book:

1. George J.Klir and Tina A. Folger, *Fuzzy Sets, Uncertainty and Information,* Asoke K.Ghosh Prentice Hall of India Private Limited, 2006.

Unit I: Chapter 1(1.1 -1.3)
Unit II: Chapter 1(1.4 -1.6)
Unit III: Chapter 2(2.1 -2.3)
Unit IV: Chapter 2(2.4 -2.6)
Unit V: Chapter 3(3.1 -3.3)

Reference Books:

1. George J. Klir and Boyuan, *Fuzzy Sets and Fuzzy Logic Theory and Applications,* Prentice Hall of India Private Limited,2005.
2. Timothy J.Ross, *Fuzzy logic with Engineering Applications,* Wiley India Pvt. Ltd., Second Edition, 2008.
3. James J.Buckley Esfandiar Eslami, *An Introduction to Fuzzy Logic and Fuzzy Sets,* Springer (India) Private Limited, Second Indian Reprint 2009.

E Resources:

1. https://youtu.be/SlBy3bsdE5Q
2. https://youtu.be/a2i-lHS-c_I
3. https://youtu.be/tC3K8RLRIZc0

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	9	9	3	3	3	**33**
CO2	3	3	9	9	3	3	3	**33**
CO3	9	9	9	9	9	9	3	**57**
CO4	3	3	9	3	3	3	3	**27**
CO5	3	3	9	3	3	3	3	**27**
Total	**21**	**21**	**45**	**33**	**21**	**21**	**15**	**177**

Low-1 **Medium-3** **High-9**

Core V –Algebra-I

(For Students Admitted from 2024-2025)

Semester: II **Hour / week: 6**
Subject Code: HMMXC211 **Credit: 5**

Course Objectives:

1. To learn the fundamental abstract algebraic structures namely groups and rings, the need for the abstract concepts are illustrated with numerous examples.
2. To study in detail the basic concepts of Rings such as Ring homomorphisms and Euclidean domains.

Unit I **(18 hours)**

Binary Operations –Isomorphic Binary Structures- Groups - Subgroups – Cyclic Groups.

Unit II **(18 hours)**

Groups of Permutations-Groups of Cosets- Direct Products - Finitely Generated Abelian groups –Homomorphisms-Normal subgroups and factor groups.

Unit III **(18 hours)**

Group action on a set- Applications of G-sets to counting - Sylow's theorems - Applications of Sylow's theorems.

Unit IV **(18 hours)**

Rings and Fields - Integral Domains – Fermat's and Euler's Theorem - The Field of quotients of an Integral domain.

Unit V **(18 hours)**

Rings of polynomials - Factorization of Polynomials overa field

Course Outcomes:

After successful completion of this course, student will be able to
CO 1: Analyze the nature of Sylow's theorem
CO 2: Explain the concept of direct product and finite abelian groups
CO 3: Infer the concept of Ring Theory
CO 4: Justify the theoretical aspects of vector space
CO 5: Recapitulate the concepts of roots of polynomials

Text Book:

1. John B. Fraleigh, *A First course in Abstract Algebra*, Pearson, 7th Edition, 2013.

Unit I : Pages 20-28, 28-36,36-49,49-58,58-68
Unit II : Pages 75-87, 96-104,104-113,125-135,135-144
Unit III : Pages 154-161,161-166
Unit IV : Pages 167-197
Unit V **:** Pages 198-220

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	3	3	9	**45**
CO2	9	9	9	3	9	3	9	**51**
CO3	9	9	9	3	9	3	9	**51**
CO4	3	3	3	1	1	3	3	**17**
CO5	9	9	9	3	9	9	9	**57**
Total	**39**	**39**	**39**	**13**	**31**	**21**	**39**	**221**

Low-1 Medium-3 High-9

Reference Books:

1. Gallian, *Contemporary Abstract Algebra*, Cenpage Learning India Pvt Ltd., Ninth Edition, 2019.
2. Mark R. Sepanski, *Algebra*, AMS Indian Edition, 2012.
3. David S. Dummit and Richard M. Foote, *Abstract Algebra*, Wiley , Third Edition, 2011.

E-Resources:

1. https://www.youtube.com/watch?v=vTWC6LKBBA0
2. https://www.youtube.com/watch?v=CJhFmWBJ5z0
3. https://www.youtube.com/watch?v=9pqhfDyzbhw

Core VI- Analysis – II

(For Students Admitted from 2024-2025)

Semester: II **Hours / week: 6**
Subject Code: HMMXC221 **Credit: 5**

Course Objectives:

1. To deal with the definition of the Riemann integral which depends very explicitly on the order structure of the real line
2. To enable students to learn basic concepts about functions of bounded variation, grasp basic concepts about the total variation, learn about Riemann - Stieltjes integrals, sequences and series of functions

Unit I **(18 hours)**

Differentiation of single variable: Derivatives - The chain rule - local extrema - Rolle's theorem - Mean Value Theorem - Taylor's formula - Derivatives of vector - valued functions - Functions of Bounded variation and rectifiable curves - Total variation - Functions of bounded variation - Equivalence of paths - Change of parameter.

Unit II **(18 hours)**

Riemann –Stieljes integral: Definition - linear properties of the integral - Necessary conditions for the existence - First fundamental theorem of Integral calculus - Mean Value Theorems for integrals - Second fundamental theorem of Integral calculus- Change of variable in a Riemann integral – Second Mean Value Theorem for Riemann integrals

Unit III **(18hours)**

Sequence and series of functions - Point wise convergence - Uniform convergence Uniform convergence and integration - Uniform convergence and Differentiation - Sufficient conditions for uniform convergence of a series - The Weierstrass theorem - Equicontinuity - The Stone - Weierstrass theorem.

Unit IV **(18 hours)**

Functions of Severable variables - Directional derivative - Total derivative - Jacobian Chain rule - Mean Value Theorem - Taylor's formula.

Unit V **(18 hours)**

Inverse function theorem - Implicit function theorem - Extremum problems with side conditions.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Gain mastery on single variable differentiable calculus. The role of Mean Value of theorem will be appreciated

CO 2: Comprehend the basic integration theory and demonstrate how the results are obtained and gain the confidence in Analysis.

CO 3: Attain the mastery in the concept of convergence of sequences and series of functions. Students will be able to identify and discuss about them occurring in lot of examples and get geometric insights from them.

CO 4: Calculate Directional derivative and Total derivative of functions and discuss about Jacobian matrix. Further they able to deal with chain rule and the Mean Value Theorem of Multivariable Calculus exploiting the trick of one variable calculus.

CO 5: Thoroughly understand the geometric ideas leading to implicit and inverse function theorems.

Text Book:

1. Tom M. Apostol, *Mathematical Analysis* Second Edition, Narosa Publishing House, New Delhi, 1985.
2. N.L. Carothers, *Real Analysis*, Cambridge University Press, South Asian Edition, 2000.

Unit I: Chapter 5 and 6 from (1)
Unit II: Chapter 7 Section 7.1 -7.22 from (1)
Unit III: Chapter 9 Section 9.1 - 9.11 and 9.14 -9.18 from (1)
Unit IV: Chapter 11 and 12 from (2) (only the corresponding sections) Chapter 12 from (1)
Unit V: Chapter 13 from (1)

Reference Books:

1. Walter Rudin, *Principles of Mathematical Analysis*, McGraw-Hill International Editions,Third Edition, 1976.
2. V.Ganapathy Iyer, *Mathematical Analysis*, Tata McGraw Hill, 1985.
3. S.C. Malik, *Principles of Real Analysis*, New Age International Private Limited, Second Edition, 2018.
4. Ajit Kumar and S. Kumaresan, *A Basic Course in Real Analysis*, CRC Press, Third Indian Reprint, 2015
5. Tom Apostol, Calculus II, Wilely, 2nd edition,

E-Resources:

1. http://ramanujan.math.trinity.edu/wtrench/texts/TRENCH_REAL_ANALYSIS.PDF
2. http://www.trillia.com/dA/zakon-analysisI-a4-one.pdf
3. https://www.youtube.com/watch?v=QS-zUSu-nxA
4. https://www.youtube.com/watch?v=XzaeYnZdK5o

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	1	3	3	**19**
CO2	3	9	9	3	3	9	9	**45**
CO3	3	3	1	3	3	3	3	**19**
CO4	9	9	3	3	1	3	3	**31**
CO5	9	3	3	3	1	3	3	**25**
Total	**27**	**27**	**19**	**15**	**9**	**21**	**21**	**139**

Low-1 Medium-3 High-9

Core VII - Topology

(For Students Admitted from 2024-2025)

Semester: II **Hours / week: 6**
Subject Code: HMMXC232 **Credit: 5**

Course Objectives:

1. To recognize the concept of connectedness, compactness and countability of topology of real numbers
2. To visualize the construction of topology of real numbers

Unit I **(20 hours)**

Topological Spaces: Basis for a Topology - The Order Topology - The Product Topology on X x Y - The Subspace Topology - Closed Sets and Limit Points.

Unit II **(18 hours)**

Continuous Functions: Continuity of a function - The Product Topology - The Metric Topology - The Metric Topology (Continued).

Unit III **(18 hours)**

Connectedness and Compactness: Connected Spaces - Connected Subspaces of the Real Line - Components and Local Connectedness.

Unit IV **(16 hours)**

Compact Spaces: Compact Subspaces of the Real Line - Limit Point Compactness - Local Compactness**.**

Unit V **(18 hours)**

Countability and separation axioms: The Countability Axioms - The Separation Axioms - Normal Spaces - The Urysohn Lemma - The Urysohn metrization Theorem – The Tietze extension Theorem.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Categorize the different types of topologies with examples

CO 2: Analyze the concept of continuity on product topology and metric topology

CO 3: Explain the concept of connectedness and components of the real line and able toapply in theorems

CO 4: Infer the aspects of compactness and its related theorems

CO 5: Examine the concept of Countability and separation axioms with illustrations

Text Book:

1. James R. Munkres, *Topology*, PHI Learning Pvt. Ltd, New Delhi, Second Edition, Reprint 2017.

Unit I: Chapter 2 (Sec: 12 - 17)

Unit II: Chapter 2 (Sec: 18 - 21)

Unit III: Chapter 3 (Sec: 23 - 25)

Unit IV: Chapter 3 (Sec: 26 - 29)

Unit V: Chapter 4 (Sec: 30 - 35)

Reference Books:

1. G. F. Simmons, *Introduction to Topology and Modern Analysis*, Tata McGraw-Hill Education Private Limited, Edition, 2004.
2. John L.Kelley, *General Topology*, Springer International Edition, 2nd Edition, Reprint 2008.
3. Seymour Lipschutz, *General Topology*, Schaum's Outline Series, v Mc Graw HillBook Company, 2004.

E-Resources:

1. http://epgp.inflibnet.ac.in/Home/ViewSubject?catid=25
2. https://nptel.ac.in/courses/111/106/111106054/
3. https://www.google.co.in/books/edition/Introduction_to_Topology/n97CAgAAQBAJ?hl=en&gbpv=1&dq=topology+mathematics&printsec=frontcover
4. https://www.google.co.in/books/edition/General_Topology/kgxHDgAAQBAJ?hl=en&gbpv1&dq=topology+mathematics&printsec=frontcover
5. https://www.mathematik.hu-erlin.de/~wendl/Winter2018/Topologie2/lecturenotes.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	9	3	9	**45**
CO2	9	3	3	1	3	1	3	**23**
CO3	9	9	9	3	3	1	9	**43**
CO4	9	9	3	3	3	1	3	**31**
CO5	9	9	9	3	3	1	1	**35**
Total	**45**	**33**	**33**	**13**	**21**	**7**	**25**	**177**

Low-1 **Medium-3** **High-9**

Core VIII – Partial Differential Equations

(For Students Admitted from 2024-2025)

Semester: II **Hours / week: 6**
Subject Code: HMMXC241 **Credit: 5**

Course Objectives:

1. The main objective is to equip students to classify partial differential equations and solve linear Partial Differential equations using different methods.
2. To give a detailed study of Heat equation, Wave equation and Laplace equation.

Unit I **(18 Hours)**

First Order P.D.E. - Curves and Surfaces - Genesis of First Order P.D.E. - Classification of Integrals - Linear Equations of the First Order - Pfaffian Differential Equations - Compatible Systems - Charpit's Method - Jacobi's Method.

Unit II **(18 Hours)**

Integral Surfaces through a Given Curve - Quasi-Linear Equations - Non-linear First Order P.D.E.

Unit III **(18 Hours)**

Second Order P.D.E.: Genesis of Second Order P.D.E. - Classification of Second Order P.D.E. One-Dimensional Wave Equation - Vibrations of an Infinite String - Vibrations of a Semi-infinite String - Vibrations of a String of Finite Length (Method of separation of variables).

Unit IV **(18 Hours)**

Laplace's Equation: Boundary Value Problems - Maximum and Minimum Principles - The Cauchy Problem - The Dirichlet Problem for the Upper Half Plane - The Neumann Problem for the Upper Half Plane - The Dirichlet Interior Problem for a Circle - The Dirichlet Exterior Problem for a Circle - The Neumann Problem for a Circle - The Dirichlet Problem for a Rectangle - Harnack's Theorem.

Unit V **(18 Hours)**

Heat Conduction Problem - Heat Conduction - Infinite Rod Case – Heat Conduction Finite Rod Case - Duhamel's Principle - Wave Equation – Heat Conduction Equation.

Course Out comes:

After completion of this course, student will be able to

CO 1: Evaluate the solutions of first order differential equation using Cauchy's, Charpit's and Jacobi's methods
CO 2: Find the solutions of Quasi-Linear Equations and Non-linear First Order P.D.E.
CO 3: Classify the second order PDE and the solution of one dimensional wave equation
CO 4: Solve the boundary value problems using Caucy's, Dirichlet's and Neumann problem
CO 5: Find the solutions of heat conduction problem in finite rod case and an infinite rod case.

Text Book:

1. T.Amarnath, *An Elementary Course in Partial Differential Equations*, 2nd edn, Narosa Publishing Company, 2010.

Unit I: Chapter 1 (Sections 1.1 to 1.8)
Unit II: Chapter 1 (Sections 1.9 to 1.11)
Unit III: Chapter 2 (Sections 2.1 to 2.3.5, except 2.3.4)
Unit IV: Chapter 2 (Sections 2.4.1 to 2.4.10)
Unit V: Chapter 2 (Sections 2.5 to 2.6)

Reference Books:

1. Tyn Myint-U, Lokenath Debnath, *Linear Partial Differential equations for scientists and engineers*, 3rd edn, Birkhauser, 2007 .
2. I.N. Snedden, *Elements of Partial Differential Equations*, Dover, 2006.
3. F. Treves, *Basic Linear Partial Differential Equations*, Dover, 2006.
4. A.K. Nandakumaran and P.S. Datti, *Partial Differential Equations, Classical Theory with a Modern Touch*, Cambridge University Press, 2020.

E-Resources:

1. https://en.wikipedia.org/wiki/First-order_partial_differential_equation
2. https://mathworld.wolfram.com/WaveEquation1-Dimensional.html
3. https://en.wikipedia.org/wiki/Partial_differential_equation
4. https://en.wikipedia.org/wiki/Laplace%27s_equation
5. https://www.geeksforgeeks.org/sample-problems-on-heat-conduction/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	1	3	9	9	**31**
CO2	3	3	3	1	3	3	3	**19**
CO3	9	9	3	3	9	9	9	**51**
CO4	9	9	3	3	9	9	9	**51**
CO5	9	9	3	3	9	9	9	**51**
Total	**33**	**33**	**15**	**11**	**33**	**39**	**39**	**203**

Low-1 **Medium-3** **High-9**

DSE II – Numerical Analysis

(For Students Admitted from2024-2025)

Semester: II **Hours / week: 6**
Subject Code: HMMXE22A **Credit: 5**

Course Objectives:

1. To apply numerical methods to obtain approximate solutions to mathematical problems
2. To develop appropriate numerical methods to solve a differential equation

Unit I **(16 hours)**

Transcendental and Polynomial equations: Iteration method based on second degree Equations: Muller Method. Chebyshev Method - Multipoint Iteration methods - Rate of Convergence: Secant Method. Regula Falsi Method - Newton-Raphson Method - Muller Method.

Unit II **(16 hours)**

Jacobi Iteration Method - Gauss Seidel Iteration Method - Successive over Relaxation (SOR) **System of Linear Algebraic Equations and Eigen value problems:** Iteration Methods: Method - Convergence Analysis of Iterative Methods - Optimal Relaxation Parameter for the SOR Method - Iterative Method to determine A^{-1} - Eigen Values and Eigen vectors - Bounds on Eigen Values.

Unit III **(20 hours)**

Interpolation and Approximation: Hermite Interpolation - Piecewise and spline Interpolation: Piecewise Linear Interpolation - Piecewise Quadratic Interpolation - Piecewise Cubic Interpolation - Piecewise Cubic Interpolation using Hermite Type Data - Spline Interpolation - Quadratic Spline Interpolation - Bivariate Interpolation. Approximation: Least square approximation.

Unit IV **(18 hours)**

differentiation - Numerical Differentiation and Integration: Numerical Differentiation - Interpolation - Partial Integration - Methods based on Interpolation.

Unit V **(20 hours)**

Ordinary differential Equations: Numerical Methods - Euler Method - Backward Euler Method - Midpoint Method - Single Step Method - Runge-Kutta Methods - Implicit Runge-Kutta Methods.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Compute roots of the transcendental and polynomial equations using an appropriate numerical method

CO 2: Inspect various method for solving the system of linear equations

CO 3: Apply the concept of system of linear algebraic equations and Eigen value problems

CO 4: Explain the concept of Numerical differentiation and integrations

CO 5: Compute the numerical solutions of ordinary differential equations by suitablemethods

Text Book:

1. M. K. Jain, S.R.K. Iyengar. R. K. Jain, *Numerical Methods for Scientific and Engineering Computation*, New Age International Private Limited, Publishers, Multicolour Edition, 2019.

Unit I: Chapter 2 (Pg. No: 29 -52)
Unit II: Chapter 3 (Pg. No: 146 - 165, 170 -179)
Unit III: Chapter 4 (Pg. No: 247 - 276, 282 -301)
Unit IV: Chapter 5 (Pg. No: 320 -356)
Unit V: Chapter 6 (Pg. No: 421 -468)

Reference Books:

1. David Kinciad & Ward Cheney, *Numerical Analysis and Mathematics of Scientific Computing*, Brooks / Cole, 1999.
2. Sastry, S.S. *Introductory Methods of Numerical Analysis*, Fourth Edition, PHI Learning Private Limited, New Delhi, 2005.
3. Shankara Rao K, *Numerical Methods for Scientists and Engineers*, Prentice Hall of India, 2001.

E-Resources:

1. http://csw.uobaghdad.edu.iq/wpcontent/uploads/sites/30/uploads/computer%20science/Lectures/2nd%20year/NUM%20ANALYSIS.pdf
2. https://youtu.be/0rtaUUonwkU
3. https://www.google.com/url?sa=t&source=web&rct=j&url=https://en.m.wikipedia.org/wiki/Numerical_methods_for_ordinary_differential_equations&ved=2ahUKEwj-rdSN9v_wAhU_7HMBHSisD7YQFjAPegQIKhAC&usg=AOvVaw3WOZRQgzKnThjh3zh_UVv4.

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	9	9	9	**51**
CO2	9	3	3	3	9	9	9	**45**
CO3	9	9	3	3	9	9	9	**51**
CO4	3	9	3	3	9	9	9	**45**
CO5	3	3	9	3	9	9	9	**45**
Total	**33**	**27**	**27**	**15**	**45**	**45**	**45**	**237**

Low-1 Medium-3 High-9

Core IX - Algebra – II

(For Students Admitted from 2024-2025)

Semester: III **Hour / week: 6**
Subject Code: HMMXC311 **Credit: 5**

Course Objectives:

1. To gain expertise in basic ring theory
2. To introduce Galois theory and obtain the fundamental Galois correspondence.

Unit-I **(18 hours)**

Prime ideals and Maximal Ideals, Irreducible polynomials.

Unit-II **(18 hours)**

Classical Formulas, Splitting Fields.

Unit-III **(18 hours)**

The Galois Group, Roots of Unity, Solvability by Radicals.

Unit-IV **(18 hours)**

Independence of Characters, Galois Extensions.

Unit-V **(18 hours)**

The Fundamental theorem of Galois theory, Applications, Galois Great Theorem.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Analyze the nature of ideals and irreducible polynomials
CO 2: Explain the concept of fields
CO 3: Infer the concept of Galois group
CO 4: Justify the theoretical
CO 5: Recapitulate the concepts of roots of polynomials

Text Book:

1. Joseph Rotman, *Galois Theory*, 2nd edition, springer verlag, 2001.

Unit I: Pages 31 - 43
Unit II: Pages 44 - 58
Unit III: Pages 59 - 75
Unit IV: Pages 76 - 82
Unit V: Pages 83 - 95

Reference Books:

1. David S. Dummit and Richard M. Foote, *Abstract Algebra*, Wiley , Third Edition, 2011.
2. Serge Lang. *Algebra* - Revised third edition - Springer - Verlag - 2005.
3. Ian Stewart, *Galois Theory*, Chapman and Hall/CRC, Fourth edition 2015.
4. R. Solomon, *Abstract Algebra*, AMS Indian edition, 2010.
5. C. Lanski, *Concepts in Abstract Algebra*, AMS Indian edition, 2010
6. John B. Fraleigh, *A First course in Abstract Algebra*, Pearson, 7th Edition, 2013.
7. M.Artin, *Algebra*, Pearson Education India, New Delhi, 2015.
8. I.N.Herstein, *Topics in Algebra*, John Wiley, 2nd Edition, 2006

E-Resources:

1. https://www.youtube.com/watch?v=vTWC6LKBBA0
2. https://www.youtube.com/watch?v=CJhFmWBJ5z0
3. https://www.youtube.com/watch?v=9pqhfDyzbhw

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	3	3	9	**45**
CO2	9	9	9	3	9	3	9	**51**
CO3	9	9	9	3	9	3	9	**51**
CO4	3	3	3	1	1	3	3	**17**
CO5	9	9	9	3	9	9	9	**57**
Total	**39**	**39**	**39**	**13**	**31**	**21**	**39**	**221**

Low-1 **Medium-3** **High-9**

Core X- Complex Analysis

(For Students Admitted from 2024-2025)

Semester: III **Hours / week: 6**
Subject Code: HMMXC321 **Credit: 5**

Course Objectives:

1. To understand and introduce the concepts of Analysis, Cauchy-Riemann relations and harmonic functions are then introduced
2. To understand the fundamental concepts of complex variable theory

Unit I **(22 hours)**

Introduction to the Concept of Analytic Function: Limits and Continuity - Analytic Functions - Polynomials - Rational Functions. Elementary theory of Power Series: Sequences Series - Uniform Convergence - Power Series – Abel's limit theorem. **Conformality:** Arcs and Closed curves - Analytic Functions in Regions Conformal Mapping - Length and Area - Linear Transformations: The Linear Group - The Cross Ratio - Symmetry - Oriented Circles - Families of Circle.

Unit II **(18 hours)**

Fundamental Theorems: Line Integrals - Rectifiable Arcs - Line integrals as Functions of Arcs – Cauchy's Theorem for a Rectangle – Cauchy's Theorem in a Disk. Cauchy's Integral **Formula:** The Index of a Point with respect to a Closed Curve - The Integral Formula - Higher Derivatives.

Unit III **(16 hours)**

Local Properties of Analytical Functions: Removable Singularities -Taylor's theorem - Zeros and Poles - The Local Mapping - The Maximum Principle.

Unit IV **(16 hours)**

The Calculus of Residues: The Residue Theorem - The Argument Principle -Evaluation of Definite Integrals.

Unit V **(18 hours)**

Power Series Expansions: Weierstrass's Theorem - The Taylor series - The Laurent Series - Partial Fractions and Factorization: Partial Fractions - Infinite Products - Canonical Products. Entire Functions: Jensen's Formula.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Examine the solution of complex-valued functions, analytic function and conformal mapping
CO 2: Show the series expansions, singularities, Cauchy's theorem and its consequences
CO 3: Identify the location and nature of a singularity of a function and calculate the order and the residue
CO 4: Analyze the results associated to Definite Integrals and Cauchy's Integral formulae
CO 5: Evaluate the region of convergence by applying Taylor's Series – Laurent's Series

Text Book:

1. Lars V. Ahlfors, *Complex Analysis*, McGraw Hill International, Third Edition, 15th Reprint 2019.

Unit I: Chapter 2(Sec 1, 2), 3(Sec.2, 3)
Unit II: Chapter 4(Sec 1, 2)
Unit III: Chapter 4(Sec 3)
Unit IV: Chapter 4(Sec 5)
Unit V: Chapter 5(Sec 1, 2.1 – 2.3, 3)

Reference Books:

1. V Karunakaran, *Complex Analysis*, Narosa Publishing House, Second Edition, 2005.
2. John M. Howie, *Complex Analysis*, Springer - Verlog London limited, 2003.
3. Liang-shin Hahn, Bernard Epstein, *Classical Complex Analysis*, Jones and Bartlett Publishers Inc, 1996.

E-Resources:

1. https://nptel.ac.in/courses/111/103/111103070/
2. https://www.youtube.com/watch?v=kn-FQvecqU&list=PLbMVogVj5nJTLfYTwvct_SlLaxv1b50Vk&index=2
3. https://math.mit.edu/~jorloff/18.04/notes/topic4.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	1	3	9	**37**
CO2	3	3	3	3	1	3	9	**25**
CO3	9	3	3	3	1	3	9	**31**
CO4	9	9	3	3	1	3	9	**37**
CO5	9	9	3	3	3	3	9	**39**
Total	**39**	**33**	**15**	**15**	**7**	**15**	**45**	**169**

Low-1 **Medium-3** **High-9**

Core XI – Measure and Integration

(For Students Admitted from 2024-2025)

Semester: III **Hours / week: 6**
Subject Code: HMMXC331 **Credit: 5**

Course Objectives:

1. To understand the abstract measure theory, definition and main properties of the integral
2. To construct Lebesgue's measure on the real line and in n-dimensional Euclidean space

Unit I **(18 hours)**

Lebesgue Measure: Introduction - Outer measure - Measurable sets and Lebesgue measure - Measurable functions – Littlewood's three principles.

Unit II **(18 hours)**

The Lebesgue Integral: The Riemann integral - The Lebesgue integral of a bounded function over a set of finite measure - The integral of a nonnegative function - The general Lebesgue integral.

Unit III **(18 hours)**

Differentiation and Integration: Differentiation of monotone functions - Functions of bounded variation -Differentiation of an integral - Absolute continuity.

Unit IV **(18 hours)**

Measure and Integration: Measure spaces - Measurable functions - Integration - Signed measures - The Radon-Nikodym Theorem.

Unit V **(18 hours)**

Measure and Outer Measure: Outer measure and measurability - The Extension Theorem - Product measures.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Determine lebesgue integrable and measurable functions
CO 2: Compare the lebsgue integral of a bounded function and a nonnegative function
CO 3: Apply the concept of Measure and integration in theorems
CO 4: Compute integral of derivative with differentiation of an integral
CO 5: Analyze the concepts of measure and outer measure in extension theorem

Text Book:

1. H.L.Royden, *Real Analysis*, Pearson Education Private Limited, 4th Edition, 1988.

Unit I: Chapter 3(Pg. No: 54 - 64, 66 - 74)
Unit II: Chapter 4(Pg. No: 75 - 95)
Unit III: Chapter 5(Pg. No: 97 - 113)
Unit IV: Chapter 11(Pg. No: 253 - 268, 270 - 282)
Unit V: Chapter 12(Pg. No: 288 - 299, 303 - 313)

Reference Books:

1. G. De Barra, *Measure Theory and Integration*, New Age International Private Limited, First Edition, 1981.
2. Inter K Rana, *An Introduction to Measure and Integration*, Narosa Publishing House Private Limited, Second Edition, 2005.
3. M.E.Munroe, *Measure and Integration*, Addison – Wesley Publishing Company, Second Edition, 1971.

E-Resources:

1. https://youtu.be/MxjRffbnNYw
2. https://youtu.be/12kFDeN6xuI
3. https://youtu.be/PGPZ0P1PJfw

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	3	3	3	1	3	3	3	19
CO2	3	3	3	1	3	3	3	19
CO3	9	9	9	3	3	3	3	39
CO4	3	3	3	1	3	3	3	19
CO5	9	9	3	3	3	3	3	33
Total	27	27	21	9	15	15	15	129

Low-1 Medium-3 High-9

Core XII - Mathematical Statistics

(For Students Admitted from 2024-2025)

Semester: III **Hours / week: 6**
Subject Code: HMMXC341 **Credit: 5**

Course objectives:

1. To know the methods to test the hypothesis for large samples
2. To work on chi-square distribution, analysis of variance and test for independence of Attributes

Unit I **(18 hours)**

Sample moments and their functions: Notion of a sample and a statistic - Distribution functions of χ^2, s^2 and ($\chi 2$, s^2) $-\chi^2$ distribution - Student t- distribution - Fisher's Z-distribution - Snedecor's F-distribution – Distribution of Sample mean from non-normal populations.

Unit II **(18 hours)**

Significance Test: Concept of a statistical test - Parametric tests for smallsamples and large samples - c2 test Kolmogorov Theorem - Smirnov Theorem - Tests of Kolmogorov and Smirnov type - The Wald - Wolfovitz and Wilcoxon-Mann-Whitney tests - Independence Tests by contingency tables.

Unit III **(18 hours)**

Estimation: Preliminary notion - Consistency estimation - Unbiased estimates- Sufficiency - Efficiency - Asymptotically most efficient estimates - methods of finding estimates-confidence Interval.

Unit IV **(18 hours)**

Analysis of Variance: One way classification and two-way classification. Hypotheses Testing Poser functions - OC function- Most Powerful test - Uniformly most powerful test - unbiased test.

Unit V **(18 hours)**

Sequential Analysis: SPRT - Auxiliary Theorem - Wald's fundamental identity - OC function and SPRT - E(n) and Determination of A and B - Testing a hypothesis, concerning p on 0-1 distribution and m in Normal distribution.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Apply the Probability theory for solving the Random Experiment
CO2: Analyze various measures of central tendency, interval estimation and their characteristics
CO 3: Evaluate the mean and variance of special probability distribution
CO 4: Determine exact and approximate confidence intervals
CO 5: Make use of chi square test to evaluate the best fit of hypothesized distribution

Text books:
1. M. Fisz, *Probability Theory and Mathematical Statistics*, John Wiley and Sons, New York,2012.

Unit I: Chapter 9 (Sections 9.1 to 9.8)
Unit II: Chapter 10,11 & 12 (Sections 10.11, 12.1 to 12.7)
Unit III: Chapter 13 (Sections 13.1 to 13.8)
Unit IV: Chapter 15 (Sections 15.1 and 15.2) & Chapter 16 (Sections 16.1 to 16.5)
Unit V: Chapter 17 (Sections 17.1 to 17.9)

Reference Books:
1. E.J.Dudewicz and S.N.Mishra, *Modern Mathematical Statistics*, John Wiley and Sons,New York, 1988.
2. V.K.Rohatgi, *An Introduction to Probability Theory and Mathematical Statistics*, WileyEastern Ltd., New Delhi, 1988(3rd Print).
3. G.G.Roussas, *A First Course in Mathematical Statistics*, Addison Wesley PublishingCompany, 1973.
4. B.L.Vander Waerden, *Mathematical Statistics*, G.Allen & Unwin Ltd., London, 19

E-Resources:
1. https://youtu.be/_JVzgkBkfew
2. https://youtu.be/_JVzgkBkfew
3. https://youtu.be/pXVnfUtrhmA

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	9	9	3	9	9	**51**
CO2	9	9	9	3	9	9	9	**57**
CO3	3	3	9	3	9	9	9	**45**
CO4	3	3	9	3	9	9	9	**45**
CO5	1	3	9	3	9	9	9	**43**
Total	**19**	**27**	**45**	**21**	**39**	**45**	**45**	**241**

Low-1 **Medium-3** **High-9**

DSE III - Optimization Techniques

(For Students Admitted from 2024-2025)

Semester: III **Hours / week: 6**
Subject Code: HMMXE31B **Credit: 5**

Course Objectives:

1. To analyze the formulation and solution of different inventory models and queuing systems
2. To familiarize the implementation of the course content in day - to - day life

Unit I **(18 hours)**

Integer Linear Programming: Illustrative Applications - Integer Programming Algorithms: Branch and Bound Algorithm - Cutting-Plane Algorithm.

Unit II **(18 hours)**

Deterministic Dynamic Programming: Recursive Nature of DP Computations - Forward and Backward Recursion - Selected DP Applications - Problem of Dimensionality.

Unit III **(18 hours)**

Queuing Systems: Elements of a Queuing Model - Role of Exponential Distribution - Pure Birth and Death Models - General Poisson Queuing Model - Specialized Poisson Queues.

Unit IV **(18 hours)**

Inventory Modeling: Inventory Problem - Role of Demand in the Development of Inventory Models - Static Economic - order - Quantity (EOQ) Models - Dynamic EOQ Models.

Unit V **(18 hours)**

Non-Linear Programming: Unconstrained Algorithms – Direct search Method – Gradient Method – Constrained Algorithms – Constrained Algorithms – Separable Programming – Quadratic Programming – chance- Constrained Programming- Linear Combinations Method – SUMT Algorithm.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Formulate and solve pure and mixed integer programming models using Branch and Bound Algorithm and Cutting plane Algorithm
CO 2: Make use of Dynamic programming and its applications to find the solution of the real life problems
CO 3: Analyze Pure Birth and Death Model
CO 4: Determine the solution of the inventory problem using Inventory models
CO 5: To solve the nonlinear programming formulation with various method

Text Book:

1. Hamdy A. Taha, *Operations Research: An Introduction*, Prentice Hall of India, Tenth Edition, 2017.

Unit I: Chapter 9 (9.1 - 9.2)
Unit II: Chapter 12 (12.1 - 12.4)

Unit III: Chapter 18 (18.2 – 18.6)
Unit IV: Chapter 13 (13.1 – 13.4)
Unit V: Chapter 21 (21.1– 21.2)

Reference Books:

1. Kanti Swarup, P.K.Gupta, Man Mohan, *Operations Research*, Sultan Chand & Sons Educational Publishers, New Delhi, Thirteenth Edition, 2006.
2. Ravindran, Philips, Solberg, *Operations Research - Principle and Practice*, Wiley India, Second Edition, 2012.
3. Fredrick S.Hillier, Gerald J.Lieberman, *Operations Research Concepts and Cases*, Tata Mc Graw Hill Publishing Company Limited, Eighth Edition, 2009.

E-Resources:

1. https://www.youtube.com/watch?v=dGqsH-1EWmg
2. https://www.youtube.com/watch?v=5ZkYEYsJQvU
3. https://www.youtube.com/watch?v=WG0mhsfcqvk

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	9	9	3	9	9	3	**51**
CO2	9	9	9	3	9	9	9	**57**
CO3	9	9	9	3	3	9	9	**51**
CO4	9	9	9	3	9	9	9	**57**
CO5	9	9	9	9	9	9	9	**63**
Total	**45**	**45**	**45**	**21**	**39**	**45**	**39**	**279**

Low-1 Medium – 3 High - 9

Core XIII – Differential Geometry

(For Students Admitted from 2024-25)

Semester: IV **Hours / week: 6**
Subject Code: HMMXC41 **Credit: 5**

Course Objectives:

1. To understand Surfaces, Smooth surfaces, Tangents, Normals and Quadric Surfaces
2. To introduce the concepts of Lengths of Curves on Surfaces, Isometries of Surfaces, Conformal Mappings of Surfaces

Unit I **(20 hours)**

The Theory of Space Curves: Introductory remarks about space curves - Definitions - Arc length, Tangent, normal and binormal - Curvature and torsion of a curve given as the Intersection of two surfaces.

Unit II **(16 hours)**

Contact between curves and surfaces: Tangent surface, involutes and evolutes -Intrinsic equations, fundamental existence theorem for space curves - Helices.

Unit III **(18 hours)**

The Metric: Local Intrinsic Properties of a Surface: Definition of a surface - Curves on a Surface - Surfaces of revolution - Helicoids - Metric - Direction coefficients - Families of curves - Isometric correspondence - Intrinsic properties.

Unit IV **(20 hours)**

Geodesics: Canonical geodesic equations - Normal property of geodesics - Existence Theorems - Geodesic parallels - Geodesic curvature - Gauss-Bonnet theorem - Gaussian curvature.

Unit V **(16 hours)**

The second fundamental form: Local non-intrinsic properties of a surface: Principal Curvatures - Lines of curvature.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Explain the concept of space curves

CO 2: Describe the structures of curves and surfaces and find its involutes and evolutes of the curves

CO 3: Determine the properties of helicoids

CO 4: Make use of Geodesic curvature, to solve the problems

CO 5: Illustrate the fundamental concepts in Normal property of geodesic and intrinsic Values

Text Book:

1. T. J. Willmore, *An Introduction to Differential Geometry*, Oxford University Press, 2006.

Unit I: Chapter 1(Pg. No: 1 - 18)
Unit II: Chapter 1(Pg. No: 18 - 27)
Unit III: Chapter 2(Pg. No: 31 - 54)
Unit IV: Chapter 2(Pg. No: 54 - 80)
Unit V: Chapter 3(Pg. No: 95 - 101)

Reference Books:

1. D. Somasundaram, *Differential Geometry A First Course*, Narosa Publishing House, Sixth Reprint, 2014.
2. Christian Bar, *Elementary Differential Geometry,* Cambridge University Press India Pvt., Ltd., First Edition, 2011.
3. D.J.Struik, *Classical Differential Geometry,* Addison Wesley Publishing Company Inc., Massachusetts 1961.

E-Resources:

1. https://www.youtube.com/watch?v=qC5nJzhjDew
2. https://www.youtube.com/watch?v=W94y9IoE8do
3. http://uregina.ca/~mareal/cs8.pdf
4. https://www.youtube.com/watch?v=_-3OpGPD8lc

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	3	3	3	3	3	3	27
CO2	3	3	3	3	3	9	3	27
CO3	9	3	3	3	3	1	3	25
CO4	9	9	3	3	1	9	3	37
CO5	3	9	3	3	1	3	3	25
Total	33	27	15	15	11	25	15	141

Low-1 Medium-3 High-9

Core XIV -Functional Analysis

(For Students Admitted from 2024-25)

Semester: IV **Hours / week: 6**
Subject Code: HMMXC421 **Credit : 5**

Course Objectives:

1. To recognize the concept of Hilbert space and its properties
2. To apply the properties of Banach space and Hilbert space for proving some theorems

Unit I **(20 hours)**

Normed space: Banach space - Further Properties of Normed spaces - Finite Dimensional Normed spaces and subspaces - Compactness and Finite Dimension - Linear Operators – Bounded and Continuous Linear Operators - Linear Functionals - Normed Spaces of Operators - Dual Space.

Unit II **(18 hours)**

Inner Product Spaces: Hilbert Space - Further Properties of Inner Product Space - Orthogonal Complements and Direct Sums - Orthonormal Sets and Sequences – Series Related to Orthonormal Sequences and Sets - Total Orthonormal Sets and Sequences.

Unit III **(16 hours)**

Representation Of Functional On Hilbert Space: Riesz's Theorem - Hilbert Adjoint Operator - Self - Adjoint, Unitary and Normal Operators.

Unit IV **(18 hours)**

Hahn - Banach Theorem: Hahn - Banach Theorem for Complex Vector Spaces and Normed Spaces - Adjoint Operator - Reflexive Spaces - Category Theorem - Uniform Boundedness Theorem.

Unit V **(18hours)**

Strong and Weak Convergence: Convergence of Sequences of Operators and Functionals – Open Mapping Theorem - Closed Graph Theorem

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Illustrate the concept of normed space and Banach space
CO 2: Analyze the concept of orthogonality on Hilbert space
CO 3: Classify the different kinds of operators on Hilbert space
CO 4: Examine the intervention of continuous linear function in proving Hahn Banach theorem
CO 5: Use the concept of strong and weak convergence of sequence of operators and functional

Text Book:
1. Erwin Kreyszig – *Introductory Functional Analysis with Applications* - John Wiley, 2015.
Unit I: Chapter II (Sec: 2.2-2.8 & 2.10)
Unit II: Chapter III (Sec: 3.1-3.6)
Unit III: Chapter III (Sec: 3.8-3.10)
Unit IV: Chapter IV (Sec: 4.2, 4.3, 4.5, 4.6, 4.7)
Unit V: Chapter IV (Sec: 4.8, 4.9, 4.12, 4.13)

Reference Books:
1. George F. Simmons, *Introduction to Topology and Modern Analysis*, Tata McGraw- Hill, 2009.
2. P K. Jain. O P.Ahuja, Khalil Ahmad, *Functional Analysis*, New Age International Private Limited, 1995.
3. S.Ponnusamy, *Foundation of Functional Analysis*, Narosa Publishing House Private Limited, 2011.
4. D. Somasundaram, *Functional Analysis* S. Viswanathan Private Limited, Chennai, 1994.

E-Resources:
1. https://nptel.ac.in/courses/111/105/111105037/
2. https://www.youtube.com/watch?v=niu20BxClhA
3. https://www.youtube.com/watch?v=nzpEsT40ks0
4. https://www.mit.edu/~9.520/spring09/Classes/mathcamp01.pdf
5. http://calvino.polito.it/~terzafac/Corsi/functional_analysis/pdf/chap1.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	1	1	3	9	**35**
CO2	9	3	9	1	1	3	9	**35**
CO3	3	3	3	1	1	1	3	**15**
CO4	3	3	1	1	1	1	3	**13**
CO5	3	3	3	1	1	3	3	**17**
Total	**27**	**15**	**25**	**5**	**5**	**11**	**27**	**115**

Low-1 **Medium-3** **High-9**

Core XV - Project

(For Students Admitted from 2024-25)

Semester: IV **Hours/week: 18**
Subject Code: HMMXC43PW **Credit: 5**

Course Objectives:

1. To provide skills for high quality research and teaching in the field of Mathematics
2. To develop the knowledge, skills and attitudes necessary to pursue further studies in Mathematics

Project Outline:

1. The students undertake the project during the IV semester after the preliminary steps of student and staff allotment and topic selection in the III semester
2. The student's progress is periodically assessed by the project guide through presentation
3. The significant research work is encouraged for presentations and publications in Conferences and Journals
4. Selection of the field of study, topic & research design
5. Collection of literature review
6. Analysis, Conclusion & Preparation of rough draft

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Make use of research methodology and techniques of the literature applicable to their own research
CO 2: Determine solutions to the unsolved problems
CO 3: Analyze the abilities and techniques in the critical evaluation of current research
CO 4: Apply new ideas in the respective field of study and environment
CO 5: Design innovative projects with the application of mathematical concepts towards scientific and societal development

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	1	3	1	9	**63**
CO2	9	9	9	1	1	3	9	**41**
CO3	9	9	9	1	3	1	9	**41**
CO4	9	9	9	1	1	1	9	**39**
CO5	9	9	9	1	1	1	9	**39**
Total	**45**	**45**	**45**	**5**	**9**	**7**	**45**	**201**

Low-1 **Medium-3** **High-9**

DSE COURSE FOR OTHER PG PROGRAMME FOR M Sc & MCA
DSE II - Probability and Applied Statistics

(For Students Admitted from 2024-2025)

Semester: II **Hours / week: 6**
Subject Code: HMITE2A/ IMCAE2A **Credit: 5**

Course Objectives:

1. To know the methods to test the hypothesis for large samples
2. To work on chi-square distribution, analysis of variance and test for independence of attributes

Unit I **(18 hours)**

Probability Theory: Random Experiment - Mathematical or Apriori Definition of Probability - Statistical or Aposteriori Definition of probability - Axiomatic Definition of Probability - Conditional Probability - Independent Events - Theorem of Total Probability – Baye's Theorem or Theorem of Probability of Causes - Random Variables.

Unit II **(18 hours)**

Statistical Averages: Statistical Measures - Measure of Central Tendency - Mathematical Expectation and Moments - Relation between Central and Non central Moments –Dispersion - Definitions - The Coefficient of variation - Properties of variation - Skewness – Kurtosis - Pearson's Shape Coefficient of Skewness - Expected values of Two-Dimensional random variable - Properties of Expected Values - Conditional Expected Values -Properties.

Unit III **(18 hours)**

Some Special Probability Distributions: Introduction - Special Discrete Distributions - Mean and Variance of the Binomial Distribution - Recurrence Formula for the Central Moments of the Binomial Distribution - Poisson Distribution as Limiting form of Binomial Distribution - Mean and Variance of Poisson distribution - Geometrical Distribution - Standard Normal Distribution - Normal Probability Curve - Properties of the Normal Distribution - Importance of Normal Distribution.

Unit IV **(18 hours)**

Tests of Hypothesis: Parameters and Statistics - Sampling Distribution - Estimation and Testing of Hypothesis - Tests of Hypothesis and Tests of Significance - Critical Region and Level of Significance - Errors in Testing of Hypotheses - One-tailed and two-tailed Tests - Critical Values or Significant Values - Procedure for Testing of Hypotheses - Interval Estimation of Population Parameters - Tests of Significance for Large Samples.

Unit V **(18 hours)**

Chi-Square Distribution: Properties of Distribution - Uses of Distribution-Test of Goodness of Fit - Conditions for the Validity of Test - test of Independence of Attributes.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Apply the Probability theory for solving the Random Experiment

CO2: Analyze various measures of central tendency, interval estimation and their characteristics

CO 3: Evaluate the mean and variance of special probability distribution
CO 4: Determine exact and approximate confidence intervals
CO 5: Make use of chi square test to evaluate the best fit of hypothesized distribution

Text Book:

1. T.Veerarajan, *Probability, Statistics and Random Processes*, Tata McGraw HillEducation Private Limited, Third Edition, 2009.

Unit I: Chapter 1, 2 (Pg. No: 1 - 17 & 33 - 57)
Unit II: Chapter 4 (Pg. No: 111 - 120)
Unit III: Chapter 5 (Pg. No: 208 - 215 & 246 - 255)
Unit IV: Chapter 8 (Pg. No: 419 -426)
Unit V: Chapter 8 (Pg. No: 466 -468)

Reference Books:

1. S. Arumugam and A. Thangapandi Isaac, *Statistics*, New Gamma Publishing House, July 2009.
2. S.C Gupta, *Fundamental of Statistics*, Himalaya Publishing House, Seventh Edition,2012.
3. Mood. A. M. Graybill, F.A & Boes D.G, *Introduction to Theory of Statistics*, McGraw Hill, 1974.

E-Resources:

1. https://youtu.be/_JVzgkBkfew
2. https://youtu.be/_JVzgkBkfew
3. https://youtu.be/pXVnfUtrhmA

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	9	9	3	9	9	**51**
CO2	9	9	9	3	9	9	9	**57**
CO3	3	3	9	3	9	9	9	**45**
CO4	3	3	9	3	9	9	9	**45**
CO5	1	3	9	3	9	9	9	**43**
Total	**19**	**27**	**45**	**21**	**39**	**45**	**45**	**241**

Low-1 **Medium-3** **High-9**

B Sc MATHEMATICS

(Three Year Regular Programme)
(For Students Admitted from 2024-25)

Program Specific Outcomes

PSO 1: Domain Knowledge: Propagate the basic knowledge of the concern discipline and demonstrate practical skills, and technical knowledge along with domain knowledge of different subjects in the science stream.

PSO 2: Scientific Knowledge: Apply scientific reasoning in the approach to handle professional matters, communicate the solutions to stakeholders and enable them to understand and appreciate the outcomes

PSO 3: Critical Thinking: Able to excel our thinking, and actions which are granted in different perceptive and facilitate the needed actions to manipulate and rectify them

PSO 4: Social Interaction: realize/ identify/ classify social and environmental problems and contribute the computational expertise to face the challenges and provide sustainable solutions

PSO 5: Employability Skills: Equip the students for getting prominent careers in industry in mathematical sciences and allied fields

PSO 6: Self-Learning: Able to adapt oneself to technological advancements in computing and engage in life-long self-learning for personal development in the context of interdisciplinary nature of future endeavors

PSO 7: Problem Solving Skill: Investigate, design and apply appropriate methods to solve problems in science, mathematics, technology and/or engineering

PREAMBLE

1. Introduced the Extra credit courses “Lattice Theory” (II Semester) and “Boolean Algebra” (III Semester).
2. Introduced the Discipline Specific Elective Course “Astronomy” instead of “Fourier and Laplace Transforms” and transferred from V semester to VI Semester instead of “Lattice theory and Boolean Algebra”.
3. Modified the syllabus for the Core Course “Graph Theory” and transferred from V Semester to III Semester.
4. Modified the Open Elective Course “Quantitative Aptitude for competitive Examinations – I” (III Semester) and “Quantitative Aptitude for competitive Examinations – II” (IV Semester).
5. Interchanged the Core Courses “Abstract Algebra” (V Semester) and “Linear Algebra” (IV Semester).
6. introduced the Discipline Specific Elective Course “Coding Theory” (V Semester) instead of Fluid Dynamics.
7. The Core Course “Numerical Analysis (VI Semester) has been renamed as “Numerical Methods”.
8. The Core Course “Sequence and Series” transferred from III Semester to IV Semester.
9. The Core Course “Real Analysis” transferred from IV Semester to V Semester.
10. Introduced the Skill Enhancement Course “Numerical Methods lab using Python” (VI Semester) instead of Applied Statistics.
11. Introduced the Ability Enhancement Compulsory Course Numerical Methods instead of Discrete Mathematics (I Semester) for B Sc Cyber Security.

PROGRAM STRUCTURE

Programme Code: UMX

Sem	Part	Subject code	Course	Subject Title	Hours / Week	Credits	CIA	ESE	Total
I	I	IBLT112 / IBLA111 / IBLH111	Language I	Tamil I / Arabic I / Hindi I	5	3	25	75	100
	II	IBLEIB12/ IBLEIIA12	Language II	Language through Literature I Level I (Basic) / Language through Literature I Level II (Advanced)	5	3	25	75	100
	III	IBMXC11	Core I	Calculus	5	4	25	75	100
		IBMXC12	Core II	Theory of Equations &Trigonometry	6	5	25	75	100
		IBMXA131	AECC I	Mathematical Statistics – I	5	4	25	75	100
	IV	IBMXS14P	SEC I	Theory of Equations with SCILAB	2	2		50	50
			Library/ Browsing		1				
			Remedial / Games		1				
		Total			**30**	**21**	**125**	**425**	**550**
II	I	IBLT212 / IBLA211 / IBLH211	Language I	Tamil II / Arabic II /Hindi II	5	3	25	75	100
	II	IBLEIB22 / IBLEIIA22	Language II	Language through Literature II Level I (Basic) / Language through Literature II Level II (Advanced)	5	3	25	75	100
	III	IBMXC21	Core III	Analytical Geometry - 3D & Vector Calculus	5	5	25	75	100
		IBMXC22	Core IV	Differential Equations	4	4	25	75	100
		IBMXA231	AECC II	Mathematical Statistics - II	5	4	25	75	100
	IV	IBMXS24P	SEC II	Analytical Geometry with Geogebra	2	2		50	50
		IBES2	GIC I	Environmental Science	2	2		50	50

		IBMXX21 / IBMXX2O	Extra Credit	Lattice Theory / * Online Course		2		100	100
			Library/ Browsing		1				
			Remedial / Games		1				
		Total			**30**	**23+2**	**125**	**475 +100**	**600+ 100**
III	I	IBLT311/ IBLA31/ IBLH311	Language I	Tamil III / ArabicIII /Hindi III	5	3	25	75	100
	II	IBLEIB32 / IBLEIIA32	Language II	Language through Literature III Level I (Basic) / Language through Literature III Level II (Advanced)	5	3	25	75	100
	III	IBMXC311	Core V	# Foundation Course in Mathematics	4	4	25	75	100
		IBMXC322	Core VI	Graph Theory	4	4	25	75	100
		IBMXA33P	AECC III	Programming in"C" Lab	4	4	25	75	100
	IV	IBOE3MX1	OEC I	QuantitativeAptitude forCompetitive Examinations – I	2	2		50	50
		IBMXS34	SEC III	Fourier Series	2	2		50	50
		IBHR3	GIC II	Human Rights	2	2		50	50
	V	IBXTN3	Extension	NSS/CSS	2	2	100		100
		IBMXX31 / IBMXX3O	Extra Credit	Boolean Algebra / *Online Course		2		100	100
		Total			**30**	**26+2**	**225**	**525 + 100**	**750+ 100**
IV	I	IBLT41/ IBLA41/ IBLH411	Language I	Tamil IV / ArabicIV / Hindi IV	5	3	25	75	100
	II	IBLEIB42 / IBLEIIA42	Language II	Language through Literature IV Level I (Basic) / Language through Literature IV Level II (Advanced)	5	3	25	75	100
	III	IBMXC411	Core VII	○ Linear Algebra	5	4	25	75	100
		IBMXC421	Core VIII	Sequence and Series	4	4	25	75	100
		IBMXA43	AECC IV	Programming inJava	5	4	25	75	100

	IV	IBLVE4	GIC III	Life Skills and Value Education	2	2		50	50
		IBOE4MX1	OEC II	Quantitative Aptitude forCompetitive Examinations – II	2	2		50	50
		IBMXS44P	SEC IV	R Tool Lab	2	2		50	50
		IBMXX4/ IBMXXO	Extra Credit	Applications ofGroup Theory/ *Online Course		2		100	100
		Total			**30**	**24+2**	**125**	**525+ 100**	**650+ 100**
V	III	IBMXC512	Core IX	Abstract Algebra	6	5	25	75	100
		IBMXC522	Core X	Real Analysis	6	5	25	75	100
		IBMXC532	Core XI	Mechanics	6	5	25	75	100
		IBMXE51A/ IBMXE5B	DSE I	Astronomy/ Combinatorics	4	4	25	75	100
		IBMXE51C/ IBMXE52D	DSE II	○ Operations Research / Coding Theory	4	4	25	75	100
	IV	IBMXS54P	SEC V	Operations Research Lab- LINDO / LINGO Package	2	2		50	50
		IBWE5	GIC IV	Women Entrepreneurship	2	2		50	50
		IBESX5/ IBMXX5O	Extra Credit	Employability Skills / * OnlineCourse		2	100	-	100
		Total			**30**	**27+2**	**125+ 100**	**475**	**600+ 100**
VI	III	IBMXC611	Core XII	Complex Analysis	6	5	25	75	100
		IBMXC622	Core XIII	Numerical Methods	6	4	25	75	100
		IBMXC631	Core XIV	Number Theory	5	4	25	75	100
		IBMXC64PW	Core XV	Project	6	5	25	75	100
		IBMXE6A / IBMXE6B	DSE III	Fourier and Laplace Transforms/ Mathematical Modeling	4	4	25	75	100
	IV	IBMXS651P	SEC VI	Numerical Methods Lab using Python	2	2		50	50

			Library/ Browsing		1				
		IBMXX6/ IBMXX6O	Extra Credit	QuantitativeTechniques / *Online Course		2		100	100
		Total			**30**	**24 + 2**	**125**	**425 + 100**	**550 + 100**
		Grand Total			**180**	**145 + 10**	**850 + 100**	**2850 + 400**	**3700 + 500**

*For Online certification credit alone will be assigned on submission of certificate obtained through appearing for Online Examination from EDX, Spoken Tutorial, NPTEL or Coursera.

o Integrated Course

Internship Training

OEC for Students Other than B Sc Mathematics

Sem	Part	Subject code	Course	Subjet Title	Hours / Week	Credit	CIA	ESE	Total Marks
III	IV	IBOE3MX1	OEC I	Quantitative Aptitude for Competitive Examinations – I	2	2	-	50	50
IV	IV	IBOE4MX1	OEC II	Quantitative Aptitude for Competitive Examinations – II	2	2	-	50	50

AECC for other UG Programme (B Sc Information Technology)

Sem	Part	Subjectcode	Course	Subject Title	Hours / Week	Credit	CIA	ESE	Total Marks
III	III	IBITA331	AECC III	Discrete Mathematics	4	4	40	60	100
IV	III	IBITA43	AECC IV	Statistics	5	4	40	60	100

AECC for other UG Programme (B Sc Computer Science)

Sem	Part	Subjectcode	Course	Subject Title	Hours / Week	Credit	CIA	ESE	Total Marks
III	III	IBCSA33	AECC III	Statistics	4	4	40	60	100
IV	III	IBCSA43	AECC IV	Operations Research	5	4	40	60	100

AECC for other UG Programme (BCA & B Sc Cyber Security)

Sem	Part	Subject code	Course	Subject Title	Hours / Week	Credit	CIA	ESE	Total Marks
I	III	IBCPA131	AECC I	Numerical Methods	4	4	40	60	100
I	III	IBCYA132	AECC II	Numerical Methods	5	4	40	60	100
III	III	IBCYA33	AECC III	Statistics	4	4	40	60	100
IV	III	IBCYA43	AECC IV	Operations Research	5	4	40	60	100

AECC for other UG Programme (B Sc Chemistry & B Sc Psychology)

Sem	Part	Subject code	Course	Subject Title	Hours/ Week	Credit	CIA	ESE	Total Marks
I	III	IBCHA13	AECC I	Mathematics - I	5	4	40	60	100
II	III	IBCHA23	AECC II	Mathematics- II	5	4	40	60	100
III	III	IBSYA33	AECC III	Psychological Statistics - Descriptive	4	4	40	60	100
IV	III	IBSYA43	AECC IV	Psychological Statistics - Inferential	5	4	40	60	100

AECC - Ability Enhancement Compulsory Course

SEC – Skill Enhancement Course

DSE – Discipline Specific Elective

OEC – Open Elective Course

Core I - Calculus

(For Students Admitted from 2024-25)

Semester: I **Hours / week: 5**

Subject Code: IBMXC11 **Credit: 4**

Course Objectives:

1. To gain basic knowledge in differentiation and integration
2. To know about envelope, curvature and evolute of a curve

Unit I **(15 hours)**

Tangent and Normal: Sub tangent and subnormal - Differential coefficient of the length of an arc of y = f(x) - Polar coordinates.

Unit II **(15 hours)**

Envelopes Curvature of Plane Curves: Envelopes- Curvature - The Co-ordinates of the center of curvature - Evolute and Involute - Chord of Curvature.

Unit III **(15 hours)**

Linear Asymptotes: Special Cases - Another Method for finding asymptotes - Asymptotesby inspection - Intersections of a curve with its asymptotes.

Unit IV **(15 hours)**

Integration: Properties of definite integrals-Integration by parts, Reduction formulae-Bernoulli's formula.

Unit V **(15 hours)**

Multiple integrals: Definition of double integrals - Evaluation of double integral - Double integral in polar co-ordinates - Triple integrals - Applications of Multiple integrals.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Identify the tangent, sub tangent, subnormal, polar sub tangent, polar subnormal of a curve

CO 2: Evaluate envelope, radius and centre of curvature, evolute of a curve and polarequation

CO 3: Analyze the concept of Asymptotes and Properties of definite integrals

CO 4: Examine the techniques of integration

CO 5: Compute the area and centroid of curvature by using double and triple integrals

Text Books:

1. S. Narayanan, T. K. Manicavachagom Pillay, *Calculus - Volume I***,** S. Viswanathan Printers & Publishers Private Limited, 2017.

Unit I: Chapter 9

Unit II: Chapter 10

Unit III: Chapter 11

2. S. Narayanan, T. K. Manicavachagom Pillay, *Calculus - Volume II*, S. Viswanathan Printers & Publishers Private Limited, 2017.

Unit IV: Chapter 1(sec 11 - 15.1)

Unit V: Chapter 5(sec 1 - 5.4)

Reference Books:

1. Dr. S. Arumugam & A. Thangapandi Issac, *Calculus*, New Gamma Publishing House,June 2014.
2. Shanthi Narayan and P. K. Mittal *Differential Calculus*, S. Chand & Company, 2008.
3. George B. Thomas, Jr. & Ross L. Finney, *Calculus*, Pearson Education (Singapore)Private Limited, Indian Branch, Seventh Edition, Reprint, 2004.

E-Resources:

1. https://www.mathcentre.ac.uk/resources/uploaded/mc-ty-tannorm-2009-1.pdf
2. https://nitkkr.ac.in/docs/5-Multiple%20Integrals%20and%20their%20Applications.pdf

3. https://www.khanacademy.org/math/multivariable-calculus/integrating- multivariable-functions/double-integrals-a/v/polar-coordinates-1

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	3	3	3	1	3	3	3	19
CO2	3	3	3	1	3	3	9	25
CO3	3	3	3	1	3	3	3	19
CO4	3	3	3	3	3	9	9	33
CO5	3	3	3	3	3	9	9	33
Total	15	15	15	9	15	27	33	129

Low-1 Medium-3 High-9

Core II- Theory of Equations & Trigonometry

(For Students Admitted from 2024 -25)

Semester: I **Hours / week: 6**
Subject Code: IBMXC12 **Credit: 5**

Course Objectives:
1. To develop the ability and solving different types of algebraic equations
2. To apply and prove trigonometric identities

Unit I **(18 hours)**

Theory of Equations: Introduction about polynomials, equations - Remainder theorem - Imaginary roots - Irrational roots - Relation between roots and coefficients of equations - Symmetric functions of the roots - Sum of the powers of the roots of an equation - Newton's Theorem.

Unit II **(18 hours)**

Theory of Equations: Transformations of equations - Roots with signs changed - Roots multiplied by a given number - Reciprocal roots - Reciprocal equation - Increase and decrease the roots of a given equation by a given quantity - Removal of terms – Equations whose roots are any power of the roots of a given equation.

Unit III **(18 hours)**

Theory of Equations: Descarte's rule of signs–Rolle's theorem - Multiple roots – Strum's theorem – Newton's method of divisors – Horner's method.

Unit IV **(18 hours)**

Theory of Equations: General solution of cubic equations – Cardon's Method – Solution of biquadratic equations – **Expansions:** Expansions of $\sin n\theta$, $\cos n\theta$ and $\tan n\theta$ - Examples on formation of equations.

Unit V **(18 hours)**

Hyperbolic functions: Relation between hyperbolic functions - Inverse hyperbolic functions.
Resolution into factors: Logarithm of complex quantities.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Find the nature of the roots of an equation
CO 2: Examine the relation between roots and coefficients of the equations
CO 3: Solve the roots of the given equation by adopting different methods
CO 4: Determine the solutions of cubic equations by applying the suitable methods
CO 5: Evaluate the hyperbolic functions and inverse hyperbolic function

Text Books:
1. T. K. Manicavachagom Pillai, T. Narayanan and K. S. Ganapathy, *Algebra, Volume I*, S. Viswanathan Publishing Company, 2017.
Unit I: Chapter 6 (Sec 1 - 14)
Unit II: Chapter 6 (Sec 15 -20)
Unit III: Chapter 6 (Sec 24–30)
Unit IV: Chapter 6 (Sec 34 - 35)
2. T. K. Manicavachagom Pillai and S. Narayanan, *Trigonometry*, S. Viswanathan Publishing Company, 2017.
Unit IV: Chapter 3(Pg No.: 61 – 76)
Unit V: Chapter 4 and Chapter 5 (Pg. No.:122 – 130)

Reference Books:
1. N.P. Bali, *Golden Maths, Series Algebra*, Laxmi Publications Private Limited, First Edition, 1990.
2. Dr S. Arumugam & A. Thngapndi Issac, *Algebra, Theory of Equations, Theory of Numbersand Trigonometry*, New Gamma Publishing House, Edition2011.
3. K. Khurana and S.B Malik, *Elementary topics in Algebra*, Vikas Publishing House Private Limited, 1994.

E-Resources:
1. https://www.google.co.in/books/edition/Golden_Algebra
2. https://www.google.co.in/books/edition/HIGHER_ALGEBRA
3. https://youtu.be/oXslbssVBgQ
4. https://youtu.be/zSvo9Qy6-vE
5. https://youtu.be/uMXcKY_w3w4

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	1	3	3	3	9	**25**
CO2	3	3	1	3	1	3	3	**17**
CO3	3	3	3	3	3	3	3	**21**
CO4	3	3	1	3	1	3	3	**17**
CO5	3	3	3	3	3	3	3	**21**
Total	**15**	**15**	**9**	**15**	**11**	**15**	**21**	**101**

Low-1 **Medium-3** **High-9**

AECC I –Mathematical Statistics - I

(For Students Admitted from 2024-25)

Semester: I **Hours / week: 5**
Subject Code: IBMXA131 **Credit: 4**

Course Objectives:

1. To acquire knowledge on moment generating functions and characteristic functions
2. To explain the concept of Probability theory

Unit I **(18 hours)**

Theory of Probability: Axiomatic approach to probability – Some Theorems on Probability –Addition Theorem of Probability – Extension of Addition Theorem of Probability to n Events - Multiplication Theorem of Probability - Independent Events - Pairwise Independent Events - Baye's Theorem.

Unit II **(18 hours)**

Random Variables and Distribution Functions: Introduction - Distribution Function - Discrete Random variable – Continuous random variable – Two Dimensional Random Variables – Two dimensional or Joint Probability Mass Function - Two dimensional distribution functions – Marginal distribution function – Joint Density Function, Marginal Density Function – The Conditional Distribution Function and Conditional Probability Density Function

Unit III **(10 hours)**

Mathematical Expectation and Generating Functions: Introduction - Mathematical Expectation or Expected value of a random variable – Expected value of function of a random variable – Properties of Expectation - Covariance – Moment Generating Function.

Unit IV **(19 hours)**

Discrete Probability Distributions: Binomial Distribution – Moments of Binomial Distribution – Recurrence Relation for the moments of Binomial Distribution – Mean Deviation about mean of Binomial distribution – Mode of Binomial Distribution – Moment Generating Function of Binomial Distribution - Recurrence Relation for the probabilities of Binomial Distribution – Poisson Distribution – The Poisson Process – Moments of the Poisson Distribution – Mode of the Poisson Distribution – Recurrence Relation for moments of the Poisson Distribution – Moment generation function of the Poisson Distribution – Characteristic function of the Poisson Distribution – Additive or Reproductive property of independent Poisson Variates – Probability generating function of Poisson Distribution – Recurrence formula for the probabilities of Poisson Distribution.

Unit V **(10 hours)**

Continuous Probability Distributions: Introduction – Normal Distribution - Normal Distribution as a limiting form of Binomial Distribution – Chief Characteristic of Normal Distribution – Mode of Normal Distribution – Median of Normal Distribution – M.G.F of Normal Distribution – Moments of Normal Distribution – A Linear Combination of independent normal variates – Area Property – Impotence of Normal Distribution – Fitting of Normal Distribution.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Illustrate and differentiate the basic probability concepts
CO 2: Analyze the probability density function to solve the problems
CO 3: Evaluate relationship between joint p.m.f and joint p.d.f
CO 4: Make use of poison and binomial distribution to solve real life problems
CO 5: Classify the Random variables and determine solution to the given problems byMGF

Text Book:
1. S.C.Gupta, V. K. Kapoor, *Fundamntals of Mathematical Statistics***,** Sultan Chand andSons, Twelfth Edition, Reprint 2022.

Unit I: Chapter 3 & 4 (3.8, 3.9, 3.9.1- 3.9.2, 3.11, 3.12, 3.15, 4.2)
Unit II: Chapter 5 (5.1 – 5.5, 5.5.1 – 5.5.5)
Unit III: Chapter 6 & 7 (6.1 – 6.4, 6.6, 7.1)
Unit IV: Chapter 8 (8.4, 8.4.1, 8.4.2, 8.4.4 – 8.4.6, 8.4.12, 8.5, 8.5.1 – 8.5.6, 8.5.8 – 8.5.10)
Unit V: Chapter 9 (9.1, 9.2, 9.2.1 – 9.2.5, 9.2.7, 9.2.8, 9.2.11 – 9.2.13)

Reference Books:
1. S. Arumugam and A. Thangapandi Isaac, *Statistics***,** New Gamma Publishing Houses, Edition 2009.
2. S.C.Gupta, V. K. Kapoor, *Elements of Mathematical Statistics***,** Sultan Chand andSons, Third Editon, Reprint 2015.

E-Resources:
1. https://www.youtube.com/watch?v=JCZAVDTU0hU
2. https://www.youtube.com/watch?v=Fvi9A_tEmXQ
3. https://onlinecourses.nptel.ac.in/noc22_mg31/preview

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	9	3	3	3	**27**
CO2	3	3	9	9	3	3	3	**33**
CO3	3	9	9	9	3	9	3	**45**
CO4	9	9	9	9	3	9	9	**57**
CO5	3	9	9	9	3	9	9	**51**
Total	**21**	**33**	**39**	**45**	**15**	**33**	**27**	**213**

Low-1 **Medium-3** **High-9**

SEC I - Theory of Equations with SCILAB

(For Students Admitted from 2024-25)

Semester: I **Hours / week: 2**
Subject Code: IBMXS14P **Credit: 2**

Course Objectives:
1. To impart knowledge on solving problems on Theory of equations using SCILAB
2. To use SCILAB for polynomial factorization

List of Programmes:

1. Programs implementing solving a linear system
2. Programs implementing find the roots using remainder theorem
3. Programs implementing Roots of polynomial
4. Programs implementing solving a Algebraic equation
5. Programs implementing find the roots using Horner's Method
6. Programs implementing finding the multiple roots of the polynomial
7. Programs implementing finding the real and complex roots of the equation
8. Programs implementing Newton's Method of evaluating a real root
9. Programming implementing find the number of real roots of the equation using Strum's theorem
10. Programming implementing general solution of the cubic equation using Cardon's method
11. Programming implementing solve the cubic equation using Trigonometric method
12. Programming implementing solve the biquadratic equation by Ferrari method

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Identify the fundamental operations theory of equations

CO 2: Notice the commands in SCILAB to solve problems in theory of equations

CO 3: Apply the acquired knowledge on SCILAB to find roots of polynomials

CO 4: SCILAB to solve algebraic equation

CO5: Make use of SCILAB for Horner's Method, Newton's Method, Cardon's method, Trigonometric method and Ferrari method of evaluating a real root

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	1	3	9	3	1	9	**35**
CO2	9	1	9	1	3	1	3	**27**
CO3	3	3	3	9	3	1	9	**31**
CO4	3	9	9	9	9	3	9	**51**
CO5	3	9	1	9	9	3	1	**35**
Total	**27**	**23**	**25**	**37**	**27**	**9**	**31**	**179**

Low-1 Medium-3 High-9

Core III - Analytical Geometry - 3D & Vector Calculus

(For Students Admitted from 2024-2025)

Semester: II **Hours / week: 5**

Subject Code: IBMXC21 **Credit: 5**

Course Objectives:

1. To develop the skill of solving problems related to plane, straight line, spheres in three dimensional

2. To understand the fundamental concepts of vector differentiation and integration

Unit I **(15hours)**

The Plane: Plane Equations - Angle between the planes-Equation to a plane passing through the line of intersection of two given planes - Length of the perpendicular.

Unit II **(15 hours)**

The straight line: Symmetrical form–Image of the point-the plane and the straight line–geometrical shapes-Coplanar Lines.

Unit III **(15 hours)**

The Sphere: Equation of a Sphere: Plane section of a sphere-Equation of a circle– The Intersection of two spheres– Tangent and Tangent plane– Orthogonal spheres.

Unit IV **(15 hours)**

Vector Differentiation: Differentiation of a vector- Geometric interpretation of the Derivative - Differentiation of the Dot and Cross products. **Gradient, Divergence &Curl:** The vector differential operator Del – Gradient of a Scalar function-The Divergence of a Vector – Physical Interpretation of the Divergence of a vector- Physical Interpretation of the Curl of a vector.

Unit V **(15 hours)**

Vector Integration: Integration of a vector: The line integral- Green's theorem in two dimensions–Extension of Green's theorem.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Describe the concepts of planes and solve the related problems
CO2: Explain geometrical shapes and coplanar lines
CO3: Explicate the knowledge on the concepts of sphere
CO4: Make use of different operators, explain the different concepts of vectordifferentiations
CO5: Compute vector integration by using Green's theorem and its extension

Text Book:

1. Dr.M.K.Venkataraman & Mrs.Manorama Sridhar**,** *Analytical Geometry– 3D &Vector Calculus,* the National Publishing Company**,** First Edition. Dec 2001.

Unit I: Chapter 2 (2.1 to 2.13)
Unit II: Chapter 3 (3.1to 3.11)
Unit III: Chapter 4 (4.1to 4.12)
Unit IV: Chapter 2, 3(3.1 to 3.10)
Unit V: Chapter 4 (4.1to 4.4)

Reference Books:

1. Dr**.** S**.** Arumugam & A**.** Thangapandi Isaac, *Analytical Geometry-3D and Vector Calculus***,** New Gamma Publishing House**,** 2006.
2. T.K. Manicavachagom Pillay and T. Natarajan, *A Text Book of Analytical Geometry Part II– Three Dimensions,* S.Viswanathan (Printers &Publishers) Private Limited,2010.
3. P.K. Jain and Khalil Ahmad, *Analytical geometry of Three Dimensions***,** Wiley Eastern Limited, 1994.

E-Resources:

1. http://cloudportal.sathyabama.ac.in/coursematerial_staging/uploads/SMT1303.pdf
2. https://www.youtube.com/watch?v=a2mt2L0e06Y
3. https://www.khanacademy.org/math/multivariable-calculus/greens-theorem-and- stokes-theorem/greens-theorem/v/green-s-theorem-example-1
4. https://learn.lboro.ac.uk/archive/olmp/olmp_resources/pages/workbooks_1_50_jan2008/Workbook15/15_1_integrtn_of_vectors.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	9	3	9	**33**
CO2	3	3	1	3	9	3	9	**31**
CO3	3	3	1	3	9	3	9	**31**
CO4	9	9	3	3	1	3	3	**31**
CO5	9	9	3	3	3	3	3	**33**
Total	**27**	**27**	**11**	**15**	**31**	**15**	**33**	**159**

Low-1 Medium-3 High-9

Core IV- Differential Equations

(For Students Admitted from 2024-2025)

Semester: II **Hours / week: 4**
Subject Code: IBMXC22 **Credit**: **4**

Course Objectives:

1. To distinguish ordinary differential equations from partial differential equations
2. To use Lagrange's method and charpit's method to solve partial differentialequations

Unit I **(12 hours)**

Linear Equations with constant coefficients: Definitions - Complementary function of a linear equation with constant coefficients - Particular integral - General method of finding P.I - Special methods for finding P.I.

Unit II **(12 hours)**

Linear Equations with constant coefficients: Linear equations with variable coefficients, Equations reducible to the Linear equations.

Unit III **(12 hours)**

Simultaneous differential equations: Simultaneous equations of the first order and first degree - Simultaneous linear differential equations - Simultaneous equations with variableco-efficient.

Unit IV **(12hours)**

Linear equations of the second order: Complete solution given a known integral - Reduction to the normal form - Change of the independent variable - Variation of Parameters - Methods of Operational factors.

Unit V **(12hours)**

Partial Differential equations of the first order: Classification of integral - Derivation of partial differential equations – Lagrange's method of solving the linear equation - Special method: standardforms – Charpit's method.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Select the suitable method and find particular integral
CO 2: Determine the solutions of differential equations by various methods
CO 3: Analyze the concepts of simultaneous differential equations and solve the Problems
CO 4: Compute the solution to the problem of linear equations of second order
CO 5: Use Lagrange's and Charpit's methods to solve the partial differential equations

Text Book:

1. S. Narayanan and T.K. Manicavachagom Pillai, *Differential Equations and its Applications*, S. Viswanathan (Printers & Publishers) Private Limited, 2019.

Unit I: Chapter V (Pg.no: 68 - 88)
Unit II: Chapter V (Pg.no: 89 - 102)
Unit III: Chapter VI (Pg.no: 119 - 134)
Unit IV: Chapter VIII (Pg.no: 145 - 160)
Unit V: Chapter XII (Pg.no: 219 - 249)

Reference Books:

1. K.Venkataraman and Mrs. Manorama Sridhar, *Differential Equations and Laplace Transforms*, the National Publishing Company, 2004.
2. Dr. Arumugam and Mr A. Thangapandi Issac, *Differential Equations and Laplace Transfroms*, New Gamma Publishing House, 2014.
3. Nita H. Shah, *Ordinary and Partial differential equations - Theory and Applications*, PHI Learning Private Limited, New Delhi, 2010.
4. Shepley L. Ross, *Differential Equations*, 3rd Ed., John Wiley and Sons, 1984.

E-Resources:

1. https://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/video-lectures/
2. https://solitaryroad.com/c651.html
3. https://youtu.be/VyWBA0THDRk
4. http://people.cs.uchicago.edu/~lebovitz/Eodesbook/lc.pdf

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	9	3	3	1	3	1	29
CO2	9	9	3	3	1	3	3	31
CO3	3	3	3	3	3	3	9	27
CO4	3	3	3	3	1	3	9	25
CO5	3	3	9	3	3	9	9	39
Total	27	27	21	15	9	21	31	151

Low-1 Medium-3 High-9

AECC II – Mathematical Statistics -II

(For Students Admitted from 2024-2025)

Semester: II **Hours / week: 5**
Subject Code: IBMXA231 **Credit: 4**

Course Objectives:

1. To acquire knowledge about the theory of attributes and exact sampling distribution
2. To gain knowledge about the testing of significance for large samples and small samples

Unit I **(18 hours)**

Correlation and Regression: Introduction – Meaning of Correlation - Scatter diagram -Karl Pearson Coefficient of Correlation - Rank Correlation - Introduction – Linear Regression – Regression Coefficients – Properties of Regression Coefficients – Angle between two lines of regression.

Unit II **(10 hours)**

Theory of Attributes: Introduction - Notations and Terminology - Classes and Class frequencies - Consistency of data - Independence of attributes - Association of Attributes.

Unit III **(18 hours)**

Sampling and Large Sample Test: Introduction -Types of Sampling- Parameters and statistic - Tests of Significance – Procedure of Test of hypothesis - Tests of significance for large samples – Sampling of Attributes – Sampling of Variables – Test of significance for Single Mean – Test of Significance for Difference of Means.

Unit IV **(18 hours)**

Exact Sampling Distribution: Introduction – Derivation of the Chi-square Distribution - M.G.F of Chi-Square distribution – Additive Property of Chi – Square Variates – Applications of Chi-Square distribution – Goodness of Fit test – Test of Independence of Attributes – Contingency Tables

Unit V **(11 hours)**

Exact sampling distribution: Introduction – Student's t –Distribution – Derivation of Student's t –Distribution – Application of t- distribution - F- distribution - Applications of F – distribution – F – Test for Equality of Two populations Variances.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Analyze the concept of correlation and regression
CO 2: Estimate and apply all aspects of theory of attributes
CO 3: Classify the concepts of sampling, testing of hypothesis and critical region
CO 4: Analyze the M.G.F of chi-square distribution
CO 5: Justify the concept of Student's t-distribution and F-distribution

Text Book:
1. S.C.Gupta, V. K. Kapoor, *Fundamntals of Mathematical Statistics*, Sultan Chand and Sons, Twelfth Edition, Reprint 2022.

Unit I: Chapter 10 & 11 (10.1 - 10.5, 10.7, 11.1, 11.2, 11.2.1 -11.2.3)
Unit II: Chapter 13 (13.1-13.6)
Unit III: Chapter 14 (14.1-14.7, 14.8.3, 14.8.4)
Unit IV: Chapter 15 (15.1 -15.3, 15.3.5, 15.6.2, 15.6.3)
Unit V: Chapter 16 (16.1, 16.2, 16.2.1, 16.3, 16.6, 16.7, 16.7.1)

Reference Books:
1. S. Arumugam and A. Thangapandi Isaac, *Statistics*, New Gamma Publishing Houses, Edition, 2009.
2. S.C.Gupta, V.K.Kapoor, *Elements of Mathematical Statistics*, Sultan Chand and Sons,Third Editon, Reprint 2015.

E-Resources:
1. https://udrc.lkouniv.ac.in/Content/DepartmentContent/SM_6dc18628-deb8-41c0-b3e0-7f39c1ca0125_38.pdf
2. https://www.youtube.com/watch?v=ktXwySpRrR8
3. https://www.simplypsychology.org/sampling-distribution.html

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	9	3	9	9	9	**45**
CO2	3	3	3	1	3	9	9	**31**
CO3	3	9	9	9	9	9	9	**57**
CO4	3	3	9	9	9	9	9	**51**
CO5	3	9	9	9	9	9	9	**57**
Total	**15**	**27**	**39**	**31**	**39**	**45**	**45**	**241**

Low-1 **Medium-3** **High-9**

SEC II – Analytical Geometry with Geogebra

(For Students Admitted from 2024-2025)

Semester: II **Hours / week: 2**
Subject Code: IBMXS24P **Credit: 2**

Course Objectives:
1. To develop and share classroom materials, and to continually improve and extend the dynamic mathematics software Geogebra

2. To use the Geogebra software to solve the equations, plane, line and Sphere

List of Programmes:

1. Programs implementing Equation of a plane
2. Programs implementing Angle between two planes
3. Programs implementing Equation of a line
4. Programs implementing Angle between a line and a plane
5. Programs implementing Two lines are coplanar
6. Programs implementing Equation of a sphere
7. Programs implementing Equation of a circle
8. Programs implementing Intersection of two spheres
9. Programs implementing Equation of a Tangent Plane
10. Programs implementing Length of a Perpendicular line

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Demonstrate and use Geogebra to find the Equations of a plane and angle betweentwo planes

CO 2: Utilize the Geogebra to solve the Equations of a line

CO 3: Compare Angle between a line and a plane

CO 4: Compute the solution of two lines that are coplanar

CO 5: Verify the results of Equation of a circle and Intersection of two spheres

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	1	3	9	3	1	9	**35**
CO2	9	1	9	1	3	1	3	**27**
CO3	3	3	3	9	3	1	9	**31**
CO4	3	9	9	9	9	3	9	**51**
CO5	3	9	1	9	9	3	1	**35**
Total	**27**	**23**	**25**	**37**	**27**	**9**	**31**	**179**

Low-1 Medium-3 High-9

Extra Credit- Lattice Theory

(For Students Admitted from 2024-2025)

Semester: II

Subject Code: IBMXX21 **Credit: 2**

Course Objectives:

1. To know more about Lattices and their usefulness in other areas of mathematics
2. To develop mathematical foundation to understand, create mathematical arguments and focusing on the formal Languages and Lattices.

Unit I

Posets: Diagrammatical representation of a poset - Isomorphism-Duality -Product of two Posets

Unit II
Lattices: Semi Lattices - Complete Lattices- Sub Lattices.

Unit III
Ideals: Dual Ideals – Principal Ideals –Principal Dual Ideals.

Unit IV
Prime Ideals: Complements – Length and covering condition - Homomorphisms - Quotient Lattices

Unit V
Modular and Distributive Lattices: Modular Lattice - Ideal Lattice - Isomorphism Theorem - Distributive Lattices – Direct Product

Course Outcomes:
After successful completion of this course, student will be able to
CO1: Identify the Posets and product of two Posets
CO2: To know the concept of Lattices
CO3: Examine the properties of ideals and principle Ideals
CO4: Highlight the characteristics of prime Ideals and Modular Lattices
CO5: Categorize the distributive Lattices

Text Book:
1. Vijay K.Khanna, *Lattices and Boolean Algebras*, Vicas Publishing House Private Limited, Second Edition, 2004.

Unit I: Chapter 2(Pages 11-20)
Unit II: Chapter 2(Pages 20-37)
Unit III: Chapter 3 (Pages 38-47)
Unit IV: Chapter 3 (Pages 47-69)
Unit V: Chapter 4(Pages 70 - 95)

Reference Books:
1. Mendelson Elliott, *Theory and Problems of Boolean Algebra*, & Schaums outline Series, NewYork, Mc Graw Hill Publications, 1970.
2. Whitesitt.J Eldon, *Boolean Algebra and its Applications* ,Massachusetts: Adition Wesley,1962
3. P K Agarwal, *Test of Verbal Reasoning for Competitive Examinations*, Edition 2004.

E-Resources:
1. https://www.youtube.com/watch?v=saAkSk_arPA
2. https://www.youtube.com/watch?v=3UkC3sXLqhQ
3. https://www.youtube.com/watch?v=AnZSgCV_QII
4. https://www.youtube.com/watch?v=W0aOoC6rag8

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	3	3	1	3	3	3	9	25
CO2	3	3	1	3	3	3	9	25
CO3	3	3	1	3	3	3	9	25
CO4	3	3	3	3	3	3	9	27
CO5	3	3	3	3	3	3	9	27
Total	15	15	9	15	15	15	45	129

Low-1 Medium-3 High-9

Core V –Foundation course in Mathematics

(For Students Admitted from 2024-2025)

Semester: III **Hours / week: 4**
Subject Code: IBMXC311 **Credit: 4**

Course Objectives:
1. To explain the fundamental ideas of sets and functions
2. To introduce basic logic

Unit I **(12 hours)**
Statements and Logic: Statements - Statements with quantifiers - Compound statements - Implications - Proofs in Mathematics.

Unit II **(12 hours)**
Sets: Basic terminologies - Operations on sets - Family of sets - Power sets - Cartesian product of sets.

Unit III **(12 hours)**
Functions: Basic definitions - One-one, onto functions and bijections - Composition of functions - Inverse of a function - Image of subsets under functions - Inverse image of subsets under functions.

Unit IV **(9 hours)**
Relation: Relations on sets -Types of relations - Equivalence relations - Equivalence classes and partitions of a set.

Unit V **(15 hours)**
Induction Principles: The Induction Principle -The Strong Induction Principle -The Well-ordering Principle -Equivalence of the three principles. **Countability of Sets**: Sets with same cardinality - Finite sets - Countable sets - Comparing cardinality.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Recall some expansions of statements and logic.
CO 2: Classify the variation of sets
CO 3: Explain Basic definitions of functions

CO 4: Analyze the Types of Relations and Solve the Equivalence relations.
CO 5: Evaluate the solution of Induction principles.

Text Book:
1. Ajit Kumar, S. Kumaresan, Bhaba Kumar Sarma, *A Foundation Course in Mathematics*, Alpha Science International Ltd. Oxford, U.K. 2018.

Unit I: Chapter 1
Unit II: Chapter 2
Unit III: Chapter 3
Unit IV: Chapter 4
Unit V: Chapter 5,6

Reference Books:
1. Charles C. , *A Book f Set Theory* ,Dover Publications, Inc. Mineola, New York 2014
2. Paul R. Halmos, *Naive Set theory*, Dover publication.Inc Minelo, New york.

E-Resources:
1. https://youtu.be/oaOm2pnKkyY
2. https://youtu.be/jNcbVOk1P2Y
3. https://youtu.be/oU60TuGHxe0
4. https://youtu.be/jZXHzpq-vmM
5. https://youtu.be/gLT58t2z48A

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	3	3	3	**21**
CO2	3	3	3	3	3	3	3	**21**
CO3	9	9	3	3	3	9	3	**39**
CO4	3	3	3	3	9	3	3	**27**
CO5	3	3	3	3	3	3	3	**21**
Total	**21**	**21**	**15**	**15**	**21**	**21**	**15**	**129**

Low-1 Medium-3 High-9

Core VI - Graph Theory

(For Students Admitted from 2024-25)

Semester: III **Hours / week: 4**
Subject Code:IBMXC322 **Credit: 4**

Course Objectives:
1. To understand and apply the fundamental concepts in graph theory.
2. To understand the various graph structures and their properties in solving the underlying physical problems

Unit I **(11 hours)**

Graphs: Varieties of graphs – Walks and connectedness – Degrees – the problem of Ramsey – Extremal graphs – Intersection graphs – Operations on graphs.

Unit II **(11 hours)**

Blocks: Cutpoints, bridges, and blocks – Block graphs and cutpoint graphs. **Trees:** Characterization of trees – Centers and Centroids – Block cutpoint trees**.**

Unit III **(13 hours)**

Traversability: Eulerian graphs – Hamiltonian graphs. **Planarity:** Plane and planar graphs – Kuratowski's theorem – Genus, thickness, coarseness, cross number.

Unit IV **(13 hours)**

Colorability: The Chromatics Number –The Five Color theorem – The Four Color Conjecture – Critical Graphs – Homomorphisms – The Chromatic Polynomial.

Unit V **(12 hours)**

Digraphs: Digraphs and connectedness – Directional duality and acyclic digraphs – digraphs and matrices – Tournaments.

After successful completion of this course, student will be able to

CO 1: Classify the properties of different types of graphs and their application
CO 2: Apply the concepts to solve the solution of the problems
CO 3: Explain the concept of the graph and identify its applications to fundamental circuits
CO 4: Analyze the concepts of colouring of a graph
CO 5: Build the real life applications to solve the real life problems

Text Book:

1. Frank Harary, *Graph Theory*, Narosa Publishing House, Tenth Reprint 2001.

Unit I: Chapter 2
Unit II: Chapter 3 & 4 (Pg No: 32 -37)
Unit III: Chapter 7 & 11 (Pg No: 102 - 106, 108 - 113, 116- 125)
Unit IV: Chapter 12 (Pg No: 126 - 135, 141 - 149)
Unit V: Chapter 16

Reference Books:

1. Dr. S. Arumugam, S. Ramachandran**,** *Invitation to graph theory* – Scitech Publications Private Limited, First published July 2015.
2. John Clark & Derek Allan Holtan, A First Look at *Graph theory*, Allied Publishers Limited, 1995.

E-Resources:

1. https://www.maths.ed.ac.uk/~v1ranick/papers/wilsongraph.pdf
2. https://d3gt.com/unit.html
3. https://nptel.ac.in/courses/111/106/111106102/
4. https://www.maths.ed.ac.uk/~v1ranick/papers/wilsongraph.pdf
5. https://d3gt.com/unit.html

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	9	3	3	3	3	**33**
CO2	3	9	3	3	3	3	3	**27**
CO3	3	9	9	3	3	3	3	**33**
CO4	3	9	9	3	3	3	3	**33**
CO5	3	3	3	1	1	1	1	**13**
Total	**15**	**39**	**33**	**13**	**13**	**13**	**13**	**139**

Low-1 Medium-3 High-9

SEC III – Fourier Series

(For Students Admitted from 2024-2025)

Semester: III **Hours / week: 2**
Subject Code:IBMXS34 **Credit: 2**

Course Objectives:
1. To get exposed to the concepts of Fourier Series
2. To break up an arbitrary periodic function into a set of simple terms

Unit I **(6 hours)**
Fourier Series: Fourier series - Introduction - Trigonometric series - problems.

Unit II **(6hours)**
Fourier Series: Even and odd functions - Properties of odd and even functions - Half range Fourier series.

Unit III **(6hours)**
Fourier Series: Development in cosine series - Development in sine series -Problems.

Unit IV **(6 hours)**
Fourier Series: Change of interval - Combination of series.

Unit V **(6 hours)**
Fourier Series: Harmonic Analysis - Method 1 - Method 2.

Course Outcomes:
After successful completion of this course, student will be able to
CO1: Find the solution of problem using trigonometric series
CO2: Evaluate Fourier series using properties of odd and even function
CO3: Classify trigonometric functions of sine and cosine and solve problems
CO4: Evaluate Fourier series using change of Interval
CO5: Compute the solution of Harmonic Analysis

Text Book:
1. S. Narayanan & T. K. Manicavachagom Pillay, *Calculus - Volume - III*, S.Viswanathan Printers and Publishers Private Limited, 2013.

Unit I: Chapter 6 (sec 1, 2)
Unit II: Chapter 6 (sec 3, 4)
Unit III: Chapter 6 (sec 5.1, 5.2)
Unit IV: Chapter 6 (sec 6, 7)
Unit V: Chapter 6 (sec 8)

Reference Books:

1. T. Veerarajan, *Engineering Mathematics*, Tata McGraw Hill, Third Edition.
2. S. Arumugam and A. Thangapandi Isaac, *Calculus*, New Gamma Publishing House, 2008.
3. David V. Widder, *Advanced Calculus*, Prentice Hall of India Private Limited, New Delhi, Second Edition, 1996.

E-Resources:

1. https://www.google.co.in/books/edition/Engineering_Mathematics_III
2. https://youtu.be/wDIfrGaskW0
3. https://youtu.be/RleVmK-vkCc
4. https://youtu.be/LGxE_yZYigI

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	3	3	3	**21**
CO2	3	3	3	1	3	3	3	**19**
CO3	3	3	3	1	3	3	1	**17**
CO4	9	3	3	3	3	3	3	**27**
CO5	9	3	3	1	3	3	3	**25**
Total	**27**	**15**	**15**	**9**	**15**	**15**	**13**	**109**

Low-1 **Medium-3** **High-9**

Extra Credit – Boolean Algebra

(For Students Admitted from 2024-2025)

Semester: III
Subject Code:IBMXX31 **Credit: 2**

Course Objectives:

1. To know more about Boolean Algebra and their usefulness in other areas of mathematics
2. To develop mathematical foundation to understand, create mathematical arguments and focusing on the Boolean Algebra and graph theory

Unit I
Boolean algebra: Boolean Algebra – Boolean rings

Unit II
Boolean Functions: Conjunctive Normal Form- Disjunctive Normal Form

Unit III
Switching Circuits: Representation of circuits-Simplification of circuits

Unit IV
Design of Circuits: Don't care conditions –Design of n-terminal circuits

Unit V
Non-Series Circuits: Non-series circuits-Parallel circuits

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Identify the characteristics of Boolean algebra
CO 2: Examine the types of Boolean functions
CO 3: To know the concepts of switching circuits
CO 4: Classify the design of circuits
CO 5: Simplify the parallel circuits

Text Book:
1. Vijay K.Khanna, *Lattices and Boolean Algebras*, Vicas Publishing House Private Limited, Second Edition, 2004.

Unit I: Chapter 5 (Pages 96-110)
Unit II: Chapter 5 (Pages 111-127)
Unit III: Chapter 5 (Pages 127-131)
Unit IV: Chapter 5 (Pages 131-138)
Unit V: Chapter 5 (Pages 138-146)

Reference Books:
1. Mendelson Elliott, *Theory and Problems of Boolean Algebra*, & Schaums outline Series, NewYork, Mc Graw Hill Publications, 1970.
2. Whitesitt.J Eldon, *Boolean Algebra and its Applications* ,Massachusetts: Adition Wesley,1962
3. P K Agarwal, *Test of Verbal Reasoning for Competitive Examinations*, Edition 2004.

E-Resources:
1. https://www.geeksforgeeks.org/boolean-algebra/
2. https://www.youtube.com/watch?v=IQlUxZ9GiVY
3. https://www.youtube.com/watch?v=9RLEt0r0SCs
4. https://www.youtube.com/watch?v=XE_XkPT0pJk

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	9	1	3	1	1	**21**
CO2	3	3	9	1	1	1	1	**19**
CO3	3	3	9	1	1	1	1	**19**
CO4	3	3	9	1	1	1	1	**19**
CO5	3	3	3	1	1	1	1	**13**
Total	**15**	**15**	**39**	**5**	**7**	**5**	**5**	**91**

Low-1 **Medium-3** **High-9**

Core VII- Linear Algebra

(For Students Admitted from 2024-25)

Semester: IV **Hours / week: 5**
Subject Code:IBMXC411 **Credit: 4**

Course Objectives:

1. To gain knowledge on fundamental concepts of the third algebraic system called vector space and linear transformations
2. To understand inner product spaces and their properties

Unit I **(15 hours)**
Vector Spaces: Elementary Basic Concepts - Linear Independence and Bases.

Unit II **(15 hours)**
Linear Equations: Matrices and Elementary Row Operations – Row - Reduced Echelon Matrices – Matrix Multiplication – Invertible Matrices.

Unit III **(17 hours)**
Inner Product Spaces: Introduction - Inner products – Linear functions and Adjoints.

Unit IV **(13 hours)**
Inner Product Spaces: Unitary operations – Normal operations.

Unit V **(15 hours)**
Linear transformations: The Algebra of Linear Transformations – Characteristic Roots.

Course Outcomes:

After successful completion of this course, student will be able to
CO1: Illustrate the concepts of Vector Space
CO2: Assess the different transforms in matrices
CO3: Analyze the concept of Inner product space
CO4: Justify the implication of unitary operations and Normal operations in inner product space
CO5: Measure the roots of linear transformations

Text Books:

1. I.N. Herstein, *Topics in Algebra*, Wiley India Private Limited, New Delhi, Second Edition, 2015.

Unit I: Chapter 4 (4.1, 4.2)
Unit V: Chapter 6 (6.1 & 6.2)

2. Kenneth Hoffman and Ray Kunze, *Linear Algebra*, Second Edition, Prentice Hall of India Private Limited, New Delhi, 2014.

Unit II: Chapter 1 (1.3- 1.6)
Unit III: Chapter 8 (8.1 – 8.3)
Unit IV: Chapter 8 (8.4 & 8.5)

Reference Books:

1. Surjit Singh, *Linear Algebra***,** Vikas Publishing House Private Limited, First Edition, 1997.
2. Dr M K Venkataraman, *Linear Algebra***,** The National Publishing Company, 1999.

3. Gilbert Strang, *Linear Algebra and its Applications*, Cengage Learning India Private Limited, Fourth Edition, 2014.

E-Resources:

1. https://nptel.ac.in/courses/111/104/111104137/
2. https://www.youtube.com/watch?v=ERfbtPBEYVA
3. https://gacbe.ac.in/pdf/ematerial/18BMA51C-U4.pdf
4. https://nptel.ac.in/courses/111/107/111107105/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	3	3	1	3	3	**25**
CO2	3	3	3	3	1	3	3	**19**
CO3	3	3	3	3	1	3	3	**19**
CO4	9	3	3	3	1	3	9	**31**
CO5	9	9	3	3	1	3	9	**37**
Total	**27**	**27**	**15**	**15**	**5**	**15**	**27**	**131**

Low-1 Medium-3 High-9

Core VIII – Sequence and Series

(For Students Admitted from 2024-2025)

Semester: IV **Hours / week: 4**
Subject Code:IBMXC421 **Credits: 4**

Course Objectives:

1. To differentiate a sequence and a series in the mathematical context
2. To understand the fundamentals of sets and functions on real numbers

Unit I **(12 hours)**

Sets and Functions: Sets and elements-Set operations - Functions - Direct and inverse images- Special types of functions-Inverse functions-Composition of functions-Restrictions of functions - Finite and infinite sets - Countable sets –Cantor's theorem.

Unit II **(12 hours)**

Real Numbers: The real line - Suprema and infrima -The completeness property of R-Applications of the supremum property-Functions-Archimedean property - Density of rational numbers in R.

Unit III **(12 hours)**

Sequence and Series: Sequence and their limits - The limit of the sequence –Uniqueness of limits- Limit theorems- Squeeze Theorem-Monotone Sequence-Monotone convergence theorem.

Unit IV **(12 hours)**

Sequence and Series: Subsequences and Bolzano Weierstrass theorem-Divergence criteria-The Cauchy criterion-Cauchy convergence theorem- Introduction to infinite series -
The nth term test- Cauchy criterion for series - Comparison test - Limit comparison test.

Unit V **(12 hours)**

Infinite Series: Absolute convergence - Tests for absolute convergence - The root and ratio tests (statements only)-Integral test (statement only)-Raabe's test (statement only)- Tests for non-absolute convergence-Alternating series-Alternating series test- The Dirichlet and Abel tests(statements only)-Problems.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Compute the direct, inverse images and composition of functions
CO 2: Make use of completeness property of R in the real line
CO 3: Evaluate the limit of the sequence
CO 4: Analyze the concepts of subsequences, series and their application in various fields of sciences
CO 5: Apply various tests to find the absolute convergence of an infinite series of real numbers

Text Book:

1. Robert G. Bartle and Donald R. Sherbert, *Introduction to Real Analysis*, John- Wiley & Sons, Inc., Fourth Edition, 2011.

Unit 1: Chapter 1 (1.1.1 -1.1.14 and 1.3.1 -1.3.13)
Unit 2: Chapter 2 (2.2.7-2.2.9, 2.3.1 -2.3.6 and 2.4.1 -2.4.6, 2.4.8)
Unit 3: Chapter 3 (3.1.1-3.1.11, 3.2.1 -3.2.11 and 3.3.1 -3.3.6)
Unit 4: Chapter 3 (3.4.1-3.4.9, 3.5.1-3.5.6, and 3.7.1 -3.7.9)
Unit 5: Chapter 9 (9.1.1 -9.1.2, 9.2.1 -9.2.10, and 9.3.1 -9.3.5)

Reference Books:

1. S. Kumaresan, *Topology of metric spaces*, Alpha Science International Limited First Edition, 2005.
2. K.Viswanatha, *Real Analysis*, Naik-Emerald Publishers -First Edition.
3. Richard R Goldberg, *Methods of Real Analysis*, Oxford & IBH Publishing Company Private Limited, New Delhi, 1970.

E-Resources:

1. https://www.google.co.in/books/edition/Methods_of_Solving_Sequence_and_Series
2. https://www.whitman.edu/mathematics/calculus/calculus11_Sequences and Series
3. https://youtu.be/teM8h3Nk09I
4. https://s2pnd-matematika.fkip.unpatti.ac.id/wp-content/uploads/2019/03/Real-Analysis-4th-Ed-Royden.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	3	3	3	**21**
CO2	3	3	3	3	3	3	3	**21**
CO3	3	9	9	3	3	3	9	**39**
CO4	9	3	9	3	3	3	9	**39**
CO5	9	9	9	3	1	3	9	**43**
Total	**27**	**27**	**33**	**15**	**13**	**15**	**33**	**163**

Low-1 **Medium-3** **High-9**

SEC IV - R Tool Lab

(For Students Admitted from 2024-2025)

Semester: IV **Hours / week: 2**
Subject Code: IBMXS44P **Credit: 2**

Course Objectives:

1. To navigate and optimize the R integrated development environment (IDE) R Studio and install and load add-in packages
2. To import external data into R for data processing and statistical analysis, learn the main R data structures and compute basic summary statistics

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Classify the basics concept in R programming in terms of constructs, control statements and functions
CO 2: Identify data analytics software
CO 3: Enhance the problem solving, programming and debugging skill
CO 4: Apply the R programming from a statistical perspective
CO 5: Learn and implement the various data structures of R

List of Program

1. Develop a program to implement correlation analysis
2. Develop a program to implement regression analysis
3. Develop a program to implement t-test
4. Develop a program to implement z-test
5. Develop a program to implement f-test
6. Develop a program to implement chi-square test
7. Develop a Program to implement analysis of variance (ANOVA)

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	1	3	9	3	1	9	**35**
CO2	9	1	9	1	3	1	3	**27**
CO3	3	3	3	9	3	1	9	**31**
CO4	3	9	9	9	9	3	9	**51**
CO5	3	9	1	9	9	3	1	**35**
Total	**27**	**23**	**25**	**37**	**27**	**9**	**31**	**179**

Low-1 **Medium-3** **High-9**

Extra Credit – Applications of Group Theory

(For Students Admitted from 2024-2025)

Semester: IV
Subject Code: IBMXX4 **Credit: 2**

Course Objectives:
1. To use group theory in information theory
2. To recognize the concept of error correcting group codes

Unit I
Group theory in matrices: Linear transformations and Matrices - Matrix addition - Matrix multiplication - Diagonal, Permutation and Triangular Matrices.

Unit II
Rectangular Matrices - Inverses - Rank and Nullity - Elementary Matrices - General Equivalence Canonical form - Quaternions.

Unit III
Group theory in information theory - Two metric spaces of continuous random variable – Hamming's codes - Group codes - A detections scheme for group codes - Slepian's Technique for single - error correcting group codes – Hamming's lemma.

Unit IV
Further notes on group codes - Algebraic operations on group codes.

Unit V
The applications of group theory to parity check coding - Matrix of code words – Error patron vectors and received sequences for a group code.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Understand the concept of Matrices and linear transformation
CO 2: Apply the concepts of Matrices in applications of group theory
CO 3: Make use of Group theory in Information theory
CO 4: Analyze the concept of linear transformation and matrices
CO 5: Illustrate the concept of rank and nullity

Text Book:
1. P.N. Arora, *Group theory and Mathematics*, Anmol Publishing House, 1995.
Unit I: Part II (Pg.no: 379 – 395)
Unit II: Part II (Pg.no: 395 – 418)
Unit III: Part II (Pg.no: 435 – 450)
Unit IV: Part II (Pg.no: 450 – 458)
Unit V: Part II (Pg.no: 458 – 468)

Reference Books:
1. Dr. M.K. Venkatraman, Dr. N. Sridharan & Dr. N. Chandrasekaran, *Discrete Mathematics,* Edition, 2006.
2. Arumugam S & Issac. A.T, *Modern Algebra*, Scitech Publications (India) Private Limited, 2007.

3. JK Sharma, *Discrete Mathematics*, Macmillan India Limited, Second Edition, 2005.

E-Resources:

1. https://www.youtube.com/watch?v=kYB8IZa5AuE
2. https://www.youtube.com/watch?v=9IVYVtAuuQs
3. https://home.iitk.ac.in/~peeyush/102A/Lecture-notes.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	9	3	9	**33**
CO2	3	3	3	3	9	3	3	**27**
CO3	3	3	3	3	3	3	3	**21**
CO4	3	3	3	3	9	3	9	**33**
CO5	3	3	3	3	9	3	9	**33**
Total	**15**	**15**	**15**	**15**	**39**	**15**	**33**	**147**

Low-1 Medium-3 High-9

Core IX - Abstract Algebra

(For Students Admitted from 2024-2025)

Semester: V **Hours / week: 6**
Subject Code: IBMXC512 **Credit: 5**

Course Objectives:

1. To learn the basic ideas and notions of abstract algebra which includes Group theory and ring theory
2. To analyze and demonstrate examples of ideals and quotient rings, Use the concepts of isomorphism and homomorphism for groups and rings

Unit I **(18 hours)**

Group Theory: Definition of a Group - Some Examples of Groups – Some Preliminary Lemmas – Subgroups.

Unit II **(18 hours)**

Group Theory: A counting principle - Normal Subgroups and Quotient Groups - Homomorphisms.

Unit III **(18 hours)**

Group Theory: Automorphisms – Cayley's Theorem – Permutation Groups.

Unit IV **(18 hours)**

Ring Theory: Definition and Examples of Rings - Some Special Classes of Rings – Homomorphisms.

Unit V **(18 hours)**

Ring Theory: Ideals and Quotient Rings - More Ideals and Quotient Rings.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Summarize the concept of groups and subgroups and able to find the groups
CO 2: Make use of the concept of normal subgroups, able to construct Quotient group
CO 3: Analyze the concepts of automorphism and permutation groups
CO 4: Compare the types and elucidate the concept of homomorphism of rings
CO 5: Distinguish the types of rings and establish relationship between various types of ideals

Text Books

1. I.N. Herstein, *Topics in Algebra,* Wiley India Private Limited, New Delhi, Second Edition, 2015.

Unit I: Chapters 2 (Sections: 2.1 - 2.4)
Unit II: Chapter 2 (Sections: 2.5 - 2. 7)
Unit III: Chapter 2 (Section: 2.8 - 2.10)
Unit IV: Chapter 3 (Sections: 3.1 - 3.3)
Unit V: Chapter 3 (Sections 3.4 - 3.5)

Reference Books:

1. William J. Gilbert, *Modern Algebra with applications***,** john Wiley & sons, lnc.2005.
2. Jimmie Gilbert**,** Linda Gilbert, *Elements of Modern Algebra***,** Cengage Learning, 5th Edition, 2004.
3. M.L. Santiago, *Modern Algebra*, Tata McGraw Hill Publishing Company Limited, New Delhi.

E-Resources:

1. https://youtu.be/NJN6cQsu0_o
2. https://youtu.be/_RTHvweHlhE
3. https://youtu.be/RatkBWHUSqo
4. https://www.youtube.com/watch?v=OjvZxxLb_78

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	9	3	3	3	9	**39**
CO2	3	9	9	3	1	3	9	**37**
CO3	9	3	9	3	3	3	9	**39**
CO4	9	9	9	3	1	3	9	**43**
CO5	9	3	9	3	1	3	9	**37**
Total	**33**	**33**	**45**	**15**	**9**	**15**	**45**	**195**

Low-1 **Medium-3** **High-9**

Core X – Real Analysis

(For Students Admitted from 2024-2025)

Semester: V **Hours / week: 6**
Subject Code: IBMXC522 **Credit: 5**

Course Objectives:

1. To acquire the knowledge of real functions – Limits of functions and their properties
2. To recognize the concept of Riemann integral and related theorems

Unit I **(18 hours)**

Limits: Limits of functions - Limit theorems - Some extensions of the limit concept.

Unit II **(18 hours)**

Continuous functions - Composition of continuous functions - Continuous functions on intervals - Uniform continuity.

Unit III **(18 hours)**

Differentation: The derivative - The chain rule – Caratheodory's theorem - Inverse functions - The mean value theorem - Interior extremum theorem – Rolle's theorem.

Unit IV **(18 hours)**

Differentation: L'Hospital's rules - Indeterminate forms - Cauchy mean value theorem – L'Hospital's rule I – L' Hospital's rule II - Other indeterminate forms – Taylor's theorem - Applications of Taylor's theorem.

Unit V **(18 hours)**

The Riemann Integral: Riemann Integral - Riemann Integrable Functions - The Fundamental Theorem.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Describe the concepts of limits, continuity, differentiability and integrability of real functions
CO 2: Make use of continuity in Bolzano intermediate value theorem
CO 3: Examine the derivative of L' Hospital's rules and Taylor's theorem
CO 4: Illustrate the concept of Riemann integral and its Properties
CO 5: Differentiate closed set and open set

Text Book:

1. Robert G. Bartle and Donald R. Sherbert, John, *Introduction to Real Analysis*, Wiley & Sons Inc, Fourth Edition, 2011.

Unit 1: Chapter IV (Section: 4.1- 4.3)
Unit 2: Chapter V (Section: 5.1-5.4**)**
Unit 3: Chapter VI (Section: 6.1- 6.2)
Unit 4: Chapter VI (Section: 6.3- 6.4)
Unit 5: Chapter VII (Section: 7.1-7.3)

Reference Books:

1. S. Kumaresan, *Topology of metric spaces*, Alpha Science International Limited, 2005.
2. Richard R Goldberg , *Methods of Real Analysis*, Oxford & IBH Publishing Company, Private Limited, NewDelhi,1970.
3. D. Somasundaram, Choudhary D, *A first course in mathematical Analysis*, Narosa Publications, Corrected Edition, 2006.

E- Resources:

1. https://freevideolectures.com/course/2267/mathematics-i/17
2. https://nptel.ac.in/courses/111/106/111106053/
3. https://www.youtube.com/watch?v=kaVXVry47s8
4. https://www3.nd.edu/Inicolae/Hon Calc Lectures.pdf
5. https://www.youtube.com/watch?v=mhi5TdWLUjs

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	1	9	3	3	**37**
CO2	3	3	1	1	3	1	1	**13**
CO3	9	3	1	1	3	3	1	**21**
CO4	3	3	3	1	3	1	3	**17**
CO5	9	9	3	1	9	1	1	**33**
Total	**33**	**27**	**11**	**5**	**27**	**9**	**9**	**121**

Low-1 Medium-3 High-9

Core XI- Mechanics

(For Students Admitted from 2024-25)

Semester: V **Hours / week: 6**
Subject Code: IBMXC532 **Credit: 5**

Course Objectives:

1. To understand the concepts of parallel forces, moments of forces and the principles behind them.
3. To determine the resultant of the system of forces acting on the body, moment of forces and the motion of inertia of the body.

Unit I **(18 hours)**

Introduction: Scope and divisions of the subject- Force- Types of force- Equilibrium - Equilibrium of two forces - Principle of the Transmissibility of a force. **Forces Acting at a point:** Resultant and Components - Simple cases of finding the resultant - Parallelogram of Forces - Analytical expression for the resultant of two forces acting at a point - Triangle of forces - Perpendicular triangle of forces- Converse of the triangle of forces – The Polygon of Forces - Lami's theorem- An Extended form of the parallelogram law of forces - Resolution of a force - Components of a force along two given directions - Theorem on Resolved Parts - Resultant of any number of forces acting at a point (Graphical and analytical methods) -

conditions of equilibrium of any number of forces acting upon a particle.

Unit II **(18 hours)**

Parallel Forces and Moments: Introduction - Resultant of two like parallel forces acting on a rigid body- Resultant of two unlike and unequal parallel forces acting on a rigid body - Resultant of a number of parallel forces acting on a rigid body - Conditions of equilibrium of three coplanar parallel forces - Center of two parallel forces - Moment of a force - Physical significance of the moment of a force - Geometrical representation of a moment - Sign of the moment- Unit of moment - Varigon's theorem of Moments- Generalized theorem of moments (Principle of Moments) - Moment of a force about an axis – **Couples:** Couples - Equilibrium of two couples - Equivalence of two couples - Couples in parallel planes - Representation of a couple by a vector - Resultant of a Coplanar couples - Resultant of a couple and a force.

Unit III **(18 hours)**

The Laws of Motion: Introduction – Momentum - Newton's Laws of Motion – Explanation and Illustration of the First Law - Explanation of the Second Law of Motion – Composition of Forces : Parallelogram law of Forces - Absolute Unit of Forces – Weight - Gravitational units of forces- Distinction between Mass and weight - Conservation of linear momentum - Explanation of the Third Law of Motion - Force of Friction - Motion of a particle on a rough horizontal plane under the action of a constant forces - Motion of a particle up a rough inclined plane under the action of a constant force - Pressure of a body resting on a moving horizontal plane - Motion of connected particles - Atwood's machine.

Unit IV **(18 hours)**

Projectiles: Definitions - Two fundamental principles - Path of a projectile - Characteristics of the motion of the projectile - A particle projected horizontally from a point at a certain height above the ground - The horizontal range of a projectile is maximum - various possible directions of projection- The velocity of the projectile in magnitude and direction at the end of time t - Range on an inclined plane.

Unit V **(18 hours)**

Moment of Inertia: Definition - Theorem of Parallel Axes - Theorem of perpendicular Axes - Moment of Inertia of some standard geometrical shapes: thin uniform rod - Rectangular lamina - uniform rectangular parallelepiped - Uniform circular ring - Uniform circular disc - Uniform elliptic lamina - Solid sphere - Hollow sphere- solid right circular cone - Hollow cone. Dr. Routh's rule.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Understand and be able to distinguish between various force systems, moments, couple and projectiles

CO 2: Determine the parallel forces and moments of the mechanical problems.

CO 3: Examine the theoretical aspects of Laws of Motion.

CO 4: Evaluate the resulting force and Projectile.

CO 5: Build mechanical models and show how they can be used to solve Moment of Inertia.

Text Book:

1. Dr. M.K Venkataraman, *Statics*, Agasthiar publications, 19th edition, 2018.

Unit 1: Chapter I & II

Unit 2: Chapter III & Chapter IV
2. Dr. M.K Venkataraman, *Dynamics*, Agasthiar publications, 19th edition, 2018.
Unit 3: Chapter IV (Sections 4.1 - 4.23)
Unit 4: Chapter VI (Sections 6.1 - 6.15)
Unit 5: Chapter XII (Sections 12.1 - 12.5)

Reference Books:
1. Duraipandiyan, *Mechanics (Vector Treatment)*, S.Chand and Co,2007.
2. S. Ramsey, *Statics*, CBS publishers and Distributers, Delhi, First Indian Edition,1985
3. A.V. Dharmapadam, *Dynamics*, S.Viswanathan Publishers Private Limited, 2006.
4. P. Duraipandian, Laxmi Duraipandian and Muthamizh Jayapragasam, *Mechanics*, S.Chand & Company Private Limited, First Edition, 2014.

E- Resources:
1. https://www.youtube.com/watch?v=jhGYYlwfkE0
2. https://www.youtube.com/watch?v=UABd38mEzsw
3. https://openstax.org/books/university-physics-volume-1/pages/4-3-projectile-motion
4. https://www.youtube.com/watch?v=JqkwmJtjfBk

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	3	9	1	**37**
CO2	9	9	3	3	3	9	1	**37**
CO3	9	3	3	3	3	9	1	**31**
CO4	9	3	3	3	3	9	1	**31**
CO5	9	3	3	3	3	9	1	**31**
Total	**45**	**27**	**15**	**15**	**15**	**45**	**5**	**167**

Low-1 Medium-3 High-9

DSE I - Astronomy

(For Students Admitted from 2024-25)

Semester: V **Hours / week: 4**
Subject Code: IBMXE51A **Credit: 4**

Course Objectives:
1. To understand astronomical phenomena of celestial bodies.
2. To visualize and analyze the occurrence of astronomical events.

Unit I **(13 hours)**
Celestial Sphere, Diurnal Motion: Astronomy - Equinox and Solstice – Celestial Co-ordinates – Sidereal times- Diagram of the Celestial sphere.

Unit II **(13 hours)**
The Earth: Dip of Horizon- Twilight. **Refraction:** Laws of Refraction - Astronomical Refraction - Tangent formula for Refraction- General Effects of Refraction – Cassini's Formula - Horizontal Refraction.

Unit III **(11 hours)**

The Moon: Moon - Sidereal Month and Synodic Month - Successive Phase of Moon - Lunar Librations - Path of the Moon with respect to the sun - Harvest Moon - Surface Structure of Moon- lunar Mountains - Earth Shines - The Tides.

Unit IV **(12 hours)**

Eclipses: Introduction - Umbra and Penumbra - Lunar Eclipse - Solar eclipse - Angle between a direct common tangent and the line of centres of two circles - Angle between a transverse common tangent and the line of centres of two circles - conditions for the occurrence of a lunar and solar eclipse – Lenth of earth's shadow - Ecliptic limits - Calculate the major and minor ecliptic limits - Synodic period of the nodes of lunar orbit - maximum and minimum number of eclipses in a year – Eclipse Season.

Unit V **(11 hours)**

Cosmology: The Universe: Introduction – The birth of the solar System. **Stars and their lives:** Plotting the stars – A star is born - The life of a star – Death of star - The milky way – Our home Galaxies.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Describe the basic concepts in astronomy and the theory of motion of celestial bodies
CO 2: Understand how the phase of the Moon is controlled by the relative positions of the Sun and Moon in the sky
CO 3: Emphasis on the formation of Universe
CO 4: Assess the application of mathematics in astronomy
CO 5: explain the evolution of stars as well as of the large scale structure of the Universe.

Text Book:

1. S. Kumaravelu, and Susheela Kumaravelu, *Astronomy*, A Bhaskara Selvan, Sivakasi, 2009.
   Unit I: Chapter II (Pg.no: 41 – 74, 91 - 93)
   Unit II: Chapter III (Pg.no: 135 -152) Chapter IV (Pg.no: 154 – 172)
   Unit III: Chapter XII (Pg.no: 373 – 394)
   Unit IV: Chapter XIII (Pg.no: 396 – 417 & 425 – 430)
2. John Scalzi, *The Rough Guide to the Universe*, Rough guide Ltd., 2nd edition, 2008
   Unit V: Sections 1(Pg.no: 3 -12), 12(Pg.no:169 - 178), 13(Pg.no:184 – 188)

Reference Books:

1. Rukmani Ramachandran, *Astronomy for Under Graduate & Post Graduate Classes*, 1968.
2. G.V. Ramachandran, *Astronomy*, Mission Press, Palayamkottai.
3. Jayant Narlikar, *A Journey through the Universe*, National Book Trust, India, Sixth Edition, 2004.
4. Peter Schneider, *Extragalactic Astronomy and Cosmology*, Springer

E-Resources:

1. https://www.youtube.com/watch?v=yBodZ9LBhRE
2. https://www.youtube.com/watch?v=sr_QJF3Ca48
3. https://www.youtube.com/watch?v=gr5sCrdCfVA
4. http://www.astronomycast.com/2012/03/ep-254-reflection-and-refraction/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	1	1	3	3	**23**
CO2	3	3	3	1	1	3	1	**15**
CO3	3	3	3	1	1	3	1	**15**
CO4	9	9	9	3	3	3	3	**39**
CO5	3	3	9	3	3	3	3	**27**
Total	**27**	**21**	**27**	**9**	**9**	**15**	**11**	**119**

Low-1 Medium-3 High-9

DSE I – Combinatorics

(For Students Admitted from 2024 - 25)

Semester: V **Hours / week: 4**
Subject Code: IBMXE5B **Credit: 4**

Course Objectives:

1. To make the students familiar with fundamental combinatorial structures that naturally appears in various fields of Mathematics and Computer Science
2. To give the structures to represent mathematical and applied questions and they will become comfortable with the combinatorial tools commonly used to analyze such structures

Unit I **(12 hours)**

Classical Techniques: Basic Combinatorial numbers – Stirling numbers of the first kind – Stirling numbers of the second kind – Patterns of distributions.

Unit II **(12 hours)**

Classical Techniques: Generating functions and Recurrence relations – The algebra of formal power series – Recurrence relations – Symmetric functions.

Unit III **(12 hours)**

Classical Techniques: Multinomials - Inclusion and Exclusion principle - Applications of the sieve formula.

Unit IV **(12 hours)**

Classical Techniques: Permutations with forbidden positions – The Menage' problem – Problem of Fibonacci.

Unit V **(12 hours)**

Polya Theory: Necklace problem and Burnside's lemma – Cycle index of a permutation group – Polya's theorems and their immediate applications.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Identify the part of Discrete Mathematics that deals with enumeration and existence problems

CO 2: Solve difference equations using generating functions technique

CO 3: Examine the solutions of Permutations with forbidden problems
CO 4: Estimate the number of derangements using the principle of inclusion and exclusion
CO 5: Solve the problems by using Burnside and Polya‟s theorem

Text Book:
1. V. Krishnamurthy, *Combinatorics – Theory and Applications*, East – West Press Private Limited, New Delhi, 2010.

Unit I: Chapter 1 (sec 1)
Unit II: Chapter 1 (sec 2,3)
Unit III: Chapter 1 (sec 4,5)
Unit IV: Chapter 1 (sec 6)
Unit V: Chapter 2 (sec 1,2,3)

Reference Books:
1. K. Balakrishnan, *Theory and Problems of Combinatorics*, Tata McGraw-Hill Publishing Company Limited, New Delhi, Edition, 2006.
2. C.T. Liu, *Introduction to Combinatorial Mathematics*, Tata McGraw Hill, New Delhi, 1968.
3. Alan Tucker, *Applied Combinatorics*, Wiley Student Edition India, New Delhi, Fifth Edition.

E- Resources:
1. https://www.google.com/url?sa=t&source=web&rct=j&url=https://mathworld.wolfram.com
2. https://en.wikipedia.org/wiki/Stirling_numbers_of_the_second_kind
3. http://faculty.washington.edu/moishe/hanoiex/counting/recurrence.pdf
4. https://www.whitman.edu/mathematics/cgt_online/book/section02.02.html

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	1	3	3	**19**
CO2	3	3	3	3	3	3	3	**21**
CO3	3	3	3	3	1	3	1	**17**
CO4	3	3	3	3	1	3	3	**19**
CO5	3	3	1	1	1	3	1	**13**
Total	**15**	**15**	**13**	**13**	**7**	**15**	**11**	**89**

Low-1 Medium-3 High-9

DSE II - Operations Research

(For Students Admitted from 2024-25)

Semester: V **Hours / week: 4**
Subject Code: IBMXE51C **Credit: 4**

Course Objectives:
1. To apply these techniques constructively to make effective business decisions
2. To impart the knowledge of formulation of practical problems using the linear programming method and its extensions

Unit I **(16 hours)**

Linear Programming Problem: Introduction – Linear Programming Problem - Mathematical formulation of the problem - Illustrations on Mathematical Formulation of LPPs – **Linear Programming Problem - Graphical solution and Extension:** Introduction - Graphical solution method - some exceptional cases. General L.P.P - Canonical and standard forms of L.P.P.

Unit II **(11 hours)**

Linear Programming - Simplex method: Introduction - Fundamental properties of solutions - The computational procedure - Use of Artificial variables - Degeneracy in L.P.P.

Unit III **(12 hours)**

Duality in Linear Programming: Introduction - General Primal - Dual Pair - Formulating a Dual Problem - Primal-Dual Pair in Matrix Form - Dual Simplex method.

Transportation Model and its Variants: Definition of the Transportation model-Nontraditional Transportation Model-The Transportation algorithm

Unit IV **(10 hours)**

Transportation Model and its Variants: - The Assignment model. **Network Model:** Scope and Definition of network Models- Minimal Spanning Tree Algorithm- Shortest-Route Problem

Unit V **(11 hours)**

Network Model: Maximal Flow Model- CPM and PERT.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Explain the graphical method and to get optimality of Linear Programming Problem

CO2: Apply the LP model to tackle problems from real life.

CO3: Analyze all of the techniques used to acquire Linear Programming and Transportation Problem, when resolving difficulties in the real world.

CO4: Examine the Assignment problem model and network scheduling to get the ideal solution.

CO5: Create networks for a particular plan and PERT/CPM schedule them.

Text Books:

1. Kanti Swarup, P.K. Gupta & Man Mohan, *Operations Research*, Sultan Chand & sons, Eighteenth Edition, 2015.

Unit I: Chapter 2, Chapter 3(3.1 – 3.5)
Unit II: Chapter 4(4.1– 4.5)
Unit III: Chapter 5(5.1 – 5.4 & 5.9)

2. Hamdy A. Taha, *Operations Research - An Introduction*, Prentice Hall, Tenth Edition, 2016.

Unit III: Chapter 5 (5.1 – 5.3)
Unit IV: Chapter 5 (5.4), Chapter 6 (6.1-6.3)
Unit V: Chapter 6 (6.4-6.5)

Reference Books:

1. S.D. Sharma, *Operations Research*, Dedar Nath Ram Nath, 2009.

2. Srinivasan, *Operations Research - Principles and Appplications*, PHI Learning Private Limited, Second Edition, 2012.

E- Resources:

1. https://www.youtube.com/watch?v=YPn4yHM1YsU
2. http://www.math.wsu.edu/faculty/genz/364/lessons/l3067.pdf
3. https://www.youtube.com/watch?v=fSuqTgnCVRg
4. Transportation problem||vogel's approximation[VAM]|Northwest corner||Least cost||Using Simple Method - YouTube
5. https://www.youtube.com/watch?v=b1btzVsKp8E

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	3	9	9	**51**
CO2	3	9	9	9	3	9	9	**51**
CO3	9	9	3	3	3	9	9	**45**
CO4	9	9	3	3	3	9	9	**45**
CO5	9	9	9	9	9	9	9	**63**
Total	**39**	**45**	**33**	**27**	**21**	**45**	**45**	**255**

Low-1 Medium-3 High-9

DSE II – Coding Theory

(For Students Admitted from 2024-25)

Semester: V **Hours / week: 4**
Subject Code: IBMXE52D **Credit: 4**

Course Objectives:

1. To analyse different type of Linear Codes and the Some Good Codes
2. To acquire knowledge in Linear Codes and Some Good Codes

Unit I **(12 hours)**

Mathematical Background: Algebra - Krawtchouk Polynomials - Combinatorial Theory-Introduction-Shannon's Theorem.

Unit II **(12 hours)**

Linear Codes: Block Codes - Linear Codes-Hamming Codes - Majority logic decoding-Weight Enumerators - The Lee metric.

Unit III **(12 hours)**

Some Good Codes: Hadamard Codes and generalization- The binary Golay Code - The ternary Golay Code – Constructing Codes from other Codes – Reed- Muller Code – Kerdock Codes.

Unit IV **(12 hours)**

Bound on Codes: The Gilbert bound – Upper bounds – Cyclic Codes: Generator matrix and polynomial – Zeros of a Cyclic Codes.

Unit V **(12 hours)**

The idempotent of a Cyclic Codes : Other representations of a Cyclic Codes - BCH Codes – Decoding BCH Codes – Binary Cyclic Codes of length 2n (n is odd)

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Examine the techniques of Krawtchouk Polynomials and Combinational Theory
CO 2: Identify the appropriate linear Codes, Block Codes and majority logic decoding.
CO 3: Analyze the concept of Hadamard codes and generalizations
CO 4: Illustrate the concept of Bound on codes
CO 5: Gain the knowledge on the idempotent of a Cyclic Codes

Text Book:

1. J. H. Van Lint, *Introduction to Coding Theory***,** New Age International Private Limited, third Edition 2011.

Unit I: Chapter 1 (except 1.4) & Chapter 2 (sec 2.1 –2.2)
Unit II: Chapter 3
Unit III: Chapter 4
Unit IV: Chapter 5(except 5.3)
Unit V: Chapter 6 (except sec 6.8, 6.9 & 6.11)

Reference Books:

1. Gareth A. Jones, *Information and Coding Theory*, Springer, India, Second Edition, 2004.
2. Muralidhar Kulkarni and K.S.Shivaprkasa, *Information Theory and Coding* , Wiley Publishr, Second Edition, 2014.

E-Resources:

1. https://en.wikipedia.org/wiki/ShannonHartley_theorem
2. https://engineerstutor.com/wp-content/uploads/2020/08/Linear-Block-codes-complete-chapter-notes.pdf
3. https://www.researchgate.net/publication/324235062_Generalization_of_Hadamard_Matrices
4. https://en.wikipedia.org/wiki/Gilbert%E2%80%93Varshamov_bound_for_linear_Code
5. https://www.sciencedirect.com/science/article/abs/pii/S0924650908705336

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	1	3	9	3	1	9	**35**
CO2	9	1	9	1	3	1	3	**27**
CO3	3	3	3	9	3	1	9	**31**
CO4	3	9	9	9	9	3	9	**51**
CO5	3	9	1	9	9	3	1	**35**
Total	**27**	**23**	**25**	**37**	**27**	**9**	**31**	**179**

Low-1 Medium-3 High-9

SEC V – Operations Research Lab – LINDO / LINGO Package

(For Students Admitted from 2024-25)

Semester: V **Hours / week: 2**
Subject Code: IBMXS54P **Credit: 2**

Course Objectives:

1. To impart knowledge on solving operations research problems using computer with LINDO / LINGO Package
2. To use mathematical software to solve Economic Interpretation of Duality

List of Programmes:

1. Solving the LPP problems Under Graphical Solution Method
2. Solving the LPP Problem Using Simplex method
3. Solving the LPP Problem Using Two-Phase Method
4. Solving the LPP Problem Using Big-M method
5. Solve the problem Two Person Zero Sum Game
6. Solve the problem Duality in Transportation Problem
7. Solve the problem Solution of Assignment Problem
8. Solving the problems under Shortest – Route Algorithms by LINDO /LINGO Package

Course Outcomes:

After successful completion of this course, student will be able to
CO 1: Identify the basic concepts of LINDO / LINGO Package
CO 2: Apply commands in LINDO / LINGO Package to solve L.P.P and transportation problems.
CO 3: Discover the LINDO / LINGO Package for solving problems on assignment problems
CO 4: Examine the problems on project scheduling and Games & Strategies by using LINDO / LINGO Package
CO 5: Discover the commands in LINDO / LINGO Package to solve problems on Shortest – Route Algorithms

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	1	3	9	3	1	9	**35**
CO2	9	1	9	1	3	1	3	**27**
CO3	3	3	3	9	3	1	9	**31**
CO4	3	9	9	9	9	3	9	**51**
CO5	3	9	1	9	9	3	1	**35**
Total	**27**	**23**	**25**	**37**	**27**	**9**	**31**	**179**

Low-1 Medium-3 High-9

Core XII- Complex Analysis

(For Students Admitted from 2024-25)

Semester: VI **Hours / week: 6**
Subject Code: IBMXC611 **Credit: 5**

Course Objectives:

1. To analyse the different type of transformations and contour integrals
2. To acquire knowledge in series, functions, residues and integrals

Unit I **(22 hours)**

Complex Numbers: Regions in the complex plane - **Analytic Functions:** Functions of a complex variable - Mappings - Mappings by the Exponential function - Limits - Theorems on Limits - Continuity - Derivatives - Differentiation Formulas - Cauchy Riemann Equations - Sufficient conditions for Differentiability - polar co-ordinates - Analytic Functions - Harmonic Functions.

Unit II **(22 hours)**

Integrals: Derivatives of functions w(t) - Definite integrals of functions w(t) - contours - contour Integrals - Some Examples - Examples with branch cuts - upper bounds for moduli of contour integrals - Cauchy Integral Formula - An Extension of the Cauchy integral formula - Someconsequencesoftheextension–Liouville‟sTheoremandtheFundamentalTheoremof Algebra - Maximum modulus Principle.

Unit III **(17hours)**

Series: Convergence of Sequences and series-Taylor Series-Proof of Taylor's theorem-Examples -Laurent Series - Proof of Laurent's theorem -Examples.

Unit IV **(17hours)**

Residues and Poles: Isolated Singular Points - Residues – Cauchy's Residue Theorem - Residue at infinity - The Three types of Isolated Singular Points - Residues at Poles - Zerosof analytic functions - Zeros and Poles - Behavior of functions near isolated singular points.

Unit V **(12hours)**

Mapping by Elementary Functions: Linear Transformations - The transformation w = 1/z - Mappings by 1/z - Linear Fractional Transformations - An implicit form.

Course Outcomes:
After successful completion of this course, student will be able to
CO1: Distinguish between Analytic functions and Harmonic functions
CO2: Make use of derivatives of functions to solve the problems
CO3: Compute the series of convergence by using Taylor series and Laurent series
CO4: Analyze the different types of Residues and Poles
CO5: Classify the transformation using mapping and branches.

Text Book:
1. James Ward Brown and Ruel.V. Churchill - *Complex Variables and Applications*, Eighth Edition, Mc Graw Hill, Inc, 2016.

Unit I: Chapter 1 (section 11 only) Chapter 2 (sections 12 - 16, 18 - 26)
Unit II: Chapter 4 (sections 37 – 43 & 50 - 54)
Unit III: Chapter 5 (Sections 55 -62)
Unit IV: Chapter 6 (Sections 68 -77)
Unit V: Chapter 8 (sections 90 - 94)

Reference Books:
1. S. Arumugam, A. Thangapandi Isaac and A. Somasundaram, *Complex Analysis*, New Scitech Publications (India) Private Limited, 2002.
2. J. N. Sharma, Krishna Prakasan, *Functions of Complex Variable*, Thirteenth Edition Media Private Limited, 1996-97.

E- Resources:
1. https://people.math.gatech.edu/~cain/winter99/complex.html
2. http://web.math.ku.dk/noter/filer/koman-12.pdf
3. http://www.universityofcalicut.info/SDE/BSc_mathematics_complex_analysis.pdf
4. https://www.youtube.com/watch?v=JOfnCCNj4gQ
5. https://www.youtube.com/watch?v=Mwpz1zjPlzI

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	3	3	9	**39**
CO2	3	3	3	3	3	3	3	**21**
CO3	3	3	9	3	3	3	3	**27**
CO4	9	3	3	3	3	3	3	**27**
CO5	9	3	3	3	3	3	3	**27**
Total	**33**	**15**	**27**	**15**	**15**	**15**	**21**	**141**

Low-1 **Medium-3** **High-9**

Core XIII- Numerical Methods

(For Students Admitted from 2024-25)

Semester: VI **Hours / week: 6**
Subject Code: IBMXC622 **Credit: 4**

Course Objectives:

1. To derive numerical methods for various mathematical operations and tasks, such as interpolation
2. To derive appropriate numerical methods to solve algebraic and transcendental equations.

Unit I **(18 hours)**

Errors in Numerical Calculations: Introduction – Mathematical Preliminaries - Errors and their Computations - A General Error Formula - Error in a Series Approximation. **Solution of Algebraic and Transcendental equations:** Introduction **–** The Bisection method – The Method of False position – The Iteration method.

Unit II **(18 hours)**

Solution of Algebraic and Transcendental equations: - Newton - Raphson method – Ramanujam's method - Secant method – Muller's Method - Graeffe's Root - Squaring method - Lin-Barstow'method – The Quotient - Difference method - Solution to Systems of Nonlinear Equations.

Unit III **(18 hours)**

Interpolation: Introduction - Errors in Polynomial Interpolation - Finite Differences - Detection of Errors by use of Difference Tables - Differences of a Polynomial – Newton's Formulae for Interpolation - Central Difference Interpolation Formulae.

Unit IV **(18 hours)**

Interpolation: Practical Interpolation - Interpolation with Unevenly Spaced Points - Divided Differences and their properties - Inverse Interpolation- Double Interpolation.

Unit V **(18 hours)**

Numerical Differentiation and Integration: Introduction – Numerical Differentiation – Maximum and Minimum Values of a Tabulated Function – Numerical Integration.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Assess the solution of algebraic and transcendental equations by various methods
CO 2: Find the of solution of algebraic and transcendental equations
CO 3: Apply the concept to solve the problems in interpolation
CO 4: Compute the missing values for equal and unequal intervals using divided difference
CO 5: Apply the method of numerical differentiation and integration equation to examine the problem

Text Book:

1. S. S. Sastry, *Introductory Methods of Numerical Analysis*, Prentice Hall of India Private Limited, New Delhi, Fifth Edition, 2012.

Unit I: Chapter 1 (1.3 – 1.5), Chapter 2 (2.1- 2.4)

Unit II: Chapter 2 (2.5 – 2.12)
Unit III: Chapter 3 (3.1 – 3.7)
Unit IV: Chapter 3 (3.8 – 3.12)
Unit V: Chapter 5 (5.1 – 5.4)

Reference Books:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 6th Edition, New age International Publisher, India, 2007.
2. E. Balagurusamy, *Numerical Method***,** Tata McGraw Hill Private Limited, 2009.
3. Shankara Rao K, *Numerical Methods for Scientists and Engineers*, Prentice Hall of India, 2001.

E- Resources:

1. https://nptel.ac.in/courses/111/107/111107062/
2. https://nptel.ac.in/courses/111/107/111107105/
3. https://www.math.ust.hk/~machas/numerical-methods.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	9	9	9	**51**
CO2	9	9	9	3	9	9	9	**51**
CO3	3	3	9	3	9	9	9	**45**
CO4	9	9	9	3	3	9	3	**45**
CO5	3	3	3	3	9	9	3	**33**
Total	**33**	**33**	**33**	**15**	**39**	**45**	**33**	**231**

Low-1 Medium-3 High-9

Core XIV- Number Theory

(For Students Admitted from 2024-25)

Semester: VI **Hours / week: 5**
Subject Code: IBMXC631 **Credit: 4**

Course Objectives:

1. To define and interpret the concepts of divisibility, congruence, greatest common divisor, prime, and prime-factorization
2. To get a complete grip of various concepts to present modern mathematics in elementary

Unit I **(15 hours)**

Mathematical Induction: The Binomial Theorem - Divisibility Theory in the Integers: Early Number Theory - The Division algorithm - The Greatest Common Divisor.

Unit II **(15 hours)**

The Euclidean Algorithm: The Diophantine Equation ax + by = c. Primes and their Distribution: The Fundamental Theorem of Arithmetic - The Sieve of Eratosthenes - The Goldbach Conjecture.

Unit III **(15 hours)**

The Theory of Congruence: Carl fried rich Gauss - Basic Properties of Congruence - Binary and Decimal Representations of Integers - Linear Congruence and the Chinese Remainder Theorem.

Unit IV **(15 hours)**

Fermat's Theorem: Pierrede Fermat – Fermat's little theorem and Pseudo Primes –Wilson's theorem - The Fermat Kraitchik Factorization Method.

Unit V **(15 hours)**

Euler's Generalization of Fermat's Theorem: Leonhard Euler – Euler's Phi Functions – Euler's theorem - Some Properties of the Phi-Function.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Explain simple mathematical proof by using principle of mathematical induction

CO 2: Apply the concept of divisibility, congruence, GCD & LCM and Evaluate GCD by Euclid Algorithm

CO 3: Explicate the properties of congruence, binary and decimal representations of Integers

CO 4: Solve the problems using the concepts of Chinese remainder theorem and Fermat's Kraitchik Factorization Method

CO 5: Discuss about the properties of Phi functions

Text Book:

1. David M. Burton, *Elementary Number Theory*, Tata McGraw Hill Education Private Limited, Seventh Edition, Reprint 2015.

Unit I: Chapter 1, 2 (sec 2.1 – 2.3)
Unit II: Chapter 2 (sec 2.4 – 2.5), Chapter 3
Unit III: Chapter 4
Unit IV: Chapter 5
Unit V: Chapter 7

Reference Books:

1. R.K. Pandey, *Number Theory*, First Edition, 2014.
2. Neville Robbi, *Beginning Number Theory*, Second Edition, 2006.
3. S B Malik, *Basic Number Theory*, Second Revised Edition, 2011.

E-Resources:

1. https://www.youtube.com/watch?v=zIFehsBHB8o
2. https://www.khanacademy.org/computing/computer-science/cryptography/random-algorithms-probability/v/fermat-s-little-theorem-visualization
3. https://www.youtube.com/watch?v=w0ZQvZLx2KA
4. https://www.youtube.com/watch?v=FjliV5u2IVw

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	3	3	3	3	3	**27**
CO2	3	9	3	9	3	3	9	**39**
CO3	3	9	3	3	1	3	3	**25**
CO4	9	3	3	3	1	3	1	**23**
CO5	9	3	3	3	1	1	1	**21**
Total	**27**	**33**	**15**	**21**	**9**	**13**	**17**	**135**

Low-1 Medium-3 High-9

Core XV- Project

(For Students Admitted from 2024-2025)

Semester: VI **Hours / week: 6**
Subject Code: IBMXC64PW **Credit: 5**

Course Objectives:

1. To provide skills for high quality research and teaching in the field of Mathematics
2. To develop the knowledge, skills and attitudes necessary to pursue further studies in Mathematics

Project Outline:

1. The students undertake the project during the VI semester after the preliminary steps of student and staff allotment and topic selection in the VI semester
2. The student's progress is periodicallyassessed by the project guide through presentation
3. The significant research work is encouraged for presentations and publications in Conferences and Journals
4. Selection of the field of study, topic & research design
5. Collection of literature review
6. Analysis, Conclusion & Preparation of rough draft

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Make use of research methodology and techniques of the literature applicable to their own research
CO 2: Determine solutions to the unsolved problems
CO 3: Analyze the abilities and techniques in the critical evaluation of current research
CO 4: Apply new ideas in the respective field of study and environment
CO 5: Design innovative projects with the application of mathematical concepts towards scientific and societal development.

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	1	3	1	9	**63**
CO2	9	9	9	1	1	3	9	**41**
CO3	9	9	9	1	3	1	9	**41**
CO4	9	9	9	1	1	1	9	**39**
CO5	9	9	9	1	1	1	9	**39**
Total	**45**	**45**	**45**	**5**	**9**	**7**	**45**	**201**

Low-1 Medium-3 High-9

DSE III – Fourier and Laplace Transforms

(For Students Admitted from 2024-25)

Semester: VI **Hours / week: 4**
Subject Code: IBMXE61A **Credit: 4**

Course Objectives:

1. To solve ordinary differential equations using Laplace transforms
2. To familiarize with Fourier transforms of functions and relation between Laplace and Fourier transforms

Unit I **(10 hours)**

Fourier Transforms: Fourier Integral Theorem - Fourier Transforms - Alternative Form of Fourier Complex Integral Formula - Relationship between Fourier Transform and Laplace Transform - Worked Example.

Unit II **(13 hours)**

Fourier Transforms: Properties of Fourier Transforms, Linearity Property - Change of scale Property - Shifting Property - Modulation theorem - Conjugate symmetry property - Derivative of the transform - Convolution theorem – Parseval's Identity - Worked Example.

Unit III **(13 hours)**

Laplace Transforms: Linearity Property of Laplace and Inverse Laplace Transforms - Laplace Transforms of Some Elementary Functions- Laplace Transforms of Some Special Functions-Properties of Laplace Transforms - Worked Example.

Unit IV **(12 hours)**

Laplace Transforms: Laplace Transform of Periodic Functions - Derivatives and Integrals of Transforms - Worked Example.

Unit V **(12 hours)**

Laplace Transforms: Laplace Transforms of Derivatives and Integrals - Initial and Final Value Theorems- The Convolution - Worked Example.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Diagnose the concept of Fourier transform
CO 2: Apply the Fourier transforms to boundary value problem
CO 3: Make use of properties of Fourier and Laplace transform for solving the problem
CO 4: Determine the Laplace transform of periodic function
CO 5: Analyze the initial and final value theorems of Laplace transforms

Text Books :
1.T. Veerarajan, *Engineering Mathematics (For semester III),* Tata McGraw – Hill Publishing Company Limited, Third Edition, 2008.
Unit I: Chapter 6(6.1 - 6.5)
Unit II: Chapter 6(6.6)
2. T. Veerarajan**,** *Engineering Mathematics-II (For first year),* Tata McGraw – Hill Publishing Company Limited**,** 2014.
Unit III: Chapter 3 (3.1- 3.5)
Unit IV: Chapter 3 (3.6 - 3.7)
Unit V: Chapter 3 (3.8- 3.10 (Example 3.1 - 3.6))

Reference Books:
1. James Ward Brown & Ruel V. Churchill, *Fourier Series and Boundary Value Problems*, McGraw-Hill Education, 2011.
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, Wiley, 10th Edition, 2011.
3. Dr.J. K. Goyal and K. P. Gupta, *Laplace and Fourier Transforms*, Pragati Prakashan Publishers, Meerut 2000.

E- Resources:
1. https://www.youtube.com/watch?v=GkLmyWPpCZA
2. https://www.khanacademy.org/math/differential-equations/laplace- transform/properties-of-laplace-transform/v/laplace-transform-5
3. https://nptel.ac.in/courses/122/104/122104018/
4. https://pages.jh.edu/mzhong5/courses/EN_560_601_S17/homeworks/560_601_HW8.pf
5. http://imageprocessingplace.com/downloads_V3/root_downloads/tutorials/Wavelets--An%20eBook%20by%20Charles%20K.%20Chui.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	1	1	3	3	**21**
CO2	3	3	1	1	1	3	3	**15**
CO3	9	3	3	3	1	3	9	**31**
CO4	9	3	3	3	1	3	3	**25**
CO5	9	3	3	3	1	3	9	**31**
Total	**39**	**15**	**11**	**11**	**5**	**15**	**27**	**123**

Low-1 **Medium-3** **High-9**

DSE III – Mathematical Modeling

(For Students Admitted from 2024-2025)

Semester: VI **Hours / week: 4**
Subject Code: IBMXE6B **Credit: 4**

Course Objectives:

1. To provide rigorous instruction in fundamental mathematical concepts and skills presented in the context of real-world applications
2. To provide analytical methods for approaching problems encountered in future endeavors

Unit I **(12 hours)**

Mathematical modeling: Need, Techniques, Classifications and Simple Illustrations: some characteristics of Mathematical Models - Mathematical modeling through Geometry - through Algebra - through Trigonometry - through Calculus - Limitations of Mathematical Modeling.

Unit II **(12 hours)**

Mathematical modeling through ordinary differential equations of first order: Mathematical modeling through differential equations - linear growth and decay models - Non-Linear growth and decay models compartment models - mathematical modeling in dynamics through ordinary differential equations of first order - Mathematical modeling of Geometrical Problems through ordinary differential equations of first order.

Unit III **(12 hours)**

Mathematical modeling through difference equations: The Need of mathematical modeling through difference equations: Some simple models - Basic theory of linear difference equations with constant coefficients - Mathematical modeling through difference equation in economics and finance - Mathematical modeling through difference equation in probability theory.

Unit IV **(12 hours)**

Mathematical modeling through graphs - Situations that can be modeled through graphs - Mathematical models in terms of directed graphs - signed graphs - weighted diagraphs - Unoriented graphs.

Unit V **(12 hours)**

Mathematical modeling through calculus of variations and dynamic programming - optimization principles and techniques - Mathematical Models through calculus of variations - Mathematical Models through dynamic programming.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Examine the techniques of mathematical modeling
CO 2: Identify appropriate mathematical modeling through ordinary differential equations with relevant parameters and conditions
CO 3: Analyze the concept of mathematical modeling through differential equations in economics and finance
CO 4: Illustrate the concept of mathematical modeling through graph
CO 5: Gain the knowledge on calculus of variations and dynamic programming

Text Book:

1. J.N. Kapur, *Mathematical Modelling***,** New Age International Private Limited, 2008.

Unit I: Chapter 1 (sec 1.3 –1.9)
Unit II: Chapter 2 (sec 2.1 –2.6)
Unit III: Chapter 5 (sec 5.1 – 5.3, 5.5)
Unit IV: Chapter 7 (sec 7.1 – 7.5)
Unit V: Chapter 9 (sec 9.1 – 9.3)

Reference Books:

1. C.Fowler, *Mathematical Models in the Applied Science*, Cambridge University Press,1997.
2. I.LiangChern, *Mathematical Modelling and Ordinary Differential Equations*, 2016.
3. Prof Sara Billey, *Discrete Mathematical Modeling*, University of Washington, Winter Quarter, 2011.

E- Resources:

1. https://people.maths.bris.ac.uk/~madjl/course_text.pdf
2. https://www.rand.org/content/dam/rand/pubs/reports/2006/R441.pdf
3. https://www.researchgate.net/publication/317888204_Graphbased_Mathematical_Modelling_-_Concepts

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	1	1	3	3	**17**
CO2	3	3	9	1	1	3	3	**23**
CO3	9	3	9	1	1	3	3	**29**
CO4	3	3	3	1	1	3	3	**17**
CO5	3	3	3	1	1	3	3	**17**
Total	**21**	**15**	**27**	**5**	**5**	**15**	**15**	**103**

Low-1 Medium-3 High-9

SEC VI – Numerical Methods Lab using Python

(For Students Admitted from 2024-2025)

Semester: VI **Hours / week: 2**
Subject Code: IBMXS651P **Credit: 2**

Course Objectives:

1. To define the structure and components of a Python program.
2. To build and package Python modules for reusability.

List of Programmes:

1. Solving the problem Using Bisection Method
2. Solving the problem Using Regula Falsi Method
3. Solving the problem Using Newton's interpolation Method
4. Solving the problem Using Lagrange's Method

5. Solve the problem Forward Difference Table
6. Solve the problem Backward Difference Table
7. Solve the problem Trapezoidal Rule
8. Solving the problem Simpson's 1/3 Rule
9. Solving the problem Simpson's 3/8 Rule
10. Solving the problem Euler Method

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Identify the basic concepts of Python

CO 2: work with common Python data types like integers, floats, strings, characters, lists, dictionaries, as well as pandas Data Frames.

CO 3: Apply the proficiency in handling Numbers, Strings and functions to solve Computat.ional problems.

CO 4: Analyze and evaluate the accuracy of common numerical methods

CO 5: Design and Develop solution for real-time application using Database operations

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	1	3	9	3	1	9	**32**
CO2	9	1	9	1	3	1	3	**27**
CO3	3	3	3	9	3	1	9	**31**
CO4	3	9	9	9	9	3	9	**51**
CO5	3	3	1	9	9	3	1	**32**
Total	**24**	**20**	**25**	**37**	**27**	**9**	**31**	**173**

Low-1 Medium-3 High-9

Extra Credit – Quantitative Techniques

(For Students Admitted from 2024-2025)

Semester: VI

Subject Code: IBMXX6 **Credit: 2**

Course Objectives:

1. To understand operations, research techniques used for planning, scheduling and controlling large andcomplex projects
2. To get motivation to take up a project to solve real life problems by adopting the techniques of operations research

Unit I

Linear programming Problem: Advanced techniques: Introduction - Revised simplex method - Simplex Method versus Revised simplex method - Bounded variables - parametric linear Programming - linear fractional programming - Application of linear fractional programming – karmarkar Algorithm.

Unit II

Sequencing problem: Introduction - Problem of sequencing - basic terms used in sequencing Processing n jobs through two machines - Processing n jobs through k machines- Processing 2 jobsthrough kmachines.

Unit III

Dynamic programming: Introduction - the recursive equation approach - characteristics of Dynamic Programming - Dynamic Programming Algorithm - solution of discrete D.P.P - Some applications - Solution of L.P.P by Dynamic Programming.

Unit IV

Probability: Introduction - uncertainty and probability - sample space and probability -algebra of events - conditional probability - random variables - expectation of random variable - centraltendency and dispersion - some probability distributions.

Unit V

Decision analysis: Introduction - decision making problem - decision Making process-decision making environment - decisions under uncertainty - decisions under risk - decision tree analysis - decision makingwith utilities.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Classify the advanced techniques in linear programming problem.

CO 2: Inspect the real life problems and make use of LP techniques to solve the problems.

CO 3: Identify dynamical programming techniques and determine the solution to the given problems.

CO 4: Compare and contrast the concept of uncertainty and probability and assess the problems on random variables.

CO 5: Able to decide a decision in any critical environment.

Text Book:

1. Kanti Swarup, P. K. Gupta, Man Mohan, *Operations Research*, Sultan Chand & Sons, New Delhi,Eighteenth Edition, 2015.

Unit I: Chapter 9

Unit II: Chapter 12(Sec 12:1 – 12:6)

Unit III: Chapter 13

Unit IV: Chapter 14

Unit V: Chapter16

Reference Books:

1. P.K.Gupta and Man Mohan, *Problems in Operations Research*, Sultan Chand & Sons, New Delhi,Fourteenth Edition,2002.
2. Prem Kumar Gupta and D.S. Hira, *Operations Research*, Sultan Chand & Sons, New Delhi FirstEdition,1993.
3. Hamdy A. Taha, *Operations Research - An Introduction*, Prentice Hall, Eighth Edition, 2007.

E-Resources:

1. https://www.analyticsvidhya.com/blog/2017/02/lintroductory-guide-on-linear-programming-explained-in-simple-english/

2. https://www.hackerearth.com/practice/algorithms/dynamic-programming/introduction- to-dynamic-programming-1/tutorial/
3. https://www.verywellmind.com/problems-in-decision-making-2795486

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	3	3	3	3	3	9	3	27
CO2	9	3	9	3	3	9	9	45
CO3	3	3	3	3	3	9	3	27
CO4	3	3	3	3	3	9	3	27
CO5	9	3	9	3	3	3	9	39
Total	27	15	27	15	15	39	27	165

Low-1 Medium-3 High-9

OEC I - Quantitative Aptitude for Competitive Examinations-I

(For Students Admitted from 2024-2025)

Semester: III **Hours / week: 2**
Subject Code: IBOE3MX1 **Credits: 2**

Course Objectives: To use appropriate formulas and methods for a given situation

1. To acquire simple techniques for dealing quantities, business transactions, data analytics and geometrical structures

Unit I **(6 hours)**
HCF and LCM of numbers & simplification: Formulae -Solved Problems.

Unit II **(6 hours)**
Percentage & Average: Formulae -Solved Problems.

Unit III **(6 hours)**
Ratio and Proportion & Profit, Loss and Discount: Formulae - Solved Problems.

Unit IV **(6 hours)**
Simple interest & Compound interest: Formulae - Solved Problems.

Unit V **(6 hours)**
Shares, Stocks and Debentures: Formulae - Solved Problems.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Solve problems of any number of integers using Prime Factors.
CO 2: Analyze the Problems logically and approach the problems in a different manner
CO 3: Apply the formulas for solving some real life problems
CO 4: Build the concept of time value of money and calculate present value and future value.
CO 5: Compute the thinking ability skills

Text Book:

1. P. Gupta, *Quantitative Aptitude*, Unique publishers pvt. limited – Revised edition – 2015.

Unit I: Chapter 2, 14 (pg.no 36 - 50 & pg.no 97 - 119)
Unit II: Chapter 5, 7 (pg.no 137 -158 & pg.no 205 - 220)
Unit III: Chapter 8, 9 (pg.no 233- 247 & pg.no 258 - 274)
Unit IV: Chapter 10, 11 (pg.no 297 – 310 & pg.no 324 - 339)
Unit V: Chapter 12(pg.no 353 - 363)

Reference Books:

1. Sarvesh Kumar Verma, *The Quantitative Aptitude* for CAT Arihant Publications Private Limited, Meerut, Edition 1, 2009.
2. Chand S *Quantitative Aptitude (Mathematics & Statistics)* S.Chand & Company Limited, First Edition, 2008.
3. Mark Alan Stewart, *Master the GMAT*, Edition, 2007.

E-Resources:

1. https://www.youtube.com/watch?v=rHzggZDdtc4
2. https://www.youtube.com/watch?v=FdAkE032ODI
3. https://pdfgoal.com/downloads/quantitative_aptitude_made_easy_ugcportal_pdf
4. https://www.youtube.com/watch?v=_cW7_BUDYcw
5. https://iim-cat-questions-answers.2iim.com/quant/geometry/mensuration/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	1	9	3	9	9	**43**
CO2	3	9	1	9	9	9	9	**49**
CO3	3	9	3	9	3	9	9	**45**
CO4	3	9	9	9	9	9	9	**57**
CO5	3	9	9	9	9	9	9	**57**
Total	**15**	**45**	**23**	**45**	**33**	**45**	**45**	**251**

Low-1 **Medium-3** **High-9**

OEC II- Quantitative Aptitude for Competitive Examinations II

(For Students Admitted from 2024-2025)

Semester: IV **Hours / week: 2**
Subject Code: IBOE4MX1 **Credit: 2**

Course Objectives:

1. To gain the aptitude knowledge required for competitive examination and to provide a well- knitted path to success
2. To enrich their knowledge and to develop their logical reasoning thinking ability

Unit I **(6 hours)**
Problems based on ages & Partnership: Introduction - solved examples - practice exercise

Unit II **(6 hours)**
Time work and wages & Time and distance: Formulae - solved examples - practice exercise.

Unit III **(6 hours)**
Trains & Boats and Streams: Formulae - solved examples - practice exercise.

Unit IV **(6 hours)**
Calendars and Clocks: Formulae - solved examples - practice exercise.

Unit V **(6 hours)**
Surds and indices: Formulae- solved examples - practice exercise.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Make use of the concepts of ages and partnership to solve the problems.
CO 2: Identify the concepts of time and work problems by using the formula.
CO 3: Solve the problems use the concept Trains & Boats and Streams
CO 4: To make use the concept of calendars and clocks, to solve the problems.
CO 5: Justify the basic concept of basic building blocks with examples.

Text Book:
2. P.Gupta, *Quantitative Aptitude*, Unique publishers pvt.limited – Revised edition – 2015.
Unit I: Chapter 13, 14 (366 – 3371) &(383 - 390)
Unit II: Chapter 17, 19 (437 -454) &(499 - 510)
Unit III: Chapter 20, 21 (529 – 537) &(549 - 557)
Unit IV: Chapter 23,24 (573 – 579)&(580- 585)
Unit V: Chapter 26 (627 – 654)

Reference Books:
1. Bharat Jhunjhunwala ,*Quantitative Aptitude (Mathematics & Statistics) for CA Common proficiency Test (CPT)***,** S. Chand and Company Limited – First Edition**,** 2008.
2. Ashish Aggarwal, *Quick Arithmetic***,** S.Chand Publications, 2nd Edition, 2007.
3. Dr.R.S. Aggarwal**,** *Quantitative Aptitude***,** S.Chand Publications.7th Edition, 2015.

E-Resources:
1. https://www.youtube.com/watch?v=oGT0AOihPr8
2. https://www.youtube.com/watch?v=jxlWNJ1MghA
3. https://www.youtube.com/watch?v=PfHOs4ukM5g
4. https://www.youtube.com/watch?v=Qz-WBXsLkos
5. https://www.youtube.com/watch?v=JBNUfNpm35Y

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	3	3	3	3	1	3	3	19
CO2	3	3	3	3	1	3	3	19
CO3	3	3	3	3	1	3	3	19
CO4	3	3	3	3	3	3	3	21
CO5	3	3	3	3	3	3	9	27
Total	15	15	15	15	9	15	21	105

Low-1 Medium-3 High-9

AECC III –Discrete Mathematics
For B Sc Information Technology
(For Students Admitted from 2024-2025)

Semester: III **Hours / week: 4**
Subject Code: IBITA331 **Credit: 4**

Course Objectives:
1. To motivate the students to think logically and apply the techniques in solving problems
2. To analyze the outcomes of mathematical arguments using logical laws

Unit I **(12 hours)**
Set Theory - Introduction- sets - Venn-Euler diagrams - Operation on sets - Properties of set operations - verification of basic laws of algebra - principle of duality.

Unit II **(12 hours)**
Relations - Operation on relations - equivalence relation - Closure and Warshall's Algorithm - Partitions and Equivalence classes.

Unit III **(12 hours)**
Functions & Mathematical induction - Functions and Operators - One - One, Onto functions - special types of functions - invertible functions - composition of functions. Techniques of proofs - mathematical induction.

Unit IV **(12 hours)**
Recurrence relations and Generating functions - Recurrence - an introduction- polynomial and their relations - Solutions of finite order homogeneous (linear) relations - Solutions of non-homogeneous relations - generating functions - Primitive recursive function.

Unit V **(12 hours)**
Matrix algebra - Introduction- operations - inverse, Rank of matrix - solution of Simultaneouslinear equations - Eigen values and Eigen vectors.

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

CO 1: Compare the properties of sets and relations
CO 2: Classify different types of functions and applied suitable technique to prove the theorems
CO 3: Analyze the recurrence relation and generating functions
CO 4: Use matrix concept and solve the Simultaneous linear equations
CO 5: Apply the concept of graph theory technique to find the shortest path

Text Book:

1. Dr M.K. Venkataraman, Dr N. Sridharan, Dr N. Chandrasekaran, *Discrete Mathematics*, The National Publishing Company, 2012.

Unit I: Chapter 1
Unit II: Chapter 2
Unit III: Chapter 3, 4
Unit IV: Chapter 5
Unit V: Chapter 6

Reference Books:

1. Alan Doerr & Kenneth Levasseur, *Applied Discrete Structures for Computer Science*, Asian Student Edition, 1989.
2. J.K Sharma, *Discrete Mathematics*, Macmillan Publishers India Limited, Third Edition, 2013.
3. C.L. Liu, *Elements of Discrete Mathematics*, Mc Graw Hill Book Company, New Delhi, 1986.

E- Resources:

1. https://www.google.co.in/books/edition/Applied_Discrete_Structures
2. https://youtu.be/JVpggpCUNO4
3. https://youtu.be/IPeHcdX-Tvw

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	3	3	3	3	1	**25**
CO2	3	3	3	1	3	3	1	**17**
CO3	3	3	3	1	3	3	1	**17**
CO4	3	9	3	3	3	3	3	**27**
CO5	3	3	3	3	3	3	3	**21**
Total	**15**	**27**	**15**	**11**	**15**	**15**	**9**	**107**

Low-1 **Medium-3** **High-9**

AECC IV- Statistics
For B Sc Information Technology
(For Students Admitted from 2024-2025)

Semester: IV **Hours / week: 5**
Subject Code: IBITA43 **Credit: 4**

Course Objectives:
1. To gain knowledge on correlation and regression.
2. To know about index numbers and time series

Unit I **(15 hours)**
Central Tendencies: Introduction - Arithmetic Mean - Mode - Geometric Mean and Harmonic Mean - Measures of Dispersion.

Unit II **(15 hours)**
Moments, Skewness and Kurtosis: Curve fitting - Principle of least squares.

Unit III **(15 hours)**
Correlation and Regression: Rank correlation Regression - Correlation Coefficient for a Bivariate Frequency Distribution.

Unit IV **(15 hours)**
Interpolation: Finite Differences – Newton's Formula – Lagrange's Formula - Attributes - Consistency of Data - Independence and Association of Data.

Unit V **(15 hours)**
Index Numbers: Consumer Price Index Numbers - Analysis of Time series - Time series - Components of a Time series - Measurement of Trends.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Build the skills in basic statistical concepts
CO 2: Apply the various measures of statistical parameters in real life
CO 3: Estimate the correlation coefficient for a bivariate frequency distribution and regression
CO 4 : Make use of Newton's and lagrange's formula for solving the finite difference statistical problem
CO 5: Analyze the time series and measure the trends of statistical data

Text Book:
1. Dr. S. Arumugam and A. Thangapandi Isaac, *Statistics*, New Gamma Publishing House, June 2015.

Unit I: Chapter 2, 3
Unit II: Chapter 4, 5
Unit III: Chapter 6
Unit IV: Chapter 7, 8
Unit V: Chapter 9, 10

Reference Books:

1. R.S.N. Pillai and Bagavathi, *Statistics - Theory and Practice*, S. Chand and Company Private Limited, New Delhi, 2007.
2. S.C. Gupta & V.K. Kapoor, *Mathematical Statistics*, Sultan Chand & Sons, Eleventh Edition 2007.
3. D.C. Sancheti, V.K. Kapoor, *Statistics (Theory, Methods and Applications)*, Sultan Chand & Sons, 2012.

E-Resources:

1. https://youtu.be/ztIBfKD_eFg
2. https://youtu.be/OfANWrzQE9Q
3. https://youtu.be/F_2GIheAbtI

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	1	9	9	**43**
CO2	9	9	3	3	3	9	9	**45**
CO3	3	9	3	3	1	9	9	**37**
CO4	3	3	9	3	1	9	9	**37**
CO5	3	3	9	3	3	9	9	**39**
Total	**27**	**33**	**27**	**15**	**9**	**45**	**45**	**201**

Low-1 Medium-3 High-9

AECC III - Statistics
For B Sc Computer Science

(For Students Admitted from 2024-2025)

Semester: III **Hours / week: 4**
Subject Code: IBCSA33 **Credit: 4**

Course Objectives:

1. To gain knowledge on correlation and regression
2. To know about index numbers and time series

Unit I **(12 hours)**

Central Tendencies: Introduction - Arithmetic Mean - Mode - Geometric Mean and Harmonic Mean.

Unit II **(12 hours)**

Measures of Dispersion: Range – Quartile deviation – Mean deviation - Standard deviation
Moments, Skewness and Kurtosis: Moments - Skewness and Kurtosis.

Unit III **(12 hours)**

Correlation and Regression: Rank correlation Regression - Correlation Coefficient for a Bivariate Frequency Distribution.

Unit IV **(12 hours)**

Index Numbers: Consumer Price Index Numbers.

Unit V **(12 hours)**

Analysis of Time series: Time series - Components of a Time series - Measurement of Trends.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Build the skills in basic statistical concepts

CO 2: Apply the various measures of statistical parameters in real life

CO 3: Estimate the correlation coefficient for a bivariate frequency distribution and regression

CO4: Make use of Index numbers for solving the statistical problem

CO 5: Analyze the time series and measure the trends of statistical data

Text Book:

1. Dr. S. Arumugam and A. Thangapandi Isaac, *Statistics*, New Gamma Publishing House, June 2015.

Unit I: Chapter 2

Unit II: Chapter 3, 4

Unit III: Chapter 6

Unit IV: Chapter 9

Unit V: Chapter 10

Reference Books:

1. R.S.N. Pillai and Bagavathi, *Statistics Theory and Practice*, S. Chand and Company Private Limited, New Delhi, 2007.
2. S.C. Gupta & V.K. Kapoor, *Mathematical Statistics*, Sultan Chand & Sons, Eleventh Edition, 2007.
3. D.C.Sancheti, V.K. Kapoor, *Statistics (Theory, Methods and applications),* Sultan Chand &Sons, 2012.

E-Resources:

1. https://youtu.be/ztIBfKD_eFg
2. https://youtu.be/OfANWrzQE9Q
3. https://youtu.be/F_2GIheAbtI

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	1	9	9	**43**
CO2	9	9	3	3	3	9	9	**45**
CO3	3	9	3	3	1	9	9	**37**
CO4	3	3	9	3	1	9	9	**37**
CO5	3	3	9	3	3	9	9	**39**
Total	**27**	**33**	**27**	**15**	**9**	**45**	**45**	**201**

Low-1 **Medium-3** **High-9**

AECC IV – Operations Research
For B Sc Computer Science

(For Students Admitted from 2024-2025)

Semester: IV **Hours / week: 5**
Subject Code: IBCSA43 **Credit: 4**

Course Objectives:

1. To apply these techniques constructively to make effective business decisions
2. To impart knowledge of formulation of practical problems using the linear programming method and its extensions

Unit I **(15 hours)**

Linear Programming Problem - Mathematical formulation of the problem - Illustrations on Mathematical Formulation of LPPs - Graphical solution and Extension: Graphical solution method - some exceptional cases - General L.P.P - Canonical and standard forms of L.P.P- Linear Programming - Simplex method - Introduction - Fundamental properties of solutions - The computational procedure.

Unit II **(15 hours)**

Use of Artificial variables - Degeneracy in L.P.P - Duality in Linear Programming - Introduction - General Primal - Dual Pair - Formulating a Dual Problem – Primal - Dual Pair in Matrix Form - Dual Simplex method.

Unit III **(15 hours)**

Games and Strategies - Introduction - Two-Person Zero-Sum Games - Some Basic terms - The Maximin-Minimax Principle - Games without Saddle Points - Mixed Strategies - Graphic Solution of 2 x n and m x 2 Games – Dominance Property.

Unit IV **(15 hours)**

Transportation Model and its Variants: Definition of the Transportation model - Nontraditional Models - Transportation Model - The Transportation algorithm - The Assignment model.

Unit V **(15 hours)**

Network Model: Scope and Definition of network Models- Minimal Spanning Tree Algorithm – Shortest - Route Problem - maximal Flow Model - CPM and PERT.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Apply Graphical and Simplex method to get optimality of Linear Programming Problem
CO2: Analyze Assignment problem technique to make effective business decisions
CO3: Make use of different strategies to find the solutions for games and events
CO4: Assess Transportation Model for optimal solutions
CO5: Adapt CPM/ PERT techniques to plan schedule and control project activities

Text Books:

1. Kanti Swarup, P.K. Gupta & Man Mohan, *Operations Research***,** Sultan Chand & Sons. Eighteenth Edition, 2015.

Unit I: Chapter 2(2.3 – 2.4), Chapter 3(3.2 – 3.5) & Chapter 4(4.1 – 4.3)
Unit II: Chapter 4(4.4 – 4.5), Chapter 5(5.1 – 5.4 & 5.9)
Unit III: Chapter 17(17.1 – 17.7)
2. Hamdy A. Taha, Operations Research - An Introduction, Prentice Hall. Tenth Edition, 2016.
Unit IV: Chapter 5(5.1 - 5.4)
Unit V: Chapter 6(6.1 - 6.5)

Reference Books:
1. S.D. Sharma, *Operations Research*, Dedar Nath Ram Nath, 2009.
2. Srinivasan, *Operations Research - Principles and Appplications***,** PHI Learning Private Limited, Second Edition, 2012.

E-Resources:
1. https://www.youtube.com/watch?v=YPn4yHM1YsU
2. http://www.math.wsu.edu/faculty/genz/364/lessons/l3067.pdf
3. https://www.youtube.com/watch?v=fSuqTgnCVRg
4. Transportation problem||vogel's approximation[VAM]|Northwest corner||Least cost||Using Simple Method -YouTube
5. https://www.youtube.com/watch?v=b1btzVsKp8E

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	3	9	3	**27**
CO2	9	3	9	3	3	9	9	**45**
CO3	3	3	3	3	3	9	3	**27**
CO4	3	3	3	3	3	9	3	**27**
CO5	9	3	9	3	3	3	9	**39**
Total	**27**	**15**	**27**	**15**	**15**	**39**	**27**	**165**

Low-1 Medium-3 High-9

AECC I - Numerical Methods
For BCA

(For Students Admitted from 2024-2025)

Semester: I **Hours / week: 4**
Subject Code: IBCPA131 **Credit: 4**

Course Objectives:
1. To provide the numerical methods of solving the non-linear equations, interpolation, differentiation, and integration
2. To apply numerical methods to obtain approximate solutions to mathematical problems

Unit I **(12 hours)**
Solution of Algebraic and Transcendental equations: The Bisection method - The Method of False position - Iteration method - Newton-Raphson method.

Unit II **(12 hours)**

Interpolation: Finite differences - Forward Differences - Backward Differences - Central Differences - Symbolic Relations and Separation of Symbols. Newton's Formulae for Interpolation – Interpolation with unevenly spaced points: Lagrange's interpolation formula - Inverse Interpolation.

Unit III **(12 hours)**

Numerical Differentiation: Errors in Numerical Differentiation - The Cubic Spline Method - Maximum and Minimum of a Tabulated Function. Numerical Integration: Trapezoidal Rule – Simpson's 1/3 Rule - Simpsons 3/8 Rule.

Unit IV **(12 hours)**

Numerical Solutions of System of Linear Equations: Gauss elimination method - Gauss-Jordan method - Solution of linear systems - iterative methods.

Unit V **(12 hours)**

Numerical Solutions of Ordinary Differential Equations: Solution by Taylor's series – Runge-Kutta Methods - Predictor - Corrector Method.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Assess the solution of Algebraic and Transcendental equations

CO 2: Compute the missing values for unequal intervals using Divided difference and Lagrange's Method

CO 3: Evaluate the approximate values of the first derivative, maximum and minimumvalues of the Function using Newton's formula

CO 4: Solve the problem and using the methods of Gauss elimination, Gauss-Jordan and iterative methods

CO 5: Applying the method of numerical solutions of ordinary differential equation to examine the problem

Text Books:

1. S. S. Sastry, *Introductory Methods of Numerical Analysis*, Prentice Hall of India, Private Limited, New Delhi, 4th Edition, 2009.

Unit I: Chapter 2(2.2- 2.5)

Unit II: Chapter 3(3.3(3.3.1, 3.3.2, 3.3.4), 3.6, 3.9 (3.9.1), 3.11)

Unit III: Chapter 5 (5.2, 5.3, 5.4(5.4.1 - 5.4.3))

Unit IV: Chapter 6 ((6.3.2, 6.3.3), 6.4)

Unit V: Chapter 7 (7.2, 7.5, 7.6(7.6.1 - 7.6.2))

Reference Books:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, New age International Publisher, India, 6th Edition, 2007.
2. E. Balagurusamy, *NumericalMethod*, Tata Mc Graw Hill Education Private Limited, 2009.
3. Shankara Rao K, *Numerical Methods for Scientists and Engineers*, Prentice Hall of India, 2001.

E-Resources:

1. https://www.youtube.com/watch?v=YPn4yHM1YsU
2. http://www.math.wsu.edu/faculty/genz/364/lessons/l3067.pdf
3. https://www.youtube.com/watch?v=fSuqTgnCVRg

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	9	3	3	9	9	9	51
CO2	3	9	3	3	3	3	9	33
CO3	3	9	3	3	3	9	9	39
CO4	9	9	9	3	9	9	9	57
CO5	3	3	9	3	3	9	9	39
Total	27	39	27	15	27	39	45	219

Low-1 Medium-3 High-9

AECC II– Numerical Methods
For B Sc Cyber Security

(For Students Admitted from 2024-2025)

Semester: I **Hours / week: 5**
Subject Code: IBCYA132 **Credit: 4**

Course Objectives:

1. To provide the numerical methods of solving the non-linear equations, interpolation, differentiation, and integration
2. To apply numerical methods to obtain approximate solutions to mathematical problems

Unit I **(15 hours)**

Solution of Algebraic and Transcendental equations: The Bisection method - The Method of False position - Iteration method - Newton-Raphson method.

Unit II **(15 hours)**

Interpolation: Finite differences - Forward Differences - Backward Differences - Central Differences - Symbolic Relations and Separation of Symbols. Newton's Formulae for Interpolation – Interpolation with unevenly spaced points: Lagrange's interpolation formula - Inverse Interpolation.

Unit III **(15 hours)**

Numerical Differentiation: Errors in Numerical Differentiation - The Cubic Spline Method - Maximum and Minimum of a Tabulated Function. Numerical Integration: Trapezoidal Rule – Simpson's 1/3 Rule - Simpsons 3/8 Rule.

Unit IV **(15 hours)**

Numerical Solutions of System of Linear Equations: Gauss elimination method - Gauss-Jordan method - Solution of linear systems - iterative methods.

Unit V **(15 hours)**

Numerical Solutions of Ordinary Differential Equations: Solution by Taylor's series –

Runge-Kutta Methods - Predictor - Corrector Method.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Assess the solution of Algebraic and Transcendental equations

CO 2: Compute the missing values for unequal intervals using Divided difference and Lagrange's Method

CO 3: Evaluate the approximate values of the first derivative, maximum and minimumvalues of the Function using Newton's formula

CO 4: Solve the problem and using the methods of Gauss elimination, Gauss- Jordan and iterative methods

CO 5: Applying the method of numerical solutions of ordinary differential equation to examine the problem

Text Books:

1. S. S. Sastry, *Introductory Methods of Numerical Analysis*, Prentice Hall of India, Private Limited, New Delhi, 4th Edition, 2009.

Unit I: Chapter 2(2.2- 2.5)
Unit II: Chapter 3(3.3(3.3.1, 3.3.2, 3.3.4), 3.6, 3.9 (3.9.1), 3.11)
Unit III: Chapter 5 (5.2, 5.3, 5.4(5.4.1 - 5.4.3))
Unit IV: Chapter 6 ((6.3.2, 6.3.3), 6.4)
Unit V: Chapter 7 (7.2, 7.5, 7.6(7.6.1 - 7.6.2))

Reference Books:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, New age International Publisher, India, 6th Edition, 2007.
2. E. Balagurusamy, *NumericalMethod*, Tata Mc Graw Hill, Education Private Limited, 2009.
3. ShankaraRao K, *Numerical Methods for Scientists and Engineers*, Prentice Hall of India, 2001.

E-Resources:

1. https://www.youtube.com/watch?v=YPn4yHM1YsU
2. http://www.math.wsu.edu/faculty/genz/364/lessons/l3067.pdf
3. https://www.youtube.com/watch?v=fSuqTgnCVRg

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	9	9	9	**51**
CO2	3	9	3	3	3	3	9	**33**
CO3	3	9	3	3	3	9	9	**39**
CO4	9	9	9	3	9	9	9	**57**
CO5	3	3	9	3	3	9	9	**39**
Total	**27**	**39**	**27**	**15**	**27**	**39**	**45**	**219**

Low-1 Medium-3 High-9

AECC III –Statistics
For B Sc Cyber Security
(For Students Admitted from 2024-2025)

Semester: III **Hours / week: 4**
Subject Code: IBCYA33 **Credits: 4**

Course Objectives:
1. To find moments skewness and kurtosis from the given data and to fit the curve
2. To gain knowledge about correlation and regression

Unit I **(12 hours)**
Central Tendencies: Introduction - Arithmetic Mean - Mode - Geometric Mean and Harmonic Mean.

Unit II **(12 hours)**
Measures of Dispersion: Range – Quartile deviation – Mean deviation – Standard deviation
Moments, Skewness and Kurtosis: Moments - Skewness and Kurtosis.

Unit III **(12 hours)**
Correlation and Regression: Rank correlation Regression - Correlation Coefficient for a Bivariate Frequency Distribution.

Unit IV **(12 hours)**
Index Numbers: Consumer Price Index Numbers.

Unit V **(12 hours)**
Analysis of Time series: Time series - Components of a Time series - Measurement of Trends.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Build the skills in basic statistical concepts
CO 2: Apply the various measures of statistical parameters in real life
CO 3: Estimate the correlation coefficient for a bivariate frequency distribution and regression
CO4: Make use of Index numbers for solving the statistical problem
CO 5: Analyze the time series and measure the trends of statistical data

Text Book:
1. Dr. S. Arumugam and A. Thangapandi Isaac, *Statistics*, New Gamma Publishing House, June 2015.

Unit I: Chapter 2
Unit II: Chapter 3, 4
Unit III: Chapter 6
Unit IV: Chapter 9
Unit V: Chapter 10

Reference Books:

1. R.S.N. Pillai and Bagavathi, *Statistics Theory and Practice*, S. Chand and CompanyPrivate Limited, New Delhi, 2007.
2. S.C. Gupta & V.K. Kapoor, *Mathematical Statistics*, Sultan Chand & Sons, Eleventh Edition, 2007.
3. D.C. Sancheti, V.K. Kapoor, *Statistics (Theory, Methods and Applications)*, Sultan Chand & Sons, 2012.

E-Resources:

1. https://youtu.be/ztIBfKD_eFg
2. https://youtu.be/OfANWrzQE9Q
3. https://youtu.be/F_2GIheAbtI

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	1	9	9	**33**
CO2	9	9	3	3	3	9	9	**45**
CO3	3	9	3	3	1	9	9	**37**
CO4	3	3	9	3	1	9	9	**37**
CO5	3	3	9	3	3	9	9	**39**
Total	**27**	**33**	**27**	**15**	**9**	**45**	**45**	**201**

Low-1 Medium-3 High-9

AECC IV – Operations Research
For B Sc Cyber Security

(For Students Admitted from 2024-2025)

Semester: IV **Hours / week: 5**
Subject Code: IBCYA43 **Credit: 4**

Course Objectives:

1. To apply these techniques constructively to make effective business decisions
2. To impart knowledge of formulation of practical problems using the linear programming method and its extensions

Unit I **(15 hours)**

Linear Programming Problem - Mathematical formulation of the problem - Illustrations on Mathematical Formulation of LPPs - Graphical solution and Extension: Graphical solution method - some exceptional cases - General L.P.P - Canonical and standard forms of L.P.P - Linear Programming - Simplex method - Introduction - Fundamental properties of solutions - The computational procedure.

Unit II **(15 hours)**

Use of Artificial variables - Degeneracy in L.P.P - Duality in Linear Programming - Introduction - General Primal - Dual Pair - Formulating a Dual Problem - Primal-Dual Pair in Matrix Form - Dual Simplex method.

Unit III **(15 hours)**

Games and Strategies - Introduction - Two-Person Zero-Sum Games - Some Basic terms - The Maximin- Minimax Principle - Games without Saddle Points - Mixed Strategies - Graphic Solution of 2 x n and m x 2 Games – Dominance Property.

Unit IV **(15 hours)**

Transportation Model and its Variants: Definition of the Transportation model - Nontraditional Models - Transportation Model - The Transportation algorithm - The Assignment model.

Unit V **(15 hours)**

Network Model: Scope and Definition of network Models - Minimal Spanning Tree Algorithm – Shortest - Route Problem - maximal Flow Model - CPM and PERT.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Apply Graphical and Simplex method to get optimality of Linear Programming Problem

CO2: Analyze Assignment problem technique to make effective business decisions

CO3: Make use of different strategies to find the solutions for games and events

CO4: Assess Transportation Model for optimal solutions

CO5: Adapt CPM/ PERT techniques to plan schedule and control project activities

Text Books:

1. Kanti Swarup, P.K. Gupta & Man Mohan, *Operations Research***,** Sultan Chand & Sons., Eighteenth Edition, 2015.

Unit I: Chapter 2(2.3 – 2.4), Chapter 3(3.2 – 3.5) & Chapter 4(4.1 – 4.3)

Unit II: Chapter 4(4.4 – 4.5), Chapter 5(5.1 – 5.4 & 5.9)

Unit III: Chapter 17(17.1 – 17.7)

2. Hamdy A. Taha, *Operations Research - An Introduction*, Prentice Hall**,** Tenth Edition, 2016.

Unit IV: Chapter 5 (5.1 - 5.4)

Unit V: Chapter 6 (6.1 - 6.5)

Reference Books:

1. S.D. Sharma, *Operations Research*, Dedar Nath Ram Nath, 2009.
2. Srinivasan, *Operations Research - Principles and Appplications***,** PHI Learning Private Limited, Second Edition, 2012.

E-Resources:

1. https://www.youtube.com/watch?v=YPn4yHM1YsU
2. http://www.math.wsu.edu/faculty/genz/364/lessons/l3067.pdf
3. https://www.youtube.com/watch?v=fSuqTgnCVRg
4. Transportation problem||vogel's approximation[VAM]|Northwest corner||Least cost||Using Simple Method -YouTube
5. https://www.youtube.com/watch?v=b1btzVsKp8E

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	3	9	3	**27**
CO2	9	3	9	3	3	9	9	**45**
CO3	3	3	3	3	3	9	3	**27**
CO4	3	3	3	3	3	9	3	**27**
CO5	9	3	9	3	3	3	9	**39**
Total	**27**	**15**	**27**	**15**	**15**	**39**	**27**	**165**

Low-1 Medium-3 High-9

AECC I – Mathematics-I
For B Sc Chemistry

(For Students Admitted from 2024-2025)

Semester: I **Hours / week: 5**
Subject Code: IBCHA13 **Credit: 4**

Course Objectives:
1. To acquire knowledge about the rank of a matrix
2. To acquire basic knowledge in Algebra and Trigonometry

Unit I **(15 hours)**
Algebra: Partial fraction - Binomial series - Application of the binomial theorem to the summation of series - approximation and limits.

Unit II **(15 hours)**
Algebra: Exponential series - Logarithmic series.

Unit III **(15 hours)**
Theory of Equations: Nature of Roots - Relation between the coefficients and the roots of an algebraic equation - Transformation of equations - Reciprocal equations - Transformation of equation in general.

Unit IV **(15 hours)**
Matrices: Definition and algebraic operations - Rank of matrix.

Unit V **(15 hours)**
Trigonometry: Expansions of $\sin\theta$ and $\cos n\theta$- powers of sines and cosines of θ in terms of functions of multiple of θ- Expansion of $\sin\theta$ and $\cos\theta$ in a series of ascending powers of θ- Hyperbolic functions.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Establish the applications of Binomial theorem in terms of series
CO 2: Classify exponential series and logarithmic series
CO 3: Solve the roots of the given equation by adopting different methods
CO 4: Use algebraic operations to find the rank of the matrices

CO 5: Examine the concept of trigonometric function and hyperbolic functions

Text Book:

1. S. Narayanan, R. Hanumantha Rao**,** T.K. Manicavchagam Pillay and Dr. P. Kandaswamy, *Ancillary Mathematics – Volume –I,* S.Viswanathan (Printers & Publishers) Private Limited, 2015.

Unit I: Chapter 1(sec 1.1 - 1.2)
Unit II: Chapter 1(sec 1.3 - 1.4)
Unit III: Chapter 2(sec 2.1 - 2.5)
Unit IV: Chapter 3(sec 3.1- 3.2)
Unit V: Chapter 5 (sec 5.1 - 5.4)

Reference Books:

1. K. Thilagavathy, P. Kandaswamy, *Allied Mathematics***,** S. Chand and Company Limited, New Delhi, Second Edition, 2004.
2. Dr. M.K. Venkataraman, Mrs. Manorama Sridhar, *Allied Mathematics*, Agasthiar Publication, First Edition, 2005.
3. Prof. P. Duraipandian, Dr. S. Udayabaskaran, *Allied Mathematics Vol-2,* S. Chand & Company Private Limited, Reprint, 2016.

E- Resources:

1. https://www.youtube.com/watch?v=x6uB4JflJHk
2. https://www.youtube.com/watch?v=5oDdSb9Jv6c
3. https://kanchiuniv.ac.in/coursematerials/expansiontrignometry.pdf

`1	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	3	1	3	1	**21**
CO2	3	3	1	3	1	3	1	**15**
CO3	9	9	1	3	3	3	1	**29**
CO4	9	9	1	3	3	3	3	**31**
CO5	3	3	1	3	3	3	3	**19**
Total	**33**	**27**	**5**	**15**	**11**	**15**	**9**	**115**

Low-1 **Medium-3** **High-9**

AECC II - Mathematics-II
For B Sc Chemistry

(For Students Admitted from 2024-2025)

Semester: II **Hours / week: 5**
Subject Code: IBCHA23 **Credit: 4**

Course Objectives:

1. To acquire knowledge in Differential calculus and integral calculus
2. To solve the basic problems in numerical methods and Laplace Transform

Unit I **(15 hours)**

Finite Differences: Forward difference – Backward difference – Interpolation – Newton's Forward interpolation formula – Newton's backward difference formula.

Unit II **(15 hours)**

Differential Calculus: Higher derivatives - Jacobian - polar coordinates.

Unit III **(15 hours)**

Integration: Integrals of functions containing linear functions of x - Integrals of functions Involving $a^2 \pm b^2$- Integrals of functions of the form $\int f(x^n)\, x^{n-1} dx$ - Integrals of functions Of the form $\int^* \boldsymbol{f}(x)^n$ f´(x)dx.

Unit IV **(15 hours)**

Fourier series: Introduction - Even and Odd functions – Half range fourier series - Development in cosine series - Development in sine series - Change of interval- Combination of series.

Unit V **(15 hours)**

Laplace Transform: Definition - Method 1, 2 and 3 – some general theorems - The inverse transform.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Examine the solutions of problem using forward difference formula and backward difference formula

CO 2: Find the derivatives for higher order equations

CO 3: Simplify different forms of integral concepts

CO 4: Apply the construction of Fourier Series in different environment

CO 5: Describe the different concept of Laplace transformations

Text Books:

1. S. Narayanan, R. Hanumantha Rao, T.K. Manicavchagam Pillay, Dr. P. Kandaswamy, *Ancillary Mathematics - Volume I*, S.Viswanathan Printers and Publishers, Private Limited, 2015.

Unit I: Chapter 4 (Pg.no: 172-202)

Unit II: Chapter 6 (Pg.no: 266 – 295)

2. S. Narayanan, R. Hanumantha Rao, T.K. Manicavchagam Pillay, Dr. P Kandaswamy, *Ancillary Mathematics - Volume II*, S. Viswanathan Printers and Publishers, Private Limited, 2015.

Unit III: Chapter 1 (Pg.no: 1 -18)

Unit IV: Chapter 2 (Pg.no:123-159)

Unit V: Chapter 7 (Pg.no: 289-317)

Reference Books:

1. K. Thilagavathy and P. Kandaswamy, *Allied Mathematics paper I*, S. Chand and Company Limited**,** Reprint, 2010.
2. Dr.M.K. Venkataraman and Mrs. Manorama Sridhar, *Allied Mathematics*, Agasthiar Publications, First Edition, 2015.

3. Prof.P. Duraipandian and Dr.S. Udayabaskaran, *Allied Mathematics Vol-2*, S. Chand & Company Private Limited, Reprint, 2016.

E- Resources

1. https://nptel.ac.in/courses/111/107/111107105/
2. https://www.youtube.com/watch?v=TS9V9OfBggI
3. https://www.youtube.com/watch?v=RDtITuZDZi4
4. https://www.youtube.com/watch?v=Gxr3AT4NY_Q
5. https://www.maths.usyd.edu.au/MATH2065/r/Week9Lect3.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	1	3	3	9	3	**37**
CO2	3	3	1	3	3	3	3	**19**
CO3	9	3	1	3	3	3	3	**25**
CO4	3	3	3	3	3	3	3	**21**
CO5	3	3	3	3	3	3	3	**21**
Total	**27**	**21**	**9**	**15**	**15**	**21**	**15**	**123**

Low-1 Medium-3 High-9

AECC III – Psychological Statistics – Descriptive
For B Sc Psychology

(For Students Admitted from 2024-2025)

Semester: III **Hours / week: 4**
Subject Code: IBSYA33 **Credit: 4**

Course Objectives:

1. To analyze data pertaining to discrete and continuous variables and to interpret theresults
2. To gain the knowledge of various types of data, their organization and evaluation of summary measures such as measures of central tendency and dispersion

Unit I **(11 hours)**

Statistics - Meaning and Use: Meaning of statistics - Need and Importance of Statistics in Education and psychology - Prerequisites for studying Statistics

Organization of Data: The Meaning of the Terms "Data" - Methods of organizing data.

Unit II **(10 hours)**

Graphical Representation of Data: Meaning of Graphical Representation of Data - Advantages of Graphical Representation of Data - Mode of Graphical Representation of Data - Smoothing of frequency Curve - Polygon and Ogive.

Unit III **(12 hours)**

Measures of Central Tendency: Meaning of the Measures of Central Tendency - Arithmetic Mean, Median & Mode - Computation of Median and Mode from the Curve of Frequency Distribution - When to use the Mean, Median and Mode.

Unit IV **(12 hours)**

Measure of Variability: Meaning and Importance of the Measure of Variability - Types of Measure of Variability - When and Where to use the Various Measure of Variability.

Unit V **(15 hours)**

Linear Correlation: Meaning and Types - Coefficient of Correlation - Construction of Scatter Diagram.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Understand the scales of measurements
CO2: Analyze the results of graphical representation of data
CO 3: Apply the formula to compute the solution of mean, median, mode
CO4: Apply the formula and analyze when and where to use the measures of variability
CO 5: Construct scatter diagram using linear correlation concept

Text Book:

1. Mangal S.K., *Statistics in Psychology and Education*, PH Learning Private Limited, New Delhi, Second Edition, 2016.

Unit I: Chapter1, 2
Unit II: Chapter 3
Unit III: Chapter 4
Unit IV: Chapter 6
Unit V: Chapter 7

Reference Books:

1. Henry E. Garrett**,** *Statistics in Psychology and Education*, Surjeet Publications, Second Edition, 2012.
2. Arthur Aron, Elliot J. Coups, Elaine N. Aron, *Statistics for Psychology*, Sixth Edition, 2019.
3. K.R. Gupta, *Statistical Methods in Education and Psychology*, 2017.

E- Resources:

1. https://www.yourarticlelibrary.com/education/statistics/graphic-representation-of-data-meaning-principles-and-methods/64884
2. https://www.scribbr.com/statistics/central-tendency/
3. https://m.youtube.com/watch?v=qb3X01m4H68

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	1	1	1	1	1	3	**11**
CO2	3	1	3	1	3	3	3	**17**
CO3	3	3	3	3	3	3	9	**27**
CO4	3	1	1	1	1	3	9	**19**
CO5	3	1	1	3	3	3	3	**17**
Total	**15**	**7**	**9**	**9**	**11**	**13**	**27**	**91**

Low-1 Medium-3 High-9

AECC IV Psychological Statistics-Inferential

For B Sc Psychology

(For Students Admitted from 2024-2025)

Semester: IV **Hours / week: 5**
Subject Code: IBSYA43 **Credit: 4**

Course Objectives:

1. To apply large and small sample tests in real life situations
2. To understand the main features and characteristics of normal distributions and the Standard normal distribution

Unit I **(14 hours)**

The Normal Curve and Its Applications: Introduction - Characteristics and Properties of a Normal Curve - Applications of a Normal Curve - Illustration of the Applications of a Normal Curve.

Unit II **(12 hours)**

Significance of the Mean and other Statistics: Introduction - Significance of the Sample Mean and Other Statistics - Significance of Some Other Statistics.

Unit III **(17 hours)**

Significance of the Difference Between Means: Need and Importance - Fundamental Concepts in Determining the Significance of the Difference between Means - How to Determine the Significance of the Difference between Two Means.

Unit IV **(16 hours)**

Chi square and Contingency Coefficient: Use of chi square as a Test of Goodness of Fit - Procedure of Chi Square Testing - Use of Chi Square as a Test of Independence between Two Variables - Contingency Coefficient - Correction for Small Frequencies in a 2x2 Table - Underlying Assumptions, Uses and Limitations of Chi Square Test.

Unit V **(16 hours)**

Analysis of Variance: Need for the Technique of Analysis of Variance – Meaning of the Term "Analysis of Variance" - Procedure for Calculating the Analysis of Variance - Two-way Analysis of Variance - Underlying Assumptions in Analysis of variance.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Examine and apply the concepts of normal curve to problem solving
CO 2: Solve the sample mean of statistics
CO 3: Analyze the concepts of significance between means
CO 4: Test the chi square as a test of independent between two variables
CO 5: Calculate analysis of variance

Text Book:

1. Mangal S.K., *Statistics in Psychology and Education*, PH Learning Private Limited, New Delhi, Second Edition, 2016.

Unit I: Chapter 8
Unit II: Chapter 9
Unit III: Chapter 10
Unit IV: Chapter 11(Page No: 181-196)
Unit V: Chapter 17(Page No: 319 – 334)

Reference Books:

1. Henry E. Garrett, *Statistics in Psychology and Education***,** Surjeet Publications, Second Edition, 2012.
2. Arthur Aron, Elliot J. Coups, Elaine N. Aron, *Statistics for Psychology*, Sixth Edition, 2019.
3. K.R. Gupta, *Statistical Methods in Education and Psychology*, 2017.

E- Resources:

1. https://www.youtube.com/watch?v=wRfL_EhC-E8
2. https://www.youtube.com/watch?v=LXTCbOyDIlo
3. https://www.youtube.com/watch?v=-yQb_ZJnFXw

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	3	3	3	**21**
CO2	3	3	3	1	1	3	3	**17**
CO3	3	3	3	1	1	3	1	**15**
CO4	3	3	3	3	1	3	3	**19**
CO5	3	3	3	3	3	3	3	**21**
Total	**15**	**15**	**15**	**11**	**9**	**15**	**13**	**93**

Low-1 Medium-3 High-9

Value Added Programme in LATEX

(For Students Admitted from 2023- 2024)

PROGRAMME STRUCTURE

Subject Code	Course	Subject Title	Hours	Credit	ESE
HCLT22P	Core I	Pictures andColors Lab in Latex	50	5	100

Core I -Pictures and Colors Lab in Latex

(For Students Admitted from 2023-2024)

Subject Code: HCLT22P

Hours / week: 50
Credit: 5

1. Create a document using Input Files.
2. Create a document using Special Symbols, Dashes.
3. Create a document using Line Breaks and Foot Notes.
4. Create a document using Sectioning Command.
5. Create a document using Quotations.
6. Create a document using Type Style and Colors.
7. Create a document using Commands and Environments.
8. Create a document using Mathematical formulas and Mathematical Symbols.
9. Create a document using Arrays.
10. Create a document using Table.
11. Create a document using Bibliography and Bibliography Database
12. Create a document using Page Style.
13. Create a document using Pictures.
14. Create a document using Basic of the Math Index.
15. Create a document using Fine Print.
16. Create a document using Math Mode Environment.
17. Create a document using Tabbing Environment.
18. Create a document using Line and Page Breaking.
19. Create a document using Boxes.
20. Create a document using Graphics Packages.

B Sc Data Science

(Three Year Regular Programme)
(For Students Admitted from 2024-2025)

Programme Educational Objectives:

PEO1: To create and strengthen women leaders through disciplinary Knowledge, Professional skills and ethical sensitivity
PEO2: To transform students as successful entrepreneurs to face the modern challenges
PEO3: To nurture the students to invent, innovate and create solutions for current moral, ecological and economic issues

Programme Outcomes:

PO 1: Disciplinary Knowledge: Acquiring knowledge of different dimensions in the related areas of study and identifying the assumptions that frame thinking and actions
PO 2: Effective Communication: Ability to share thoughts, Ideas and applied skills of communications in its various perspectives
PO 3: Research Skill and Critical Thinking: Ability to plan, execute and report the results of an experiment and to draw conclusions from evidences and the capability to apply analytical thought by following scientific approach to knowledge development
PO 4: Moral ethical awareness / Reasoning: Ability to embrace moral\ ethical values in conducting one‟s life, about an ethical issue from multiple perspectives, and use ethical practices in all works and appreciating environmental and sustainability issues and adopting unbiased and truthful actions in all aspects of work
PO 5: Information / Digital Literacy: Capability to use ICT in case of need and the ability to access, evaluate and use the relevant information
PO 6: Problem Solving: Ability to apply their competence to solve non-familiar everyday problems in real life situations
PO 7: Self - directed and Lifelong Learning: Acquire the ability to engage in independent and Lifelong learning through self-paced and self - directed learning to meet out the change in life

Programme Specific Outcomes:

PSO 1: Disciplinary Knowledge: Apply computing theory, languages and algorithms, as well as mathematical and statistical models and the principles of optimization to appropriates, formula and use data analyze. Formulate and use appropriate models of data analysis to solve hidden solution to business related challenges
PSO 2: Effective Communication: Organize, visualize and analyze large, complex datasets using descriptive statistics and graphs to make decisions
PSO 3: Research Skill and Critical Thinking: Critically apply the theories and methodologies of data science to new research in their primary area of study.
PSO 4: Ethical Awareness: Develop and implement data analysis Strategies base on theoretical principles, ethical considerations and detailed knowledge of the underlying data
PSO 5: Digital Literacy: Demonstrate an ability to articulate, assess and apply appropriate theories and principles of information management. Student can construct complex statistical models, assess the fit of such models to the data and apply the models in real-world contexts

PSO 6: Problem Solving Skill: Identify, assess and select appropriate among data analytics methods and models for solving a particular real-world problem, weighing their advantages and disadvantages.

PSO 7: Self-Learning: Recognize the need for lifelong learning and have the ability to engage independent learning keeping in mind the rapid technological changes

PREAMBLE

1. Introduced Ability Enhancement Compulsory Course I on "Fundamental of Mathematics" (I Semester)
2. Modified the core course Mathematical Statistics - II and transferred from Semester II to Semester III
3. Combined and Modified the Core Courses Numerical Methods-I (Semester V) and Numerical Methods-II (Semester VI) and renamed as Numerical Methods (Semester VI)
4. Transferred the Core Course Calculus and Differential Equations from Semester III to Semester II
5. Transferred the Ability Enhancement Compulsory Course I Mathematical Statistics-I from Semester I to Semester II
6. Transferred the Core Course Discrete Mathematics from Semester II to Semester V

PROGRAMME STRUCTURE
Programme Code: UDS

Sem	Part	Subject code	Course	Subject Title	Hours/ Week	Credit	Marks		
							CIA	ESE	Total
I	I	IBLT112 / IBLA111/ IBLH111	Language I	Tamil I / Arabic I / Hindi I	5	3	25	75	100
	II	IBLEIB12/ IBLEIIA12	Language II	Language through Literature I Level I (Basic) / Language through Literature I Level II (Advanced)	5	3	25	75	100
	III	IBDSC111	Core I	o Programming in C	5	4	25	75	100
		IBDSC12	Core II	R Programming	6	5	25	75	100
		IBDSA132	AECC I	Fundamentals of Mathematics	5	4	25	75	100
	IV	IBDSS14P	SEC I	Programming in C Lab	2	2		50	50
			Library / Browsing		1				
			Remedial / Games		1				
				Total	**30**	**21**	**125**	**425**	**550**

II	I	IBLT212 / IBLA211/ IBLH211	Language I	Tamil II / Arabic II /Hindi II	5	3	25	75	100
	II	IBLEIB22 / IBLEIIA22	Language II	Language through Literature II Level I (Basic) / Language through Literature II Level II (Advanced)	5	3	25	75	100
	III	IBDSC211	Core III	Calculus & Differential Equations	5	5	25	75	100
		IBDSC22	Core IV	Python Programming	4	4	25	75	100
		IBDSA232	AECC II	Mathematical Statistics – I	5	4	25	75	100
	IV	IBDSS24P	SEC II	Data Analytics Lab - I	2	2		50	50
		IBES2	GIC I	Environmental studies	2	2		50	50
		IBDSX2 / IBDSX2O	Extra Credit	Arithmetic for Competitive Examinations/ *Online Course		2		100	100
			Library/ Browsing		1				
			Remedial/ Games		1				
				Total	**30**	**23+2**	**125**	**475 +100**	**600+ 100**
III	I	IBLT311/ IBLA31/ IBLH311	Language I	Tamil III / Arabic III /Hindi III	5	3	25	75	100
	II	IBLEIB32 / IBLEIIA32	Language II	Language through Literature III Level I (Basic) / Language through Literature III Level II (Advanced)	5	3	25	75	100
	III	IBDSC311	Core V	Mathematical Statistics – II	4	4	25	75	100
		IBDSC32	Core VI	Structured Query language	4	4	25	75	100
		IBDSA33	AECC I	Natural Language Processing	4	4	25	75	100
	IV		OEC I		2	2		50	50
		IBDSS34P	SEC III	PHP Lab	2	2		50	50

		IBHR3	GIC II	Human Rights	2	2		50	50
	V	IBXTN3	Extension	NSS/CSS	2	2	100		100
		IBDSX3/ IBDSX3O	Extra Credit	Logical Reasoning/*Online course		2		100	100
				Total	**30**	**26+2**	**225**	**525+ 100**	**750+ 100**
IV	I	IBLT41/ IBLA41/ IBLH411	Language I	Tamil IV / Arabic IV / Hindi IV	5	3	25	75	100
	II	IBLEIB42 / IBLEIIA42	Language II	Language through Literature IV Level I (Basic) / Language through Literature IV Level II (Advanced)	5	3	25	75	100
	III	IBDSC41	Core VII	Matrix Theory & Linear Algebra	4	4	25	75	100
		IBDSC421	Core VIII	# Machine Learning & Artificial Intelligence	5	4	25	75	100
		IBDSA43	AECC II	Big Data Analytics	5	4	25	75	100
	IV	IBLVE4	GIC III	Life Skills and Value Education	2	2		50	50
			OEC II		2	2		50	50
		IBDSS44P	SEC IV	Data Analytics Lab - II	2	2		50	50
		IBDSX4/ IBDSX4O	Extra Credit	Applications of Group Theory /*Online Course		2		100	100
				Total	**30**	**24+2**	**125**	**525+ 100**	**650+ 100**
V	III	IBDSC51	Core IX	Discrete Mathematics	6	5	25	75	100
		IBDSC521	Core X	o Deep Learning	6	5	25	75	100
		IBDSC53	Core XI	Graph Theory	6	5	25	75	100
		IBDSE5A/ IBDSE51B	DSE I.a/ DSE I.b	Time Series Analysis and Forecasting / Predictive Analysis	4	4	25	75	100
		IBDSE5C/ IBDSE51D	DSE II.a/ DSE II.b	Operations Research / Data Mining	4	4	25	75	100
		IBDSS54P	SEC V	Programming in Java Lab	2	2		50	50

	IV	IBWE5	GIC IV	Women Entrepreneurship	2	2		50	50
		IBESX5/IBDSX5O	Extra Credit	Employability Skills/ *Online Course		2	100		100
				Total	**30**	**27+2**	**125 + 100**	**475**	**600+ 100**
VI		IBDSC611	Core XII	Numerical Methods	6	5	25	75	100
	III	IBDSC62 PW	Core XIII	Project	6	5	25	75	100
		IBDSC63	Core XIV	Computer Vision	5	4	25	75	100
		IBDSC64	Core XV	Regression Analysis	6	4	25	75	100
		IBDSE6A / IBDSE6B	DSE III.a/ DSE III.b	Data Structures and Algorithms /Data base Security	4	4	25	75	100
	IV	IBDSS65P	SEC VI	Data Mining Lab	2	2		50	50
			Library/ Browsing		1				
		IBDSX6/ IBDSX6O	Extra Credit	Quantitative Techniques/* Online Course		2		100	100
				Total	**30**	**24+2**	**125**	**425+ 100**	**550+ 100**
				Grand Total	**180**	**145 + 10**	**850+ 100**	**2850 +400**	**3700 +500**

*For Online certification credits alone will be assigned on submission of certificate obtained through appearing for Online Examination from SWAYAM, EDX, Spoken Tutorial, NPTEL or Coursera.

o integrated course

Internship Course

AECC - Ability Enhancement Compulsory Course

SEC – Skill Enhancement Course

DSE – Discipline Specific Elective

OEC – Open Elective Course

Core I - Programming in C

(For Students Admitted from 2024-25)

Semester: I **Hours/week: 5**

Subject Code: IBDSC111 **Credit: 4**

Course Objectives:

1. To improve the knowledge of complete understanding of Programming language C
2. To understand the main features of operators, input/ output statements, control

statementsand program structure

Unit I **(15 hours)**

Introduction to C Programming: C Character Set-Writing first program of C- Identifiers and Keywords - Data types- Constants -Variables - Declarations - Expressions- Statements- Symbolic constants. **Operators and Expressions:** Arithmetic Operators-Unary Operators - Relational and logical Operators-Assignment Operators-The conditional Operators.

Unit II **(15 hours)**

Data Input and Output: Preliminaries – The getchar function- The putchar function - The scanf function-The printf function- gets and puts function-Interactive programming. **Control Statements:** Preliminaries -**Branching:** The If-else Statement-Looping- while statement- do-while statement- for statement -nested control structures- switch statement - break statement- continue statement- coma operator -goto statement.

Unit III **(15 hours)**

Functions: Defining a function - Accessing a function - Function prototypes- Passing arguments to a function- Recursion. **Program Structure:** Storage classes – Automatic variables – External variables – Static variables – Multi File programs. **Arrays:** Defining an Array – Processing an Array – Passing arrays to Functions – Multidimensional arrays- Strings Handling Functions.

Unit IV **(15 hours)**

Pointers: Fundamentals – Pointer Declarations – Passing pointers to a function – Pointers and one dimensional arrays – Dynamic memory allocation – Operations on pointers - Pointers and multidimensional arrays – Arrays of Pointers - Passing functions to other functions – More about pointer declarations.

Unit V **(15 hours)**

Structures and Unions: Defining a Structure – Processing a Structure – User defined data types – Structures and pointers – Passing structures to functions – Self Referential structures – Unions. **File Handling:** Opening and closing a Data file – Reading and writing a data file – Processing a data file – Unformatted data files – Concept of binary files – Accessing the file randomly

Course Outcomes:

After successful completion of this course, the student will be able to

CO1: Describe the basic programming knowledge of C, operators and expressions
CO2: Demonstrate data input and output, control statements & functions
CO3: Analyse program structure and arrays
CO4: Evaluate strings and pointers
CO5: Formulate structures, unions and file handling

Text Book:

1. Byron Gottfried, *Programming with C*, Tata McGraw Hill, Fourth Edition, 2018.

Reference Books:

1. Balagurusamy E**,** *Programming in ANSI C*, Tata McGraw Hill, Sixth Edition, 2012.
2. Venugopal K R , Sudeep R Prasad, *Programming with C*, Tata McGraw Hill ,2008.

3. Mullish, Henry Cooper, Herbert, *The Spirit of C - An Introduction to Modern Programming*, Jaico Publishing House, Third Edition, 2006.

E - Resources:

1. https://onlinecourses.nptel.ac.in/noc19_cs42/preview
2. https://nptel.ac.in/courses/106/105/106105171/
3. https://onlinecourses.nptel.ac.in/noc21_cs01/preview
4. https://spoken-tutorial.org/tutorial-search/?search_foss=C+and+Cpp&search_language=English

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	9	9	3	9	**45**
CO2	9	3	3	3	9	3	9	**39**
CO3	9	3	3	3	9	9	9	**45**
CO4	9	3	3	3	9	3	9	**39**
CO5	9	9	9	3	9	9	9	**57**
Total	**45**	**21**	**21**	**21**	**45**	**27**	**45**	**225**

Low-1 Medium-3 High-9

Core II - R Programming

(For Students Admitted from 2024-2025)

Semester: I **Hours/week: 6**

Subject Code: IBDSC12 **Credit: 5**

Course Objectives:

1. To know the fundamentals of statistical analysis in R environment
2. To understand probability and sampling distributions

Unit I **(18 hours)**

Introduction to R Programming: R and R Studio, Logical Arguments, Missing Values- Characters- Factors and Numeric- Help in R- Vector to Matrix- Matrix Access- Data Frames- Data Frame Access- Basic Data Manipulation Techniques- Usage of various apply functions – apply- lapply- sapply and tapply- Outlier's treatment.

Unit II **(18 hours)**

Descriptive Statistics: Types of Data- Nominal, Ordinal, Scale and Ratio- Measures of Central Tendency-Mean, Mode and Median- Bar Chart- Pie Chart and Box Plot- Measures of Variability- Range- Inter-Quartile- Range- Standard Deviation- Skewness and Kurtosis- Histogram- Stem and Leaf Diagram- Standard Error of Mean and Confidence Intervals.

Unit III **(18 hours)**

Probability- Probability& Sampling Distribution: Experiment- Sample Space and Events- Classical Probability- General Rules of Addition- Conditional Probability- General Rules For Multiplication- Independent Events- Bayes‟ Theorem- Discrete Probability Distributions: Binomial- Poisson- Continuous Probability Distribution- Normal Distribution & t-distribution- Sampling Distribution and Central Limit Theorem.

Unit IV **(18 hours)**

Statistical Inference and Hypothesis Testing: Population and Sample- Null and Alternate Hypothesis- Level of Significance- Type I and Type II Errors- One Sample t Test- Confidence Intervals- One Sample Proportion Test- Paired Sample t Test- Independent Samples t Test- Two Sample Proportion Tests- One Way Analysis of Variance and Chi Square Test.

Unit V **(18 hours)**

Correlation and Regression: Analysis of Relationship- Positive and Negative Correlation- Perfect Correlation- Correlation Matrix- Scatter Plots- Simple Linear Regression- R Square, Adjusted R Square- Testing of Slope- Standard Error of Estimate- Overall Model Fitness- Assumptions of Linear Regression- Multiple Regression- Coefficients of Partial Determination- Durbin Watson Statistics- Variance Inflation Factor.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Describe key terminologies, concepts and techniques employed in Statistical Analysis
CO 2: Demonstrate fundamentals of statistical analysis in R environment
CO 3: Analyze the purpose of exploration using Descriptive and Inferential Statistics
CO 4: Evaluate the variety of Hypothesis Tests to aid Decision Making.
CO 5: Create application of Linear Regression in multivariate context for predictive purpose.

Text Book:

1. Ken Black, 2013, *Business Statistics*, New Delhi,Wiley.

Reference Books:

1. Lee, Cheng. et al., 2013, *Statistics for Business and Financial Economics*, New York: Heidelberg Dordrecht.
2. Anderson, David R., Thomas A. Williams and Dennis J. Sweeney, 2012, *Statistics for Business and Economics*, New Delhi: Southwestern.
3. Waller, Derek, 2008, *Statistics for Business*, London: BH Publications.
4. Levin, Richard I. and David S. Rubin, 1994, *Statistics for Management*, New Delhi: Prentice Hall.

E Resources:

1. https://onlinecourses.nptel.ac.in/noc19_ma33/preview
2. https://onlinecourses.nptel.ac.in/noc22_ma69/preview
3. https://onlinecourses.nptel.ac.in/noc22_ma34/preview

Course Outcome	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	1	9	9	9	**43**
CO2	9	3	3	1	9	9	9	**43**
CO3	9	3	3	1	9	9	9	**43**
CO4	9	3	3	1	9	9	9	**43**
CO5	9	3	3	1	9	9	9	**43**
Total	45	15	15	5	45	45	45	**215**

Low-1 Medium-3 High-9

AECCI - Fundamentals of Mathematics

(For Students Admitted from 2024-2025)

Semester: I **Hours/Week: 5**
Subject Code: IBDSA132 **Credit: 4**

Course Objective:

1. To develop a strong foundation in the basic concepts of mathematics.
2. To introduce the ideas in differential calculus, set and its relations

Unit I **(15 hours)**

Theory of Sets: Introduction- The Concept of a Set- Set Inclusion – Union of Sets – Intersection of Sets – Difference of Sets – Complement of a Set – Symmetric Difference of Two Sets – Cartesian Product of Sets – **Relations and Mappings:** Relations – Equivalence Relations – Partial order – Functions.

Unit II **(15 hours)**

Vectors Spaces: Linear Transformation – Span of a set – Linear Independence – Basis and Dimension – Rank and Nullity – Matrix of a Linear Transformation - **Theory of Matrices:** Eigen Values and Eigen Vectors.

Unit III **(15 hours)**

Limits and Derivatives: The Derivative as a Function – **Applications of Differentiation:** Maximum and Minimum Values – Optimization Problems.

Unit IV **(15 hours)**

Integrals: The Definite Integral - The Fundamental Theorem of Calculus –**Applications of Integration:** Areas Between Curves – Volumes.

Unit V **(15 hours)**

Distances and Nearest Neighbors: L_p Distances and their Relatives - L_p Distances - Mahalanobis Distance - Cosine and Angular Distance - KL Divergence - Distances for Sets and Strings - Jaccard Distance - Edit Distance - Modeling Text with Distances - Bag-of-Words Vectors - k-Grams –Similarities - Set Similarities - Normed Similarities - Normed Similarities between Sets.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Recall all aspects of set theory and Analyze the Types of Relations and Solve the Equivalence relations.
CO 2: Justify the theoretical aspects of vector space and eigen values
CO 3: Calculate the Maximum and Minimum values of a function.
CO 4: Evaluate the definite integrals and find area between curves
CO 5: Communicate Mathematical solutions clearly and concisely.

Text Book

1. Arumugam, S. and Thangapandi Isaac. 2008. *Modern Algebra*. Chennai: Scitech Publications (India) Pvt. Ltd.
   Unit I : Section (1.0 – 1.8, 2.1 – 2.4)
   Unit II : Section (5.3 – 5.8 & 7.8)
2. James Stewart, *Calculus: Early Transcendentals* , 7th Edition, Cengage Learning, USA, 2012
   Unit III : Section (2.8, 4.1, 4.7)
   Unit IV : Section (5.2 - 5.3, 6.1 - 6.2)
3. Jeff M. Phillips, *Mathematical Foundations for Data Analysis*, December 2018.
   Unit V : Section (4.2 – 4.5)

Reference Book

1. Micheal D. Greenberg, *Foundations of Applied Mathematics*, Dover Publications Inc.,2013.
2. Kenneth Kunen, *The Foundations of Mathematics*, College Publications, 2009.

E-Resources

1. https://youtu.be/fzd0Viu6Qx8?si=vudX1w_hCAfvosl2
2. https://youtu.be/WCq3sRzsJfs?si=f5luzZ-lSMVWklyd

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	TOTAL
CO1	9	3	9	1	3	3	3	31
CO2	3	1	3	3	1	1	1	13
CO3	9	3	9	1	3	3	3	31
CO4	3	1	3	3	1	1	1	13
CO5	9	3	1	1	1	1	1	17
TOTAL	33	11	25	9	9	9	9	105

Low-1 Medium-3 High-9

SEC I- Programming in C Lab

(For Students Admitted from 2024-2025)

Semester: I **Hours/week: 2**
Subject Code: IBDSS14P **Credit: 2**

Course Objectives:

1. To introduce the programming skills using C language
2. To enhance the analysing and problem solving skills and use the same for writing Programs in C

List of Programs

Formula Substitution

1. Check whether the given number is odd or even
2. Find sum of the digits and reverse the digits
3. Generate the Fibonacci series
4. Generate Prime number with in range
5. Find whether a given number is Armstrong or not
6. Count the number of positive, negative and zero in the list
7. C Program to solve the Quadratic Equation
8. C Program to find the area of various shapes using switch case

Array

9. Create a C Program to Find Matrix Addition , Subtraction, Multiplication and Transpose of a matrix using switch case
10. Create a C Program to Check whether the element is present in the given list or not
11. Create a C Program to sort numbers in ascending and descending order
12. Create a C Program to sort names in Alphabetical order

Functions & Structures

13. Create a C Program to find the factorial of a given number using function declaration
14. Create a C Program to find the factorial of a given number using recursion function
15. Create a C Program to Prepare student mark list using structure
16. Create a C Program to Prepare electricity bill using structure

String Manipulation

17. Create a C Program to count the vowels in the given string
18. Create a C Program to convert the case of given string from upper case to lower case and vice versa

Pointers

19. Create a C Program to sort numbers in ascending order using pointers
20. Create a C Program to find average of two numbers using pointers

Note:-Questions for Internal and External examination will be based on concept learnt Course Outcomes:

After successful completion of this course, student will be able to

CO1: Remember the control structures and loops

CO2: Apply the concepts of functions and pointers

CO3: Analyze the concepts of structures by creating student mark list and electricity bill
CO4: Evaluate string handling functions
CO5: Create programs with pointers, arrays and structures

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO7**	**Total**
CO1	9	3	3	1	9	9	9	**43**
CO2	9	3	3	1	9	9	9	**43**
CO3	9	3	3	1	9	9	9	**43**
CO4	9	3	3	1	9	9	9	**43**
CO5	9	3	3	1	9	9	9	**43**
Total	45	15	15	5	45	45	45	**215**

Low-1 **Medium-3** **High-9**

Core III – Calculus & Differential Equations

(For Students Admitted from 2024-2025)

Semester: II **Hours / week: 5**
Subject Code: IBDSC211 **Credit: 5**

Course Objectives:

1. To solve application problems in a variety of setting ranging from physics and biology to Business and economics. Compute limits, derivatives and integrals
2. To recognize the appropriate tools of calculus to solve applied problems

Unit I **(15 hours)**

Limits and Continuity: Rates of Change and Tangent Lines to curves – Limit of a Function and Limit Laws - Continuity - The Fundamental Theorem of Calculus.

Unit II **(15 hours)**

Infinite Sequences and Series : Sequences – Infinite Series - The Integral test – Absolute Convergence - ratio and root tests - Taylor and Maclaurin series.

Unit III **(15 hours)**

Partial Derivatives: Functions of Several Variables - Partial Derivatives - Extreme Values and Saddle Points.

Unit IV **(15 hours)**

Multiple Integral: Double integrals in polar form - Triple Integrals in Rectangular Coordinates - Triple Integrals in Cylindrical and Spherical Coordinates.

Unit V **(15 hours)**

Ordinary Differential Equations: Basic Concepts, Modeling - Exact ODEs,

Integrating Factors - Linear ODEs, Bernoulli Equation - Homogeneous Linear ODEs with Constant Coefficients.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Understand and apply the basic concepts of limit and continuity
CO 2: Make use of the methods to solve the sequence and series problems
CO 3: Examine the methods of partial derivatives to solve theproblems
CO 4: Explicate and solve the examples using multiple integral
CO 5: Evaluate the techniques of ordinary differential equations

Text Books:
1. Hass M. D. J., Giordano Weir F.R. *Thomas Calculus*, Pearson Education,2013

Unit I: Chapter 2, 5 (sec: 2.1, 2.2, 2.5) & (Sec:5.4)
Unit II: Chapter 10 (Sec: 10.1-10.3, 10.5,10.8)
Unit III: Chapter 14 (Sec: 14.1, 14.3, and 14.7)
Unit IV: Chapter 15 (Sec: 15.4, 15.5, and 15.7)
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons,2011.

Unit V: Chapter 1 & 3 (Sec: 1.1, 1.4, 1.5(Page No: 27-33) and 3.2)

Reference Books:
1. Lian, Hungerford, and Holcomb *Mathematics with Applications*, Addison Wesley,2010.
2. Riley K. F., Hobson M. P. and Bence S. J., *Mathematical Methods for Physics and Engineering*, Cambridge University Press,2006.
3. Michael D. Greenberg, *Advanced Engineering Mathematics*, Pearson Education,2014.

E-Resources:
1. https://www.youtube.com/watch?v=_5fVpdOPLEw
2. https://www.youtube.com/watch?v=UvotN4v9L4c
3. https://www.youtube.com/watch?v=PGmVvIglZx8
4. https://www.youtube.com/watch?v=sZP048TJTXE
5. https://www.youtube.com/watch?v=EzzXTIIX_CU

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	1	1	3	3	3	**17**
CO2	3	1	1	1	3	3	3	**15**
CO3	3	3	1	1	3	3	3	**17**
CO4	3	3	1	1	1	3	3	**15**
CO5	3	1	1	1	1	3	3	**13**
Total	**15**	**11**	**5**	**5**	**11**	**15**	**15**	**77**

Low-1 Medium-3 High-9

Core IV – Python Programming

(For Students Admitted from 2024-2025)

Semester: II **Hours/week: 4**
Subject Code: IBDSC22 **Credit: 4**

Course Objectives:

1. To know lists, tuples and dictionaries in Python programs.
2. To understand exception handling in Python applications for error handling.

Unit I **(12 hours)**

Introduction: History of Python- Need of Python Programming- Applications Basics of Python Programming Using the REPL(Shell)- Running Python Scripts- Variables- Assignment- Keywords- Input- Output- Indentation.

Unit II **(12 hours)**

Types, Operators and Expressions: Types - Integers- Strings- Booleans; Operators- Arithmetic Operators- Comparison (Relational) Operators- Assignment Operators- Logical Operators- Bitwise Operators- Membership Operators- Identity Operators- Expressions.

Unit III **(12 hours)**

Data Structures and Control Flow: Lists- Operations- Slicing- Methods- Tuples- Sets- Dictionaries- Sequences- Comprehensions- Conditional blocks using If- Else and El-if- For Loop- For loop using Ranges- String- list and Dictionaries- While Loop- Loop Manipulation using Pass- Continue- Break and Else- Conditional and Loops Block.

Unit IV **(12 hours)**

Functions Modules and Packages: Defining Functions - Calling Functions - Passing Arguments - Keyword Arguments - Default Arguments - Variable-length arguments- Anonymous Functions- Function Returning Values- Scope of the Variables in a Function - Global and Local Variables. Creating modules- Name Spacing- Introduction to PIP- Installing Packages via PIP- Using Python Packages.

Unit V **(12 hours)**

Object Oriented Programming & Exception Handling: Classes- Self-Variable- Methods- Constructor Method- Inheritance- Overriding Methods- Data Hiding- Difference between an Error and Exception- Handling Exception- Try Except Block- Raising Exceptions- and User Defined Exceptions.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Outline lists, tuples, and dictionaries in Python programs
CO2: Demonstrate the concepts of loops and decision statements in Python
CO3: Illustrate functions and pass arguments in Python
CO4: Design object-oriented programs with Python classes
CO5: Develop Python applications.

Text Book:

1. R. Nageswara Rao, 2018, *Core Python Programming*, Dream tech.

Reference Books:

1. John Hearty, 2016, *Advanced Machine Learning with Python*, Packt.
2. Jake Vander Plas, 2016, *Python Data Science Handbook: Essential Tools for Working with Data*, O'Reilly.
3. Mark Lutz, 2010, *Programming Python*, O'Reilly.
4. Tim Hall and J-P Stacey, 2009, *Python 3 for Absolute Beginners*, Apress.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs32/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs31/preview

Course Outcome	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	1	9	9	9	**49**
CO2	9	3	9	1	9	9	9	**49**
CO3	9	3	9	1	9	9	9	**49**
CO4	9	3	9	1	9	9	9	**49**
CO5	9	3	9	1	9	9	9	**49**
Total	**45**	**15**	**45**	**5**	**45**	**45**	**45**	**245**

Low-1 Medium-3 High-9

AECC II –Mathematical Statistics - I

(For Students Admitted from 2024-2025)

Semester: II **Hours / Week: 5**
Subject Code: IBDSA232 **Credit: 4**

Course Objectives:

1. To acquire knowledge about moment generating functions and characteristic functions
2. To explain the concept of Probability theory

Unit I **(18 hours)**

Theory of Probability: Axiomatic approach to probability – Some Theorems on Probability –Addition Theorem of Probability – Extension of Addition Theorem of Probability to n Events - Multiplication Theorem of Probability - Independent Events - Pairwise Independent Events - Baye's Theorem.

Unit II **(18 hours)**

Random Variables and Distribution Functions: Introduction - Distribution Function - Discrete Random variable – Continuous random variable – Two Dimensional Random Variables – Two dimensional or Joint Probability Mass Function - Two dimensional distribution functions – Marginal distribution function – Joint Density Function, Marginal Density Function – The Conditional Distribution Function and Conditional Probability Density Function

Unit III **(10 hours)**

Mathematical Expectation and Generating Functions: Introduction - Mathematical Expectation or Expected value of a random variable – Expected value of function of a random variable – Properties of Expectation - Covariance – Moment Generating Function.

Unit IV **(19 hours)**

Discrete Probability Distributions: Binomial Distribution – Moments of Binomial Distribution – Recurrence Relation for the moments of Binomial Distribution – Mean Deviation about mean of Binomial distribution – Mode of Binomial Distribution – Moment Generating Function of Binomial Distribution - Recurrence Relation for the probabilities of Binomial Distribution – Poisson Distribution – The Poisson Process – Moments of the Poisson Distribution – Mode of the Poisson Distribution – Recurrence Relation for moments of the Poisson Distribution – Moment generation function of the Poisson Distribution – Characteristic function of the Poisson Distribution – Additive or Reproductive property of independent Poisson Variates – Probability generating function of Poisson Distribution – Recurrence formula for the probabilities of Poisson Distribution.

Unit V **(10 hours)**

Continuous Probability Distributions: Introduction – Normal Distribution - Normal Distribution as a limiting form of Binomial Distribution – Chief Characteristic of Normal Distribution – Mode of Normal Distribution – Median of Normal Distribution – M.G.F of Normal Distribution – Moments of Normal Distribution – A Linear Combination of independent normal variates – Area Property – Impotence of Normal Distribution – Fitting of Normal Distribution.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Illustrate and differentiate the basic probability concepts
CO 2: Analyze the probability density function to solve the problems
CO 3: Evaluate relationship between joint p.m.f and joint p.d.f
CO 4: Make use of poison and binomial distribution to solve real life problems
CO 5: Classify the Random variables and determine solution to the given problems by MGF

Text Book:

1. S.C.Gupta, V. K. Kapoor, *Fundamntals of Mathematical Statistics***,**
Sultan Chand and Sons, Twelfth Edition, Reprint 2022.
Unit I: Chapter 3 &4 (3.8, 3.9, 3.9.1- 3.9.2, 3.11, 3.12, 3.15, 4.2)
Unit II: Chapter 5 (5.1 – 5.5, 5.5.1 – 5.5.5)
Unit III: Chapter 6 & 7 (6.1 – 6.4, 6.6, 7.1);
Unit IV: Chapter 8 (8.4, 8.4.1, 8.4.2, 8.4.4 – 8.4.6, 8.4.12, 8.5, 8.5.1 – 8.5.6, 8.5.8 – 8.5.10)
Unit V: Chapter 9 (9.1, 9.2, 9.2.1 – 9.2.5, 9.2.7, 9.2.8, 9.2.11 -9.2.13)

Reference Books:

1. S. Arumugam and A. Thangapandi Isaac, *Statistics***,** New Gamma Publishing Houses, Edition 2009.
2. S.C.Gupta, V. K. Kapoor, *Elements of Mathematical Statistics***,** Sultan Chand and Sons, Third Edition, Reprint 2015.

E - Resources:

1. https://cims.nyu.edu/~cfgranda/pages/stuff/probability stats forDS.pdf
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=+u3y6UdbIvOJ97LFeSCmHQ=
3. https://www.researchgate.net/publication/272237355 Probability and Mathematical Statistics

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	9	3	3	3	**27**
CO2	3	3	9	9	3	3	3	**33**
CO3	3	9	9	9	3	9	3	**45**
CO4	9	9	9	9	3	9	9	**57**
CO5	3	9	9	9	3	9	9	**51**
Total	**21**	**33**	**39**	**45**	**15**	**33**	**27**	**213**

Low-1 Medium-3 High-9

SEC II - Data Analytics Lab- I

(For Students Admitted from 2024-2025)

Semester: II **Hours/week: 2**

Subject Code: IBDSS24P **Credit: 2**

Course Objectives:

1. To know the modern quantitative tools to data analysis in a business context
2. To apply the tools to transform the data into useful information

List of Programs Using Spread Sheet

1. To perform Basic Functions in Spreadsheets
2. To perform Formatting and Proofing
3. To perform Mathematical & Text Functions
4. To Implement Date and Time Functions
5. To Implement Sorting
6. To Implement Filtering Techniques
7. To perform Logical Functions
8. To perform Data Validation
9. To display PivotTables
10. To display Charts and Slicers
11. To perform Lookup Functions

Note:-Questions for Internal and External examination will be based on concept learnt Course Outcomes:

After successful completion of this course, student will be able to

CO1: Outline Excel functions to solve mathematical, text, date and time operations

CO2: Demonstrate the concepts of sorting, filtering using Excel

CO3: Illustrate Data validation feature of spread sheet

CO4: Evaluate Statistical operations using Pivot Table tool

CO5: Develop spread sheet with visualization using charts

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	1	9	9	**43**
CO2	9	1	9	3	1	9	9	**41**
CO3	9	1	9	3	1	9	9	**41**
CO4	9	1	9	3	1	9	9	**41**
CO5	9	3	9	3	1	9	9	**43**
Total	**45**	**9**	**45**	**15**	**5**	**45**	**45**	**209**

Low-1 Medium-3 High-9

Extra Credit- Arithmetic for Competitive Examinations

(For Students Admitted from 2024-2025)

Semester: II

Subject Code: IBDSX2 **Credit: 2**

Course Objectives:

1. To introduce the basic concepts of Mathematics
2. To promote the problem solving ability to write the competitive examinations

Unit I

Numbers: Four Fundamental Rules - Solved Problems.

Unit II

Simplification: Solved Problems.

Unit III

Average: Solved Problems**.**

Unit IV

Chain Rules: Solved Problems.

Unit V

Allegation or Mixture: Solved Problems.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Compute the average of numbers
CO2: Make use of Allegation or Mixture in problems
CO3: Solve and simplify the real life problems
CO4: Apply the chain rule for solving the problems
CO5: Build the analytical and logical skills

Text Book:

1. R.S Aggarwal, *Arithmetic (Subjective & Objective) for Competitive Examinations*, S.Chand and Company Limited, Reprint 2009.

Unit I: Chapter 1(Pg.No: 1 - 29)
Unit II: Chapter 4(Pg.No:73 - 89)
Unit III: Chapter 7(Pg.No: 142-157)
Unit IV: Chapter 10(Pg.No: 205 -223)
Unit V: Chapter 17(Pg.No: 332 – 347)

Reference Books:

1. S.L Gulati, *A Complete Book on Objective Arithmetic* – Cosmos Bookhive(P) Limited, 32nd Edition.
2. R.S Aggarwal, *Objective Arithmetic (Numerical Ability Test) For Competitive Examinations*, S.Chand and CompanyLimited.
3. R.S Aggarwal & S.Chand, *Quantitative Aptitude for Competitive Examination*, Seventh Edition, 2008.

E- Resources:

1. https://www.youtube.com/watch?v=yoGq9IGc74E
2. https://careerdost.in/aptitude-questions/average-problems
3. https://byjus.com/govt-exams/mixture-alligation-questions

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	1	3	3	3	9	**25**
CO2	3	3	1	3	3	3	9	**25**
CO3	3	3	1	3	3	3	9	**25**
CO4	3	3	3	3	3	3	9	**27**
CO5	3	3	3	3	3	3	9	**27**
Total	**15**	**15**	**9**	**15**	**15**	**15**	**45**	**129**

Low-1 Medium-3 High-9

Core V – Mathematical Statistics – II

(For Students Admitted from 2024-2025)

Semester: III **Hours / week: 4**
Subject Code: IBDSC311 **Credit: 4**

Course Objectives:

1. To acquire knowledge about the Correlation,Regression and exact sampling distribution
2. To gain knowledge about the testing of significance for large samples and small samples

Unit I **(10 hours)**

Correlation: Introduction – Meaning of Correlation - Scatter diagram - Karl Pearson Coefficient of Correlation - Rank Correlation.

Unit II **(10 hours)**

Curve Fitting and Regression Analysis: Introduction – Linear Regression – Regression Coefficients – Properties of Regression Coefficients – Angle between two lines of regression.

Unit III **(14 hours)**

Large Sample Theory: Introduction -Types of Sampling- Parameters and statistic - Tests of Significance – Procedure of Test of hypothesis - Tests of significance for large samples – Sampling of Attributes – Sampling of Variables – Test of significance for Single Mean – Test of Significance for Difference of Means.

Unit IV **(14 hours)**

Exact Sampling Distribution: Introduction – Derivation of the Chi-square Distribution - M.G.F of Chi-Square distribution – Additive Property of Chi – Square Variates – Applications of Chi-Square distribution – Goodness of Fit test.

Unit V **(12 hours)**

Exact sampling distribution: Introduction – Student's t –Distribution – Derivation of Student's t –Distribution – Application of t- distribution - F- distribution - Applications of F – distribution – F – Test for Equality of Two populations Variances.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Understand the concept of Correlation and Regression
CO 2: Estimate and apply all aspects of Statistics
CO 3: Classify the concepts of sampling, testing of hypothesis and critical region
CO 4: Analyze the M.G.F of chi-square distribution
CO 5: Justify the concept of Student's t-distribution and F-distribution

Text Book:

1. S.C.Gupta, V. K. Kapoor, *Fundamntals of Mathematical Statistics***,** Sultan Chand and Sons, Twelfth Edition, Reprint 2022.

Unit I: Chapter 10 (10.1 -10.5, 10.7)
Unit II: Chapter 11 (11.1, 11.2, 11.2.1 -11.2.3)
Unit III: Chapter 14 (14.1-14.7, 14.8.3, 14.8.4)

Unit IV: Chapter 15 (15.1 -15.3, 15.3.5)
Unit V: Chapter 16 (16.1, 16.2, 16.2.1, 16.3, 16.6, 16.7, 16.7.1)

Reference Books:

1. S. Arumugam and A. Thangapandi Isaac, *Statistics***,** New Gamma Publishing Houses, Edition, 2009.
2. S.C.Gupta, V.K.Kapoor, *Elements of Mathematical Statistics***,** Sultan Chand and Sons, Third Editon, Reprint 2015.
3.

E-Resources:

1. https://udrc.lkouniv.ac.in/Content/DepartmentContent/SM_6dc18628-deb8- 41c0-b3e0-7f39c1ca0125_38.pdf
2. https://www.youtube.com/watch?v=ktXwySpRrR8
3. https://www.simplypsychology.org/sampling-distribution.html

Course Outcome	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	9	3	9	9	9	**45**
CO2	3	3	3	1	3	9	9	**31**
CO3	3	9	9	9	9	9	9	**57**
CO4	3	3	9	9	9	9	9	**51**
CO5	3	9	9	9	9	9	9	**57**
Total	**15**	**27**	**39**	**31**	**39**	**45**	**45**	**241**

Low-1 Medium-3 High-9

Core VI - Structured Query Language

(For Students Admitted from 2024-2025)

Semester: III **Hours/week: 4**
Subject Code: IBDSC32 **Credit: 4**

Course Objectives:

1. To know basic concepts and the applications of Database Systems
2. To understand basics of SQL and queries using SQL

Unit I **(12 hours)**

Introduction to Database Management Systems: Introduction-Database System Applications- Purpose of Database Systems- Views of Data- Data Abstraction- Instances and Schemas- Data Models- Database Languages- DDL- DML- Database Architecture- Database Users and Administrators- Database Design- ER Diagrams- Entities- Attributes and Entity Sets- Relationships and Relationship sets- Integrity Constraints- Views.

Unit II **(12 hours)**

SQL Operators and Relational Theorems: Relational Algebra and Calculus- Selection and Projection- Set Operations- Renaming- Joins- Division- Relational calculus- Tuple Relational Calculus- Domain Relational Calculus- Formsof Basic SQL Query- Nested Queries- Comparison Operators- Aggregate Operators- NULL values- Logical connectives- AND, OR and NOT- Outer Joins- Triggers.

Unit III **(12 hours)**

Normalization Problems Caused by Redundancy: Decompositions- Functional Dependencies- Normal Forms- First, Second, Third Normal forms- BCNF- Properties of Decompositions- Loss less Join Decomposition- Dependency Preserving Decomposition- Multi Valued Dependencies- Fourth Normal Form- Join Dependencies- Fifth Normal Form**.**

Unit IV **(12 hours)**

Transactions: Transaction Management- Transaction Concept- Transaction State- Implementation of Atomicity and Durability- Concurrent Executions- Serializability- Recoverability- Implementation of Isolation- testing for serializability- Concurrency Control- Lock- Timestamp Based Protocols- Validation Based Protocols- Recovery- Failure Classification- Storage Structure- Atomicity- Log Based Recovery- Remote Backup Systems.

Unit V **(12 hours)**

No SQL: Overview of No SQL- Types of No SQL Databases- No SQL Storage Architecture- CRUD Operations in MongoDB- Querying- Modifying and Managing No SQL Databases- Indexing and Ordering- Migrating from RDBMS to No SQL-No SQL in Cloud- Database Administration.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Describe the basic concepts and the applications of Database Systems

CO2: Demonstrate basics of SQL and queries using SQL

CO3: Illustrate Normalization

CO4: Evaluate indexing and ordering in No SQL

CO5: Create No SQL data bases

Text Book:

1. Guy Harrison, 2015, *Next Generation Databases: No SQL and Big Data*,Apress.

Reference Books:

1. Ramez Elmasri, ShamkatB.Navathe, 2013, *Database Systems*,Pearson.
2. Pramod J. Sadalage, Martin Fowler, 2012, *No SQL Distilled,* AddisonWesley.
3. A.Silberschatz, H.F. Korth, S.Sudarshan, 2006, *Database System Concepts*, McGraw Hill.
4. Raghurama Krishnan, Johannes Gehrke, 2003, *Database Management Systems*, McGraw Hill.

E-Resources:

1. https://archive.nptel.ac.in/courses/106/105/106105175/
2. https://onlinecourses.nptel.ac.in/noc21_cs04/preview

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	1	9	3	3	**31**
CO2	9	3	9	1	9	9	3	**43**
CO3	9	3	9	1	9	9	3	**43**
CO4	9	3	3	1	9	3	3	**31**
CO5	9	3	3	1	9	3	3	**31**
Total	**45**	**15**	**27**	**5**	**45**	**27**	**15**	**179**

Low-1 Medium-3 High-9

AECC I -Natural Language Processing

(For Students Admitted from 2024-2025)

Semester: III **Hours/week: 4**
Subject Code: IBDSA33 **Credit: 4**

Course Objectives:

1. To know the concepts of Text Analytics, Unstructured Information Analysis for better decision making
2. To understand the roots behind Text Mining which evolved from Machine Learning, Natural Language Processing and Statistics

Unit I **(12 hours)**

Introduction to Text Mining: Basics of Text Mining- Natural Language Content Analysis- Core Text Mining Operations- Associations- Using Background Knowledge for Text Mining- Domain Ontologies- Domain Lexicons. Text Mining Pre-processing Techniques- Task Oriented Approaches- NLP Tasks- Tokenization- Part-of-Speech Tagging- Syntactical Parsing and Shallow Parsing.

Unit II **(12 hours)**

Extracting Features, Relations from Text: Finding Implicit Features- Finding Opinion Phrases and their Polarity- Context-Specific Word Semantic Orientation- Analysis of Word- and Document Frequency- tf-idf - Zipf‟s Law- bind tf- idf Function- Subsequence Kernels for Relation Extraction- Capturing Relation Patterns witha StringKernel.

Unit III **(12 hours)**

Text Categorization and Clustering: Applications of Text Categorization- Document Representation- Knowledge Engineering Approach to Text Categorization- Machine Learning Approach to Text Categorization- Evaluation of Text Classifiers. Clustering Tasks

in Text Analysis- Clustering Algorithms and Clustering of Textual Data.

Unit IV **(12 hours)**

Relationships between Words: Tokenizing by N-gram- Counting and Filtering N-gram- Analyzing Bigrams to provide Contextin Sentiment Analysis- visualizing a Network of Bigrams using ggraph- Counting and Correlating Pairs of Words with the widyr Package- Counting and Correlating among Sections- Examining Pairwise Correlation.

Unit V **(12 hours)**

Topic Modelling and Probabilistic Models for Information Extraction: Latent Dirichlet Allocation- Word Topic Probabilities- Per-Document Classification- By-words Assignments- Alternative LDA Implementations. Hidden Markov models- Stochastic Context Free Grammar- Conditional Random fields- Parallel LearningAlgorithms.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Describe the approaches to Syntax and Semantics in NLP

CO2: Demonstrate various methods for Statistical approaches to Machine Translation

CO3: Illustrate Topic Modelling and Probabilistic Models for Information Extraction.

CO4: Implement and deploy programs based on Relationship Extraction, POS Tagging and Clustering Algorithms based on NLP.

CO5: Build Models which extract information from Textual Unstructured Data

Text Book:

1. Julia Silge, David Robinson, 2018, *Text Mining with R-A Tidy Approach*, O'Reilly

Reference Books:

1. Matthew L. Jockers, 2014, *Text Analysis with R for Students of Literature*, Springer.
   James Pustejovsky, Amber Stubbs, 2012, *Natural Language Annotation for Machine Learning*, O'Reilly.
2. Steve R. Poteet, 2007, *Natural Language Processing with Text Mining*, Springer.
3. James Sanger, Ronen Feldman, 2002, *The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data*, Cambridge.

E-Resources:

1. https://nptel.ac.in/courses/106105158
2. https://nptel.ac.in/courses/106101007

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	1	9	3	3	**31**
CO2	9	3	3	1	9	3	3	**31**
CO3	9	3	3	1	9	3	9	**37**
CO4	9	3	3	1	9	3	3	**31**
CO5	9	3	3	1	9	3	9	**37**
Total	**45**	**15**	**15**	**5**	**45**	**15**	**27**	**167**

Low-1 Medium-3 High-9

SEC III – PHP Lab

(For Students Admitted from 2024-2025)

Semester: III **Hours/week: 2**

Subject Code: IBDSS34P **Credit: 2**

Course Objectives:

1. To understand the concepts of regular expressions including modifiers, operators and met characters
2. To develop PHP programs that use various PHP library functions and that manipulate files and directories

List of Programs

1. Develop a PHP program to print Sum of digits
2. Develop a PHP program to print factorial of a number
3. Develop a PHP program to display count, from 10 to 20 using loop
4. Develop a PHP program to print prime number
5. Develop a PHP program to check Armstrong number
6. Develop a PHP program to check Palindrome number
7. Develop a PHP program to swap two numbers with and without using third variable.
8. Develop a PHP program to reverse the number with strrev().
9. Develop a PHP program to show day of the week (for eg: Monday) based on numbers using Switch/case statements
10. Develop a PHP program to print alphabet triangle
11. Develop a PHP program to check student grade based on the marks using if- else statement
12. Develop a PHP program Using nested for loop that creates a chessboard

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Describe the fundamentals of PHP Language in trivial problem solving
CO2: Determine solution to a problem and apply control structures
CO3: Simplify the use of Strings and String Handling functions
CO4: Justify real time applications using PHP language features.
CO5: Build skill on problem solving by constructing algorithms

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	1	9	1	1	**25**
CO2	9	3	3	3	9	3	3	**33**
CO3	9	3	1	3	9	9	3	**37**
CO4	9	3	3	3	9	9	3	**39**
CO5	9	3	3	3	9	9	3	**39**
Total	**45**	**15**	**11**	**13**	**45**	**31**	**13**	**173**

Low-1 **Medium-3** **High-9**

Extra Credit - Logical Reasoning

(For Students Admitted from 2024-2025)

Semester III

Subject Code: IBDSX3 **Credit: 2**

Course Objectives:

1. To correlate an application of acquired knowledge on subjective test questions with Linguistically and structurally appropriate answers
2. To attend for competitive examinations

Unit I

Puzzle Test.

Unit II

Logical Venn diagram.

Unit III

Alphabet Test.

Unit IV

Alpha - Numeric Sequence Puzzle.

Unit V

Inserting the Missing Character.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Determine the solutions to a range of elementary problems using puzzle test

CO 2: Demonstrate the ability to perform logical Venn diagrams and solve the problem

CO 3: Use analysis of variance techniques to Alphabet test

CO 4: Inspect the alpha numeric sequence puzzle

CO 5: Explicate graph coloring to solve the problems

Text Book:

1. Dr R S Aggarwal, *A Modern Approach to Verbal Reasoning*, S. Chand & Company Private Limited, Edition, 2013.

Unit I: Chapter 6
Unit II: Chapter 9
Unit III: Chapter 10
Unit IV: Chapter 11
Unit V: Chapter16

Reference Books:

1. Dr R S Aggarwal, *A Modern Approach to Verbal and Non-verbal Reasoning*, S.Chand &Company Private Limited, Edition2012.
2. Dr R S Aggarwal**,** *A Modern Approach to Logical Reasoning*, S. Chand & Company Private Limited, Edition2013.
3. P K Agarwal, *Test of Verbal Reasoning for Competitive Examinations*, Edition2004.

E- Resources:

1. https://youtu.be/3hNmmZBN6jw
2. https://youtu.be/xmSSMH6RDBQ
3. https://youtu.be/aDPu39j-mBY

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	3	9	1	3	1	3	3	23
CO2	3	9	1	3	3	3	3	25
CO3	3	9	1	3	1	3	3	23
CO4	3	9	1	3	1	3	3	23
CO5	3	9	1	3	1	3	3	23
Total	15	45	5	15	7	15	15	117

Low-1 Medium-3 High-9

Core VII- Matrix Theory and Linear Algebra

(For Students Admitted from 2024-2025)

Semester: IV **Hours / week: 4**
Subject Code: IBDSC41 **Credit: 4**

Course Objectives:

1. To understand the basic concepts of matrix algebra and itsapplications
2. To solve computational problems in linearalgebra

Unit I **(12 hours)**

Linear Equations and Matrices: Systems of linear equations - Gaussian elimination - Sums and scalar multiplications of matrices - Products of matrices Block matrices - Inverse matrices - Elementary matrices and finding A^{-1}.

Unit II **(12 hours)**

Determinants: Basic properties of the determinant - Existence and uniqueness of the determinant - Cofactor expansion – Cramer‟s rule.

Unit III **(12 hours)**

Vector spaces: The n-spaceand vector spaces-Subspaces - Bases - Dimensions - Row and column spaces - Rank and nullity - Bases for subspaces - Invertibility.

Unit IV **(12 hours)**

Linear Transformations: Basic properties of linear transformations - Invertible linear transformations - Matrices of linear transformations - vector spaces of linear transformations-change of bases.

Unit V **(12 hours)**

Inner Product spaces: Dot products and inner products - The lengths and angles of

vectors - Matrix representations of inner products - Gram - Schmidt orthogonalization - Projections - Orthogonal projections - Relations of fundamental subspaces - Orthogonal matrices and isometries.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Make use of Gaussian elimination method to solve system of linear equations

CO 2: Classify the properties of Determinants and use Cramer's rule to solve the problems

CO 3: Summarize the results obtained about solvability of the system, obtain several characterizations of the invertibility of a square matrix

CO 4: Examine the concept of vector space of linear transformation using algebraic operations

CO 5: Construct orthonormal basis for a matrix

Text Book:

1. Jin Ho Kwak Sungpyo Hong, *Linear Algebra*, Springer International, Second Edition, Third Indian, Reprint, 2010.

Unit I: Chapter 1(Pg.no: 01 - 29)
Unit II: Chapter II (Pg.no: 45 - 63)
Unit III: Chapter III (Pg.no: 75 - 108)
Unit IV: Chapter IV (Pg.no: 117 - 138)
Unit V: Chapter V (Pg.no: 157 -181)

Reference Books:

1. Gilbert Strang, *Linear Algebra and Learning from Data*, willesley, Cambridge,2019.
2. Peter Selinger, *Matrix theory and Linear Algebra***,** Lyryx Learning and Ken Kuttler, First Edition, 2022.
3. Friedberg S, Insel A, and Spence L, *Linear Algebra*, Pearson,2019.

E- Resources:

1. https://www.youtube.com/embed/5ahKAiBc-DI
2. https://www.swayamprabha.gov.in/index.php/program/archive/8
3. https://math.mit.edu/~gs/linearalgebra/
4. http://www.math.nagoya-u.ac.jp/~richard/teaching/f2014/Lin_alg_Lang.pdf
5. https://web.stanford.edu/~boyd/vmls/vmls.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	3	3	1	3	3	**25**
CO2	3	9	3	3	1	3	3	**25**
CO3	3	9	3	3	1	3	1	**23**
CO4	3	3	3	3	1	3	3	**19**
CO5	3	3	3	3	3	3	3	**21**
Total	**15**	**33**	**15**	**15**	**7**	**15**	**13**	**113**

Low-1 Medium-3 High-9

Core VIII - Machine Learning & Artificial Intelligence

(For Students Admitted from 2024-2025)

Semester: IV **Hours/week: 5**
Subject Code: IBDSC421 **Credit: 4**

Course Objectives:

1. To gain critical knowledge and understanding about major Data Mining procedures like Decision Tree, Cluster Analysis
2. Able to apply and practice this gained knowledge in variety of Business Scenario

Unit I **(15 hours)**

Classification and Regression Tree: Classification & Regression- working of a Decision Tree- Attribute Selection Measures- Information Gain- Gain Ratio- Gini Index- Building Decision Trees- CART- C5.0 and CHAID Trees- Prediction by Decision Tree- Advantages and Disadvantages of Decision Trees- Model Overfitting- Building Decision Trees in R.

Unit II **(15 hours)**

Clustering : Cluster Analysis versus Factor Analysis- Overview of Basic Clustering Methods- Agglomerative Hierarchical Clustering- Within-Group Linkage- Nearest Neighbor or Single Linkage- Furthest Neighbor or Complete Linkage- Centroid Clustering- Ward's Method- K- Means Algorithm- Dendrogram- Profiling of Cluster- Cluster Evaluation.

Unit III **(15 hours)**

Support Vector Machine: Decision Boundaries for Support Vector Machine- Maximum Margin Hyperplanes- Structural Risk Minimization- Linear SVM-Separable Case- Linear SVM-Non-Separable Case- Kernel Function- Kernel Trick- Kernel Hilbert Space- Model Evaluation.

Unit IV **(15 hours)**

Marret Basket Analysis : Market Basket Analysis and Association Analysis- Market Basket Data- Stores- Customers- Orders- Items- Order Characteristics- Product Popularity- Tracking Marketing Interventions- Association Rules- Support- Confidence- Lift- Chi-Square Value- Sequential Pattern Analysis.

Unit V **(15 hours)**

Introduction to Artificial Intelligence: Current Trends in AI- Intelligent Agents- Environments- Problem Solving Agents- Searching Techniques- Knowledge and Reasoning in AI- Forms of Learning- Structure of a Neural Network- Analogy with Biological Neural Network- Activation Functions- Gradient Descent- Model Accuracy.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Describe the wide variety of Statistical and Machine Learning Algorithms
CO 2: Demonstrate Machine Learning techniques
CO 3: Analyze the performance of machine learning algorithms

CO 4: Evaluate performance of machine learning algorithms and select the best one based on the solution.
CO 5: Create Programming Framework to obtain acceptable decisions for the Real-World problems.

Text Book:
1. Kevin Knight, Elaine Rich, B.Nair, 2017, *Artificial Intelligence*, McGraw.

Reference Books:
1. Han, JiaweiandKamber, Micheline, 2012, *Data Mining: Concepts and Techniques*, Morgan KaufmanPublishers.
2. AnandRajaraman, 2011, *Mining of Massive Data sets*, CambridgeUniversityPress.
3. Mitchell, 2013, *Machine Learning*, McGrawHill.
4. StuartRussell, PeterNorvig, 2004, *ArtificialIntelligence–AModernApproach*, Pearson.

E-Resources:
1. https://onlinecourses.nptel.ac.in/noc21_cs42/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs24/preview

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	1	9	9	9	**49**
CO2	9	3	9	1	9	9	9	**49**
CO3	9	3	9	1	9	9	9	**49**
CO4	9	3	9	1	9	9	9	**49**
CO5	9	3	9	1	9	9	9	**49**
Total	**45**	**15**	**45**	**5**	**45**	**45**	**45**	**245**

Low-1 Medium-3 High-9

AECC II -Big Data Analytics

(For Students Admitted from 2024-2025)

Semester: IV **Hours/week: 5**
Subject Code: IBDSA43 **Credit: 4**

Course Objectives:
1. To understand about Big Data Technology, Hadoop Ecosystem and various tools related to it.
2. To learn about the HDFS File System, Map Reduce Framework, analyzing data using Hbase and Hive along with the Integration of R with Hadoop.

Unit I **(15 hours)**

Introduction to Big Data: What Is Big Data? - History of Data Management- Evolution of Big Data- Structuring of Big Data- Elements of Big Data- Application of Big Data in the

Business Context- Careers in Big Data. Business Applications of Big Data: The Significance of Social Network Data- Financial Fraud and Big Data- Fraud Detection in Insurance- Use of Big Data in the Retail Industry.

Unit II **(15 hours)**

Technologies for Handling Big Data: Distributed and Parallel Computing for Big Data- Understanding Hadoop- Cloud Computing- Grid Computing- and In-Memory Technology for Big Data. VMWare Installation of Hadoop- Linux and its Shell Commands- Different Hadoop Distributions and their advantages- Hortonworks- Cloudera- MapR.

Unit III **(15 hours)**

Understanding the Hadoop Ecosystem : The Hadoop Ecosystem- Storing Data with HDFS- Design of HDFS- HDFS Concepts- Command Line Interface to HDFS- Hadoop File Systems- Java Interface to Hadoop- Anatomyof a file read- Anatomy of a file write- Replica placement and Coherency Model- Parallel Copying with distcp- keeping an HDFS Cluster Balanced.

Unit IV **(15 hours)**

Map Reduce Fundamentals: Origins of Map Reduce- How Map Reduce Works- Optimization Techniques for Map Reduce Jobs- Applications of Map Reduce- Java Map Reduce classes (new API)- Data flow- combiner functions- running a distributed Map Reduce Job. Configuration API- setting up the development environment- Managing Configuration.

Unit V **(15 hours)**

Integrating R with Hadoop, Understanding Hive & Hbase: Understanding R-Hadoop- Integration Procedure- Packages needed for R under Hadoop Ecosystem- Text Mining for Deriving Useful Information using R within Hadoop- Introduction to Hive & Hbase- Hive and Hbase Architecture- Understanding Queries- Mining Big Data withHive & Hbase.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Explain the fundamentals of Big Data and its Applications in various Domains
CO2: Apply HDFS File Structure, Map Reduce Framework to solve complex problems
CO3: Analyze the technologies behind Big Data
CO4: Implement Hive/ Hbase shell pertaining to relational data handling under Hadoop.
CO5: Build applications integrating R with Hadoop

Text Book:

1. Arshdeep Bahga, 2016, *Big Data Science & Analytics: A Hands-OnApproach*,VPT.

Reference Books:

1. Tom White, 2012, *Hadoop: The Definitive Guide*,O‟Reilly.
2. Adam Shook and Donald Miner, 2012, *Map Reduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems*,O‟Reilly.
3. Dean Wampler, Edward Capriolo & Jason Rutherglen, 2012, *Programming Hive*, O‟Reilly.
4. Lars George, 2011, *HBase - The Definitive Guide: Random Access to YourPlanet-Size*

*Data,*O"Reilly.

E-Resources:

1. https://nptel.ac.in/courses/106104189
2. https://www.naukri.com/learning/big-data-computing-by-nptel-course-nptel33?enModal=Y&logFlow=N

Course Outcome	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	1	9	3	3	**31**
CO2	9	3	9	1	9	9	3	**43**
CO3	9	3	3	1	9	9	9	**43**
CO4	9	3	9	1	9	9	9	**49**
CO5	9	3	3	1	9	9	9	**43**
Total	**45**	**15**	**27**	**5**	**45**	**39**	**33**	**209**

Low-1 Medium-3 High-9

SEC IV - Data Analytics Lab II

(For Students Admitted from 2024-2025)

Semester: IV **Hours/week: 2**

Subject Code: IBDSS44P **Credit: 2**

Course Objectives:

1. To identify datasets and explain how they are organized and manipulate data
2. To use functions for data visualization

List of Programs Using R Tool:

1. To get the input from user and perform numerical operations (MAX, MIN, AVG, SUM, SQRT,ROUND)
2. To perform data import (.CSV, .XLS, .TXT)operations
3. To perform data export (.CSV, .XLS, .TXT)operations
4. To get the input matrix from user and perform Matrix addition, subtraction, multiplication, inverse transpose and division operations using vector concept
5. To create data frames and performs operations on it
6. To perform data pre-processing operations -Handling Missing data
7. To perform data pre-processing operations - Min-Max normalization
8. To perform statistical operations (Mean, Median, Mode and Standard deviation)
9. To perform Simple Linear Regression
10. To perform K-Means clustering operation and visualize for iris dataset

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Outline R functions to perform numerical operations

CO2: Demonstrate the concepts of import/export operations

CO3: Illustrate data pre-processing operations
CO4: Evaluate Statistical operations
CO5: Develop an application using K-Means algorithm with visualization

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	1	9	9	**43**
CO2	9	1	9	3	1	9	9	**41**
CO3	9	1	9	3	1	9	9	**41**
CO4	9	1	9	3	1	9	9	**41**
CO5	9	3	9	3	1	9	9	**43**
Total	45	9	45	15	5	45	45	**209**

Low-1 Medium-3 High-9

Extra Credit – Applications of Group Theory

(For Students Admitted from 2024-2025)

Semester: IV
Subject Code: IBDSX4 **Credit: 2**

Course Objectives:

3. To use group theory in information theory
4. To recognize the concept of error correcting group codes

Unit I

Group theory in matrices: Linear transformations and Matrices - Matrix addition - Matrix multiplication - Diagonal, Permutation and Triangular Matrices.

Unit II

Rectangular Matrices - Inverses - Rank and Nullity - Elementary Matrices - General Equivalence Canonical form - Quaternions.

Unit III

Group theory in information theory - Two metric spaces of continuous random variable – Hamming's codes - Group codes - A detections scheme for group codes - Slepian's Technique for single - error correcting group codes – Hamming's lemma.

Unit IV

Further notes on group codes - Algebraic operations on group codes.

Unit V

The application of group theory to parity check coding - Matrix of code words – Error patron vectors and received sequences for a group code.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Understand the concept of Matrices and linear transformation
CO 2: Apply the concepts of Matrices in applications of group theory
CO 3: Make use of Group theory in Information theory
CO 4: Analyze the concept of linear transformation and matrices
CO 5: Illustrate the concept of rank and nullity

Text Book:
1. P.N. Arora, *Group theory and Mathematics*, Anmol Publishing House, 1995.
Unit I: Part II (Pg.no: 379- 395)
Unit II: Part II (Pg.no: 395-418)
Unit III: Part II (Pg.no: 435– 450)
Unit IV: Part II (Pg.no:450– 458)
Unit V: Part II (Pg.no:458– 468)

Reference Books:

1. Dr. M.K. Venkatraman, Dr. N. Sridharan & Dr. N. Chandrasekaran, *Discrete Mathematics,* Edition, 2006.
2. Arumugam S & Issac. A.T, *Modern Algebra*, Scitech Publications (India) Private Limited, 2007.
3. JK Sharma, *Discrete Mathematics*, Macmillan India Limited, Second Edition, 2005.

E-Resources:
1. https://www.youtube.com/watch?v=kYB8IZa5AuE
2. https://www.youtube.com/watch?v=9IVYVtAuuQs
3. https://home.iitk.ac.in/~peeyush/102A/Lecture-notes.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	9	3	9	**33**
CO2	3	3	3	3	9	3	3	**27**
CO3	3	3	3	3	3	3	3	**21**
CO4	3	3	3	3	9	3	9	**33**
CO5	3	3	3	3	9	3	9	**33**
Total	**15**	**15**	**15**	**15**	**39**	**15**	**33**	**147**

Low-1 **Medium-3** **High-9**

Core IX- Discrete Mathematics

(For Students Admitted from 2024-2025)

Semester: V **Hours / week: 6**
Subject Code: IBDSC51 **Credit: 5**

Course Objectives:
1. To motivate the students to think logically and apply the techniques in solving problems
2. To analyze the outcomes of mathematical arguments using logical laws

Unit I **(18 hours)**

The Foundations: Logic and Proofs: Propositional Logic – Applications of Propositional Logic – Propositional Equivalences – Predicates and Quantifiers – Nested Quantifiers – Rules of Inference – Introduction to Proofs.

Unit II **(18 hours)**

Basic Structures: Sets, Functions, Sequences, Sums and Matrices: Sets – Set Operations – Functions – Sequences and Summations - Cardinality of sets – Matrices.

Unit III **(18 hours)**

Induction and Recursion: Mathematical Induction – Strong Induction and Well-Ordering - Recursive Definitions and Structural Induction. **Counting:** The Basics of Counting – The Pigeonhole Principle - Permutations and Combinations – Generalized Permutations and Combinations.

Unit IV **(18 hours)**

Advanced Counting Techniques: Applications of Recurrence Relations- Solving Linear Recurrence Relations – Divide-and-Conquer Algorithms and Recurrence Relations - Generating Functions – Inclusion-Exclusion.

Unit V **(18 hours)**

Relations: Relations and Their Properties –Representing Relations - Closure of Relations- Equivalence Relations–Partial Orderings.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Construct truth tables and to prove the results
CO 2: Apply the concept of generating functions to solve the relations
CO 3: Use the concepts of induction and recursion to solve problems
CO 4: Analyze counting concepts and apply to solve problems
CO 5: Analyze the concepts of relations and their Properties.

Text Book:

1. Kenneth H. Rosen, *"Discrete Mathematics and its Applications",* The Mc Graw- Hill Companies, New York, Seventh Edition, 2007.

Unit I: Chapter 1(Section 1.1-1.7)
Unit II: Chapter 2(Section 2.1 – 2.6)
Unit III: Chapter 5(Section 5.1 – 5.3) Chapter 6 (Section 6.1 - 6.3, 6.5)
Unit IV: Chapter 8 (Section 8.1 – 8.5)
Unit V: Chapter 9 (Section 9.1, 9.3- 9.6)

Reference Books:

1. R. P. Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, Fifth Edition, 2007.
2. Thomas Koshy, "Discrete Mathematics with Applications", Academic Press, 2005.
3. C.L.Liu, "Elements of Discrete Mathematics", Tata McGraw- Hill Publishing Company Limited , 2004.

E-Resources:

1. http://discrete.openmathbooks.org/pdfs/dmoi-tablet.pdf
2. https://www.youtube.com/watch?v=Ungebd-uC-g
3. https://en.wikipedia.org/wiki/Discrete_mathematics

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	9	9	3	3	3	3	39
CO2	9	3	3	3	1	3	3	25
CO3	3	9	3	3	1	3	3	25
CO4	3	3	3	3	1	3	3	19
CO5	3	9	9	3	3	3	3	33
Total	27	33	27	15	9	15	15	141

Low-1 Medium-3 High-9

Core X - Deep Learning

(For Students Admitted from 2024-2025)

Semester: V **Hours/week: 6**

Subject Code: IBDSC521 **Credit: 5**

Course Objectives:

1. To understand about the Deep learning, its principles and approaches
2. To learn about the Deep Learning algorithms and approaches.

Unit I **(18 hours)**

Fundamentals of Deep Networks: Defining Deep Learning- Common Architectural Principles of Deep Networks- Parameters- Layers- Activation Functions- Loss Functions- Optimization Algorithms- Hyper parameters and Frameworks to Deploy Deep learning Networks - Building Blocks of Deep Networks- Restricted Boltzmann Machines – Auto-encoders and Variational Auto-encoders.

Unit II **(18 hours)**

Regularization & Optimization for Training Deep Models: Parameter Norm Penalties- Norm Penalties as Constrained Optimization- Regularization and Under- Constrained Problems- Dataset Augmentation- Multitask Learning- Parameter Tying and Sharing- Sparse Representations- Ensemble Methods and Challenges in Neural Network Optimization- Basic Algorithms and Algorithms with Adaptive Learning Rates- Approximate Second Order- Optimization Strategies and Meta Algorithms.

Unit III **(18 hours)**

Convolutional Neural Networks: Convolution Operation- Pooling- Shortcomings of Feature Selection- Filters and Feature Maps- Convolutional layer- Architecture of CNN- Working with MNIST dataset- Image Pre- processing Pipelines- Accelerating Training with Batch Normalization- Building a CNN - The Neuro- Scientific Basis for CNN.

Unit IV **(18 hours)**

Sequence Analysis: Analyzing Variable-Length Inputs-tackling seq2seq with Neural N-Grams-Implementing Part-of- Speech Tagger-Unfolding Computation Graphs- Recurrent Neural Networks-Bidirectional-RNN- Recursive Neural Network- Echo-State Networks-Long Short-Term Memory- Tensor flow Primitives for RNN models- Implementing Sentiment Analysis Model.

Unit V **(18 hours)**

Applications of Deep Learning: Deep Reinforcement Learning- Markov Decision Processes- Versus Exploit- Policy versus Value learning- Open AI Gym- Q-Learning and Deep Q-Networks- Applications of Deep Learning in various disciplines such as Computer Vision- Speech Recognition- NLP and others.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Describe Deep Learning algorithms and approaches

CO2: Apply Deep Learning algorithms to solve problems which are almost impossible to handle via Traditional Approaches

CO3: Illustrate different types of Deep Neural Networks like CNN

CO4: Apply deep learning algorithms in real time problems

CO5: Develop applications such as NLP using Deep Learning Algorithms

Text Book:

1. Josh Patterson and Adam Gibson.(2018). *Deep Learning: A Practitioner's Approach*. O'Reilly.

Reference Books:

1. Francois Chollet. (2018). *Deep Learning with Python*.O"Reilly.
2. Sandro Skansi. (2018). *Introduction to Deep Learning: From Logical Calculus to Artificial Intelligence*. Springer.
3. Antonio Gulli and Sujit Pal. (2017). *Deep Learning with Keras.*Packt.
4. Nikhil Buduma. (2017). *Fundamentals of Deep Learning*.O"Reilly.
5. IanGoodFellow, YoshuaBengio and AaronCourville, (2016). *DeepLearning.*MITPress.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc20_cs62/preview
2. https://nptel.ac.in/courses/106106184

Course Outcome	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	1	9	9	9	**49**
CO2	9	3	9	1	9	9	9	**49**
CO3	9	3	9	1	9	9	9	**49**
CO4	9	3	9	1	9	9	9	**49**
CO5	9	3	9	1	9	9	9	**49**
Total	**45**	**15**	**45**	**5**	**45**	**45**	**45**	**245**

Low-1 **Medium-3** **High-9**

Core XI – Graph Theory

(For Students admitted from 2023-24)

Semester: V **Hours/week: 6**
Subject Code: IBDSC53 **Credit: 5**

Course Objectives:

1. To provide structural characterization of graphs with matching, perfect matching and graph coloring
2. To understand the idea of graphs and their importance in computer science

Unit I **(18 hours)**

Graphs, Sub graphs : Graphs and Simple Graphs – Graph Isomorphism – The Incidence and Adjacency Matrices – Sub graphs – Vertex Degrees – Paths and Connection Cycles. Trees- Cut Edges and Bonds – Cut Vertices – Cayley's Formula.

Unit II **(18 hours)**

Connectivity, Euler Tours and Hamilton Cycles: Connectivity – Blocks- Euler tours – Hamilton cycles.

Unit III **(18 hours)**

Matching : Matching – Matching Coverings in Bipartite Graphs – Perfect Matching Edge Colourings: Edge Chromatic Number – Vizing's Theorem.

Unit IV **(18 hours)**

Independent Sets, Cliques: Independent Sets- Ramsey's Theorem Vertex Colourings: Chromatic Number – Brook's Theorem – Hajos Conjecture –Chromatic Polynomials – Girth and Chromatic Number.

Unit V **(18 hours)**

Planar Graphs: Plane and Planar Graphs – Dual Graphs – Euler's Formula- Bridges – Kuratowski's Theorem (Proof Omitted) – The Five Colour Theorem and The Four Colour Conjecture – Non Hamiltonian Planar Graphs – Directed Graphs: Directed Graphs – Directed Paths – Directed Cycle.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Identify the types of graphs and apply the operations on the problem
CO 2: Categorize the concept of directed graph and trees
CO 3: Classify the concepts of connectivity and blocks
CO 4: Compare planar and non-planar graphs
CO 5: Explicate edge colouring of graphs and its application in Snarks-Kirkmans school girl problem

Text Book :

1. J.A. Bondy and U.S.R. Murty Graph theory with applications , The Macmillan Press Lts, Fifth Printing,1982.

Unit I: Chapter 1, Sections 1.1 to 1.7 & Chapter 2, Sections 2.1 to 2.4.
Unit II : Chapter 3, Sections 3.1 to 3.2 & Chapter 4, Sections 4.1 to 4.2
Unit III: Chapter 5, Sections 5.1 to 5.3 & Chapter 6, Sections 6.1 to 6.2
Unit IV : Chapter 7, Sections 7.1 to 7.2 & Chapter 8, Sections 8.1 to 8.5
Unit V: Chapter 9, Sections 9.1 to 9.7 & Chapter 10, Sections 10.1 to 10.3

Reference Books:

1. Nar Singh Deo Graph Theory for Computer Science and Engineers PHI, India 2016
2. R.R.Balakrishnan,K.Ranganathan. A Text Book of Graph Theory,Springer InternationalEdition,First Indian Reprint 2008.
3. John Clerk & Derek Allan Holtan, A First Look at Graph Theory,Allied Publishers Limited,1995.

E- Resources:

1. https://www.csa.iisc.ac.in/~arpita/DS14/Turan.pdf
2. https://www.youtube.com/watch?v=TBYNkgvnU2s
3. https://nptel.ac.in/courses/111/106/111106050/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	3	1	3	**19**
CO2	3	3	3	3	3	1	3	**19**
CO3	3	3	3	3	3	1	3	**19**
CO4	3	3	9	1	3	3	3	**25**
CO5	3	3	9	3	3	3	3	**27**
Total	**15**	**15**	**27**	**13**	**15**	**9**	**15**	**109**

Low-1 Medium-3 High-9

DSE I. a) -Time Series Analysis and Forecasting

(For Students Admitted from 2024-2025)

Semester: V **Hours/week: 4**
Subject Code: IBDSE5A **Credit: 4**

Course Objectives:

1. To equip students with various time series and forecasting methods and techniques to increase the knowledge on modern statistical methods for analyzing time series data
2. To understand the principles behind time series and forecasting techniques for analyzing various Stationary and Nonstationary time series model

Unit I **(12 hours)**

Introduction to Time Series: Examples of Time Series - Objectives of Time Series Analysis - Some Simple Time Series Models - **Introduction to Forecasting:** The Nature and Uses of Forecasts – Some Example of Time Series – The Forecasting Process – Data for Forecasting – Resources for Forecasting.

Unit II **(12 hours)**

Statistics Background for Forecasting: Introduction – Graphical Displays – Numerical Description of Time Series Data – Use of Data Transformations and Adjustments-General Approach to Time Series Modeling and Forecasting – Evaluating and Monitoring Forecasting Model Performance.

Unit III **(12 hours)**

Stationary Processes: Basic Properties - Linear Processes - Introduction to ARMA Processes - Properties of the Sample Mean and Autocorrelation Function – Forecasting Stationary Time Series - **ARMA Models**: ARMA(p, q) Processes - The ACF and PACF of an ARMA(p, q) Process - Forecasting ARMA Processes.

Unit IV **(12 hours)**

Nonstationary and Seasonal Time Series Models: ARIMA Models for Nonstationary Time Series - Identification Techniques - Forecasting ARIMA Models - Seasonal ARIMA Models - **Forecasting Techniques:** The ARAR Algorithm - The Holt–Winters Algorithm.

Unit V **(12 hours)**

Survey of other Forecasting Methods: Multivariate Time Series Models and Forecasting – State Space Model – Arch and Garch Model – Neural Networks and Forecasting – Spectral Analysis – Bayesian Methods in Forecasting.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Explain the concept of Time Series & Forecasting, Stationary, Nonstationary Process and Forecasting Methods

CO2: Apply the models of ARMA, ARIMA and various methods in forecasting process

CO3: Examine an example of time series models, general approach to time series modeling and forecasting and various methods in forecasting

CO4: Evaluate the performance of forecasting models, ARAR Algorithm and Holt -Winters Algorithm

CO5: Elaborate an objective of time series analysis, uses of forecasts, statistics background of forecasting and using various models in forecasting

Text Books:

1. Peter J. Brockwell, Richard A. Davis, *Introduction to Time Series and Forecasting*, Springer New York, Second Edition,2002.
2. Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulahci, *Introduction to Time Series Analysis and Forecasting*,John Wiley and Sons Publication, Second Edition,2016.

Reference Books:

1. Bruce L. Bowerman, Richard O'Connell, Anne Koehler, *Forecasting, Time Series, and Regression***,** Cengage Unlimited Publishers, Fourth Edition, 2005.
2. George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung, *Time Series Analysis Forecasting and Control*, John Wiley and Sons Publication, Fifth Edition,2016.

E – Resources:

1. https://nptel.ac.in/courses/111/104/111104098/
2. https://www.udacity.com/course/time-series-forecasting--ud980

Course Outcome	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	1	1	1	1	1	9	**23**
CO2	9	1	3	1	1	3	9	**27**
CO3	9	1	3	1	1	1	9	**25**
CO4	9	3	9	3	3	3	9	**39**
CO5	9	3	9	3	3	9	9	**45**
Total	**45**	**9**	**25**	**9**	**9**	**17**	**45**	**159**

Low-1 Medium-3 High-9

DSE I. b) Predictive Analysis

(For Students Admitted from 2024-2025)

Semester: V **Hours/week: 4**

Subject Code: IBDSE51B **Credit: 4**

Course Objectives:

1. Develop skills to analyze complex data sets
2. Develop theoretical understanding of modeling techniques in data science

Unit I **(12 hours)**

Linear Methods for Regression and Classification: Overview of supervised learning, Linear regression models and least squares, Multiple regression, Multiple outputs, Subset selection , Ridge regression, Lasso regression , Linear Discriminant Analysis , Logistic regression , Perceptron learning algorithm.

Unit II **(12 hours)**

Model Assessment and Selection : Bias, Variance, and model complexity, Bias-variance trade off, Optimism of the training error rate, Estimate of In-sample prediction error, Effective number of parameters, Bayesian approach and BIC, Cross- validation ,Boot strap methods, conditional or expected test error.

Unit III **(12 hours)**

Additive Models, Trees and Boosting: Generalized additive models, Regression and classification trees , Boosting methods-exponential loss and AdaBoost, Numerical Optimization via gradient boosting ,Examples (Spam data, California housing , New Zealand fish, Demographic data)

Unit IV **(12 hours)**

Neural Networks (NN) , Support Vector Machines(SVM),and K-nearest Neighbor: Fitting neural networks, Back propagation, Issues in training NN, SVM for classification, Reproducing Kernels, SVM for regression, K-nearest – Neighbour classifiers(Image Scene Classification)

Unit V **(12 hours)**

Unsupervised Learning and Random forests: Association rules, Cluster analysis, Principal Components, Random forests and analysis.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Formulate complex decision-making problems based on predictive analysis
CO2: Illustrate tfe formulation of complex decision-making problems
CO3: Analyze and evaluate predictive model outcomes for informing strategic decision-making processes
CO4: Evaluate the basic statistical and analytics tools for developing understanding of predictive methods and models
CO5: Build models using predictive analysis

Text Books:

1. Anasse Bari, Mohamed Chaouchi, Tommy Jung ,*Predictive Analytics for Dummies*, Wiley Publication,2016

Reference Book:

1. C.M.Bishop , *Pattern Recognition and Machine Learning*, Springer,2006
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman , *The Elements of Statistical Learning-Data Mining, Inference, and Prediction* ,Second Edition , Springer Verlag, 2009.

E-Resource:

1. https://onlinecourses.nptel.ac.in/noc23_ma46/preview

Course Outcome	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	1	1	1	1	1	9	**23**
CO2	9	1	3	1	1	3	9	**27**
CO3	9	1	3	1	1	1	9	**25**
CO4	9	3	9	3	3	3	9	**39**
CO5	9	3	9	3	3	9	9	**45**
Total	**45**	**9**	**25**	**9**	**9**	**17**	**45**	**159**

Low-1 Medium-3 High-9

DSE II. a) – Operations Research

(For Students Admitted from 2024-2025)

Semester: V **Hours / week: 4**
Subject Code: IBDSE5C **Credit: 4**

Course Objectives:

1. To apply these techniques constructively to make effective business decisions
2. To impart the knowledge of formulation of practical problems using the linear programming method and its extensions

Unit I **(12 hours)**

Introduction -Operations Research Models -Solving the OR Model - Queuing and Simulation Models -Art of Modeling -More than Just Mathematics - Phases of an OR Study - **Modeling with Linear Programming**: Two -Variable LP Model - Graphical LP Solution.

Unit II **(12 hours)**

The Simplex Method: Artificial Starting Solution – Special Cases in the Simplex Method - **Duality and Post-Optimal Analysis:** Definition of the Dual Problem - Primal –Dual Relationships.

Unit III **(12 hours)**

Transportation Model and Its Variants: Definition of the Transportation Model - Nontraditional Transportation Models -The Transportation Algorithm - The Assignment Model.

Unit IV **(12 hours)**

Games and Strategies: Introduction - Two-Person Zero-Sum Games - Some Basic terms- The Maximin - Minimax Principle - Games without Saddle Points - Mixed Strategies - Graphic Solution of 2 x n and m x 2 Games - Dominance Property.

Unit V **(12 hours)**

Network Scheduling by PERT/CPM: Introduction - Network: Basic Components - Logical Sequencing - Rules of Network construction - Concurrent activities - Critical Path Analysis - Probability Considerations in PERT - Distinction between PERT and CPM.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Demonstrate the fundamental terms, principles and elements of operation research

CO 2: Apply graphical and simplex method to get optimally of linear programming

CO 3: Assess optimal solution for the transportation problem and analyze assignment problem to make effective business decisions

CO 4: Estimate the solutions for games and events using different strategies

CO 5: Apply network model and find the shortest path using CPM/ PERT

Text Books:

1. Hamdy A. Taha, *Operations Research - An Introduction***,** University of Arkansas, 10th Edition,2012.

Unit I: Chapter 1 (1.1 – 1.7), Chapter 2 (2.1 &2.2)
Unit II: Chapter 3 (3.3 – 3.5), Chapter 4 (4.1 &4.2)
Unit III: Chapter 5 (5.1 – 5.4)

2. Kanti Swarup, P.K. Gupta & Man Mohan, *Operations Research***,** Sultan Chand &Sons, Eighteenth Edition,2015.

Unit IV: Chapter 17 (17:1 – 17:7)
Unit V: Chapter 25 (25:1 – 25:8)

Reference Books:

1. S.D. Sharma, *Operations Research*, Dedar Nath Ram Nath,2009.

2. Srinivasan, *Operations Research - Principles and Applications*, PHI Learning Private Limited, Second Edition,2012.

E-Resources:

1. https://www.youtube.com/watch?v=YPn4yHM1YsU
2. http://www.math.wsu.edu/faculty/genz/364/lessons/l3067.pdf
3. https://www.youtube.com/watch?v=fSuqTgnCVRg

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	3	3	3	3	3	**27**
CO2	3	9	3	3	9	9	3	**39**
CO3	3	9	3	3	9	9	9	**45**
CO4	3	9	3	9	9	9	9	**51**
CO5	3	3	3	9	9	9	9	**45**
Total	**15**	**39**	**15**	**27**	**39**	**39**	**33**	**207**

Low-1 Medium-3 High-9

DSE II. b) Data Mining

(For Students Admitted from 2024-2025)

Semester: V **Hours/Week: 4**
Subject Code: IBDSE51D **Credit: 4**

Course Objectives:

1. It presents methods for mining frequent patterns, associations, and correlations.
2. It describes methods for data classification and prediction, and data–clustering approaches.
3. It covers mining various types of data stores such as spatial, textual, multimedia, streams.

Unit I **(12 hours)**

Data Mining: Data–Types of Data–, Data Mining Functionalities– Interestingness Patterns– Classification of Data Mining systems– Data mining Task primitives –Integration of Data mining system with a Data warehouse–Major issues in Data Mining–Data Preprocessing.

Unit II **(12 hours)**

Association Rule Mining: Mining Frequent Patterns–Associations and correlations – Mining Methods– Mining Various kinds of Association Rules– Correlation Analysis– Constraint based Association mining. Graph Pattern Mining, SPM.

Unit III **(12 hours)**

Classification: Classification and Prediction **–** Basic concepts–Decision tree induction– Bayesian classification, Rule–based classification, Lazy learner.

Unit IV **(12 hours)**

Clustering and Applications: Cluster analysis–Types of Data in Cluster Analysis–Categorization of Major Clustering Methods– Partitioning Methods, Hierarchical Methods–Density–Based Methods, Grid–Based Methods, Outlier Analysis.

Unit V **(12 hours)**

Advanced Concepts: Basic concepts in Mining data streams–Mining Time–series data—Mining sequence patterns in Transactional databases– Mining Object– Spatial– Multimedia–Text and Web data – Spatial Data mining– Multimedia Data mining–Text Mining– Mining the World Wide Web.

Course Outcomes:

On the successful completion of the course, student will be able to

CO1: Ability to understand the types of the data to be mined and primitives to integrate a data mining system.
CO2: Apply preprocessing methods for any given raw data.
CO3: Extract interesting patterns from large amounts of data.
CO4: Discover the role played by data mining in various fields.
CO5: Choose and employ suitable data mining algorithms to build analytical applications

Text Book:

1. Jiawei Han & Micheline Kamber, *Data Mining – Concepts and Techniques*, Jiawei Han & Micheline Kamber, 3rd Edition Elsevier, 2011

Reference Books:

1. Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques (Second Edition), Morgan Kaufmann, 2005.
2. Data Mining Introductory and Advanced topics – Margaret H Dunham, PEA,2006.

E-Resource:

1. https://onlinecourses.nptel.ac.in/noc21_cs06/preview

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	1	9	9	9	**49**
CO2	9	2	3	1	9	3	9	**43**
CO3	9	3	3	1	9	3	9	**37**
CO4	9	3	3	1	9	3	9	**43**
CO5	9	3	3	1	9	3	9	**37**
Total	**45**	**27**	**15**	**5**	**45**	**27**	**45**	**209**

Low-1 Medium-3 High-9

SEC V– Programming in Java Lab

(For Students Admitted from 2024-2025)

Semester: V **Hours/week: 2**

Subject Code: IBDSS54P **Credit: 2**

Course Objectives:

1. To make the students to understand Programming language Java to implement sorting and searching techniques
2. To create programs to solve simple calculations, check whether the given number is prime, perfect or Arm strong

List of Programs Formula Substitution

1. Find the factorial and binomial coefficient
2. Calculate mean, variance and standard deviation
3. Develop the programs for Number conversions (Decimal to Binary, etc.)

Checking

4. Develop the programs for Number checking (prime, perfect, etc.)

Generation

5. Develop the programs for Number generation (prime, perfect, etc.)

Array

6. Arrange numbers and names in order
7. Perform matrix addition, subtraction, multiplication &transpose

Searching

8. Develop the programs for performing Linear search and binary search

String

9. Develop the programs for String manipulations (case conversion, reversing, etc.)

OOP Concept

10. Develop the program for implementing in heritance
11. Develop the program for implementing exception handling
12. Develop the program for implementing multithreading

Note: -Questions for the external examination will be based on the concepts learnt

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Outline Java programs that solve simple mathematical problems, number checking and number generation

CO2: Demonstrate the concepts of String Manipulation, Linear Search and Binary Search

CO3: Illustrate OOP in Java programming like inheritance

CO4: Evaluate the multi-threaded programs

CO5: Develop Exception handling programs

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	3	9	3	9	**39**
CO2	9	3	3	3	9	3	9	**39**
CO3	9	9	3	9	9	9	9	**57**
CO4	9	9	9	9	9	9	9	**63**
CO5	9	9	9	9	9	9	9	**63**
Total	**45**	**33**	**27**	**33**	**45**	**33**	**45**	**261**

Low-1 Medium-3 High-9

Core XII - Numerical Methods

(For Students Admitted from 2024-2025)

Semester: VI **Hours / week: 6**
Subject Code: IBDSC611 **Credit: 5**

Course Objectives:

1. To provide the numerical methods of solving the non-linear equations, interpolation, differentiation, and integration
2. To apply numerical methods to obtain approximate solutions to mathematical problems

Unit I **(18 hours)**

Solution of Algebraic and Transcendental equations: The Bisection method - The Method of False position - Iteration method - Newton - Raphson method.

Unit II **(18 hours)**

Interpolation: Finite differences - Forward Differences - Backward Differences - Central Differences - Symbolic Relations and Separation of Symbols. Newton's Formulae for Interpolation – Interpolation with unevenly spaced points: Lagrange's interpolation formula - Inverse Interpolation.

Unit III **(18 hours)**

Numerical Differentiation: Errors in Numerical Differentiation- The Cubic Spline Method - Maximum and Minimum of a Tabulated Function. Numerical Integration: Trapezoidal Rule – Simpson's 1/3 Rule - Simpsons 3/8 Rule.

Unit IV **(18 hours)**

Numerical Solutions of System of Linear Equations: Gauss elimination method - Gauss - Jordan method - Solution of linear systems-iterative methods.

Unit V **(18 hours)**

Numerical Solutions of Ordinary Differential Equations: Solution by Taylor's series – Runge - Kutta Methods - Predictor - Corrector Method.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Assess the solution of Algebraic and Transcendental equations
CO 2: Compute the missing values for unequal intervals using Divided difference and Lagrange's Method
CO 3: Evaluate the approximate values of the first derivative, maximum and minimumvalues of the Function using Newton's formula
CO 4: Solve the problem and using the methods of Gauss elimination, Gauss- Jordan and iterative methods
CO 5: Applying the method of numerical solutions of ordinary differential equation to examine the problem

Text Books:

1. S. S. Sastry, *Introductory Methods of Numerical Analysis*, Prentice Hall of India, Private Limited, New Delhi, 4th Edition, 2009.

Unit I : Chapter 2(2.2- 2.5)
Unit II: Chapter 3(3.3(3.3.1, 3.3.2, 3.3.4), 3.6, 3.9 (3.9.1), 3.11)
Unit III: Chapter 5 (5.2, 5.3, 5.4(5.4.1 - 5.4.3))
Unit IV: Chapter 6 ((6.3.2, 6.3.3), 6.4)
Unit V: Chapter 7 (7.2, 7.5, 7.6(7.6.1 - 7.6.2))

Reference Books:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 6th Edition, New age International Publisher, India,2007.
2. E.Balagurusamy, *NumericalMethod*,TataMcGrawHill,EducationPrivateLimited,2009.
3. ShankaraRao K, *Numerical Methods for Scientists and Engineers*, Prentice Hall of India, 2001.

E-Resources:

1. https://www.youtube.com/watch?v=YPn4yHM1YsU
2. http://www.math.wsu.edu/faculty/genz/364/lessons/l3067.pdf
3. https://www.youtube.com/watch?v=fSuqTgnCVRg

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	9	9	9	**51**
CO2	3	9	3	3	3	3	9	**33**
CO3	3	9	3	3	3	9	9	**39**
CO4	9	9	9	3	9	9	9	**57**
CO5	3	3	9	3	3	9	9	**39**
Total	**27**	**39**	**27**	**15**	**27**	**39**	**45**	**219**

Low-1 Medium-3 High-9

Core XIII – Project

(For Students Admitted from 2024 -25)

Semester: VI **Hours/Week: 6**
Subject Code: IBDSC62PW **Credit: 5**

Course Objectives:

1. Impart the students to implement project
2. Able to understand the data collection for the project

Project shall be a group project (group consisting of maximum of two members)

Course Outcomes:

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

CO1: Identify goals, constraints, deliverables, performance criteria and resource requirements in consultation with stakeholders
CO2: Apply the plan by executing the code
CO3: Illustrate the various aspects of software development for the total project
CO4: Evaluate the entire software project according to the specific problem
CO5: Develop the software project by executing with the various data

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	9	9	3	9	57
CO2	9	3	9	3	9	9	9	51
CO3	9	3	9	9	9	9	9	57
CO4	9	3	9	9	9	9	9	57
CO5	9	9	9	9	9	9	9	45
Total	**45**	**2**	**45**	**3**	**45**	**39**	**45**	**285**

Low-1 **Medium-3** **High-9**

Core XIV- Computer Vision

(For Students Admitted from 2024-2025)

Semester: VI **Hours/week: 5**
Subject Code: IBDSC63 **Credit: 4**

Course Objectives:

1. To know the fundamentals of Image Processing, Formation Models and Model Estimation Techniques
2. To able to implement fundamental image processing required for computer vision

Unit I **(15 hours)**

Introduction: Image Processing- Computer Vision and Computer Graphics- Levels in Computer Vision- Applications- Document Image Analysis- Biometrics- Object Recognition- Tracking- Medical Image Analysis – Content - Based Image Retrieval - Video Data Processing.

Unit II **(15 hours)**

Image Formation Models: Monocular Imaging System- Radiosity- Radiance- Irradiance- Colour- Orthographic and Perspective Projection- Camera Model and Camera Calibration- Binocular Imaging Systems- Multiple Views Geometry- Structure Determination- Photometric Stereo- Depth from Defocus- Construction of 3D Model from Images.

Unit III **(15 hours)**

Image Processing and Model Estimation: Image Representation and Processing- Continuous and Discrete Processing Methods- Edge Detection- Regularization Theory- Optical Computation- Motion Estimation Techniques- Structure from Motion- Stereo Vision.

Unit IV **(15 hours)**

Shape Representation and Segmentation: Contour Based Representation- Region Based Representation- Deformable Curves and Surfaces- Snakes and Active Contours- Level Set Representations- Fourier and Wavelet Descriptors- Medial Representations- Multi Resolution Analysis.

Unit V **(15 hours)**

Applications of Computer Vision: Object Detection and Recognition- Face Detection- Face Recognition- Eigen Faces- Active Appearance and 3D Shape Models of Faces- Surveillance- Foreground and Background Separation- Particle Filters- Chamfer Matching- Tracking and Occlusion- Combining Views from Multiple Cameras.

Course Outcomes:

After successful completion of this course, student will be able to

CO1: Interpret the image formation process.
CO2: Determine the fundamental image processing techniques required for computer vision.
CO3: Illustrate shape analysis, extract features, and generate 3D Models from Images.
CO4: Evaluate video processing, motion capturing, and 3D Vision
CO5: Develop applications using computer vision techniques.

Text Book:

1. D. Forsythand J. Ponce. *Computer Vision–A Modern Approach*. Prentice Hall**.** (2018).

Reference Books:

1. E. Trucco. (2017). *Introductory Techniques for 3D Computer Vision.* Prentice Hall.
2. R.C. Gonazlez. (2017). *Digital Image Processing.* Addison Wesley.
3. Mark Nixon (2016). *Feature Extraction and Image Processing for Computer Vision*. Academic Press.

4. Simon J. D. Prince (2015). *Computer Vision – Models, Learning and Inference*. Cambridge.
5. Richard Szeliski (2013). *Computer Vision – Algorithms and Applications*. Springer.

E-Resources:

1. https://nptel.ac.in/courses/108103174
2. https://onlinecourses.nptel.ac.in/noc19_cs58/preview

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	1	9	9	9	**49**
CO2	9	3	3	1	9	9	9	**43**
CO3	9	3	9	1	9	9	9	**49**
CO4	9	3	9	1	9	9	9	**49**
CO5	9	3	3	1	9	9	9	**43**
Total	**45**	**15**	**33**	**5**	**45**	**45**	**45**	**233**

Low-1 Medium-3 High-9

Core XV- Regression Analysis

(For Students Admitted from 2024-2025)

Semester: VI **Hours/week: 6**
Subject Code: IBDSC64 **Credit: 4**

Course Objectives:

1. The emphasis will be more on the development of tools from the statistical theories and concept along with their utility in real life data applications
2. The course starts with a description of need of regression analysis and lays the foundation of simple linear regression model

Unit I **(18 hours)**

Simple Linear Regression: Simple Linear Regression Model- Least square estimation of the parameters- Hypothesis Testing on the slope and intercept- Interval estimation in Simple linear Regression- Prediction of New Observations- Coefficient of Determination.

Unit II **(18 hours)**

Multiple Linear Regression: Multiple Regression Models- Estimation of the Model Parameters, Hypothesis testing in Multiple Linear Regression- Confidence Intervals in Multiple Regression- Prediction of New observations.

Unit III **(18 hours)**

Generalized Linear Models: Introduction- Logistic Regression Models- Poisson Regression
Model Adequacy Checking: Introduction- Residual Analysis - The PRESS Statistic- Detection and treatment of Outliers- Lack of fit of the Regression Model.

Unit IV **(18 hours)**

Polynomial Regression Models: Introduction- Polynomial Models in One Variable- Nonparametric Regression – Polynomial Models in Two or More Variables – Orthogonal Polynomials.

Unit V **(18 hours)**

Analysis of variance: One-Way and Two-Way Analyses: Introduction - Single - factor (One - Way ANOVA) Experiment and linear statistical model - Fixed a Effects Mode and ANOVA - Random Effects Model and ANOVA - Computations for Sum of Squares - Multiple Comparison Test: Grouping of Means - Single - factor (Two-Way ANOVA) Experiment and linear statistical model (Completely Randomized Block Design) - Fixed Effects Models for Two-way ANOVA - Random Effects Models for Two-way ANOVA - Computations for Sum of Square.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Demonstrate simple linear regression models and its use for data analysis

CO 2: Apply linear regression models for data analysis

CO 3: Classify the importance of model adequacy checks

CO 4: Distinguish between Polynomial Models in One Variable and Polynomial Models in two or more variables

CO 5: Analyze the concept of One Way and Two Way ANOVA

Text Books:

1. Douglas C. Montgomery and Elizabeth A.Peck and G.Geoffrey Vining, *Introduction to Linear Regression Analysis*, 3rd Edition, John Wiley & Sons, Inc, 2001.

Unit I: Chapter 2 (Section 2.1-2.6)

Unit II: Chapter 3 (Section 3.1 -3.5)

Unit III: Chapter 13 (Section 13.1 -13.3) & Chapter 4 (Section 4.1 - 4.5)

Unit IV: Chapter 7 (Section 7.1 – 7.5)

2. Ravichandran J. *Probability and Statistics for Engineers*, First Reprint Edition, Wiley India, 2012.

Unit V: Chapter 13 (Section 13.1-13.10).

References Book:

1. Douglas C. Montgomery, *Design and Analysis of Experiments*, 8th Edition, John Wiley& Sons, Inc, 2012.
2. Montgomery. A, *Introduction to Linear Regression Analysis*, John Wiley & Sons Canada Limited, 6th Edition.
3. Samprit Chatterjee, Jeffrey S. Simon off**,** *Handbook of Regression Analysis*, Wiley, December, 2012.

E- Resources:

1. http://www.ru.ac.bd/stat/wpcontent/uploads/sites/25/2019/03/304_01_Montgomery_Solutions-_Introduction-to-Linear-Regression-Analysis.pdf
2. http://home.iitk.ac.in/~shalab/regression/Chapter12-Regression-PolynomialRegression.pdf

3. https://www.youtube.com/watch?v=nvAMVY2cmok

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	9	3	1	3	3	**25**
CO2	3	3	3	3	1	3	3	**19**
CO3	3	1	3	3	1	3	3	**17**
CO4	3	1	3	3	1	3	3	**17**
CO5	3	1	3	1	3	3	3	**17**
Total	**15**	**9**	**21**	**13**	**7**	**15**	**15**	**95**

Low-1 Medium-3 High-9

DSE III. a) Data Structures and Algorithms

(For Students Admitted from 2024-2025)

Semester: VI **Hours / week: 4**
Subject Code: IBDSE6A **Credit: 4**

Course Objectives:

1. To understand the concepts of abstract data types. linear and nonlinear data structures
2. To be able to implement the ADTs stack, queue, and de queue and to provide students with solid foundations to deal with variety of computational problems

Unit I **(12 hours)**

Introduction: Mathematical Notations and Functions - Algorithmic Notations - Complexity of Algorithms - Other Asymptotic Notations for Complexity of Algorithms- Sub algorithms. **Linear Data Structures:** List ADT, Singly linked lists - Doubly linked lists and Circular Linked Lists - Stack ADT, Implementation of Stacks and applications. Queue ADT, Implementation of Queue and applications.

Unit II **(12 hours)**

Non-Linear Data Structure: Trees: Introduction – Binary Trees-Representing Binary Trees in memory-Traversing Binary Trees - Traversal algorithms using Stacks. **Graphs:** Graph Notation–Searching a Graph - Kruskal's algorithm-Dijkstra's algorithm- Graph representations.

Unit III **(12 hours)**

Balanced Binary Search Trees: Binary Search Trees-AVL Trees - Splay Trees- Iterative Splaying - Recursive Splaying - Performance Analysis.

Unit IV **(12 hours)**

B-Trees: Relational Databases - B-Tree Organization -The Advantages of B-Trees - B- Tree Implementation -B-Tree Insert - B-Tree Delete. **Sorting:** Preliminaries – Insertion Sort – Shell sort – Heap sort – Merge sort – Quicksort - Bucket Sort.

Unit V **(12 hours)**

Algorithm Design Techniques: Greedy Algorithms – Huffman Codes – Approximate Bin Packing- Divide and Conquer – Running Time of Divide and Conquer Algorithms– Dynamic Programming - Backtracking Algorithms.

Course Outcomes:

After successful completion of the course, the students will be able to

CO 1: Explain the basics concept of data structures and Algorithm stacks, queues and lists
CO 2: Distinguish about knowledge of tree and graphs concepts
CO 3: Analyze the concepts about searching and sorting techniques
CO 4: Demonstrate the types of Trees
CO 5: Evaluate about Algorithm and step by step approach in solving problems with the help of fundamental data structure

Text Books:

1. Seymour Lipchutz, *Data Structures*, Special Indian Edition, Revised First Edition, 2014.
2. Mark Allen Weiss. *Data Structures and Algorithm Analysis in C++*, Pearson Education Limited, 4thEdition, 2014.
3. Kent D. Lee, Steve Hubbard, *Data Structures and Algorithms with Python*, Springer International Publishing, Switzerland, 2015.

Reference Books:

1. Ellis Horowitz & Sartaj Sahni, *Fundamentals of Data Structures*, Galgotia Book Source, 2nd Edition, New Delhi, 1992.
2. Alfred V. Aho Johne, Hopcroft, *Data Structures and Algorithm*, 3rd Edition, Addison-Wesley, 2012.
3. S.Sridhar, *Design and Analysis of Algorithms*, 2014.

E-Resources:

1. http://www.math.tau.ac.il/~matias/ds03.html
2. https://onlinecourses.nptel.ac.in/noc20_cs70/preview
3. https://www.tutorialspoint.com/python_data_structure/python_data_structure_tutorial.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	1	3	1	1	**19**
CO2	9	3	9	1	9	1	3	**35**
CO3	9	1	9	9	1	1	3	**33**
CO4	9	3	3	3	3	3	3	**27**
CO5	9	1	1	9	9	9	3	**41**
Total	**45**	**11**	**23**	**23**	**25**	**15**	**13**	**155**

Low-1 **Medium-3** **High-9**

DSE III. b) - Database Security

(For Students Admitted from 2024-2025)

Semester: VI **Hours / week: 4**
Subject Code: IBDSE6B **Credit: 4**

Course Objectives:

1. To understand the fundamentals of security, and how it relates to information Systems
2. To provide an overview of database security concepts and techniques and describe new directions of database security in the context of information technology

Unit I **(12 hours)**

Security and Information Technology: Why Database Security? - A Secure Data Environment - Database Security Objectives - Who Are We Securing Ourselves Against? - Hackers - Network and Database Administrators-E-Mails. Malware: Computer Viruses – Worms-Trojan Viruses-Bots. Security Architecture: Assessment and Analysis-Design and \ Modeling -Deployment-Management and Support.

Unit II **(12 hours)**

Global Policies for the Database Environment: Security Policies- Update and Upgrade Management- Backup Management Plan- The Disaster Plan. Database Review: Database Structure Components - Database Models-Database Types- Database Management Systems.

Unit III **(12 hours)**

Oracle Architecture: The Instance and the Database- The Physical Structure- The Memory Structure- The Processes. Password, Profiles, Privileges, and Roles: Authentication - Authorization. Security Auditing: Security Auditing - Audit Classification
- The Goal of an Audit - The Auditing Process.

Unit IV **(12 hours)**

Database Auditing: Preparation and Planning for a Database Security Audit-**The Database**. Audit-Reporting a Database Security Audit-Vendor-Specific Auditing Information.

Unit V **(12hours)**

Security Testing: Security Testing Classification- The Goal of Security Testing. **Testing Methodology**: Planning and Preparation Phase- Execution Phase- Escalating Privileges-Reporting Phase.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Describe the concepts of Database security and access control
CO 2: Demonstrate the database systems structure
CO 3: Analyze security auditing and security testing
CO 4: Determine Database issues in Trust Management
CO 5: Build skill for solving complex problems in a team of database workers

Text Book:

1. Alfred Basta and Melissa Zgola, *Database Security*, Course Technology, Cengage Learning, 2012.

Reference Books:

1. Alan Williams, Angeline Janet Dhanarani, Ashok Swaminathan , Bettina Schäumer , Manish Choudhary ,Michael Mesaros, *Securing the OracleDatabase A technical primer***,** Fourth Edition, 2021.
2. Michael Gertz, SushilJajodia George Mason, *Handbook of Database Security Applications and Trends*, Springer Science - Business Media, LLC, 2008.

E- Resources:

1. https://nptel.ac.in/courses/106/104/106104135/
2. https://www.careers360.com/courses-certifications/swayam-database- management-courses-brp-org

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	3	9	1	3	**29**
CO2	9	3	1	1	9	1	1	**25**
CO3	9	3	3	3	9	3	3	**33**
CO4	9	3	1	1	9	3	3	**29**
CO5	9	3	9	3	9	9	3	**45**
Total	**45**	**15**	**15**	**11**	**45**	**17**	**13**	**161**

Low-1 Medium-3 High-9

SEC VI - Data Mining Lab

(For Students Admitted from 2024-2025)

Semester: VI **Hours/week: 2**

Subject Code: IBDSS65P **Credit: 2**

Course Objectives:

1. To understand data mining process and important issues around data cleaning, pre-processing and integration, principle algorithms and techniques used in data mining, such as clustering, association mining, classification and prediction.
2. To get exposure to real life data sets for analysis and prediction and learn performance evaluation of data mining algorithms in a supervised and an unsupervised learning

PROGRAM LIST

1. Demonstration of preprocessing on data set student.arff
2. Demonstration of preprocessing on data set labor.arff

3. Demonstration of Association rule process on dataset contact lenses.arff using apriori algorithm
4. Demonstration of Association rule process on dataset test.arff using apriori algorithm
5. Demonstration of classification rule process on dataset student.arff using j48 Algorithm
6. Demonstration of classification rule process on dataset employee.arff using j48 algorithm
7. Demonstration of classification rule process on dataset employee.arff using id3 algorithm
8. Demonstration of classification rule process on data setempl
9. Demonstration of clustering rule process on dataset iris.arff using simplek-means
10. Demonstration of clustering rule process on dataset student.arff using simple k means

Note: - Questions for the external examination will be based on the concepts learnt

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Apply Data mining concept
CO 2: Extract knowledge using data mining techniques
CO 3: Adapt to new data mining tools
CO 4: Explore recent trends in data mining such as web mining, spatial-temporal mining
CO 5: Explore different types of algorithm

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	1	9	9	**43**
CO2	9	1	9	3	1	9	9	**41**
CO3	9	1	9	3	1	9	9	**41**
CO4	9	1	9	3	1	9	9	**41**
CO5	9	3	9	3	1	9	9	**43**
Total	**45**	**9**	**45**	**15**	**5**	**45**	**45**	**209**

Low-1 Medium-3 High-9

Extra Credit – Quantitative Techniques

(For Students Admitted from 2024-2025)

Semester: VI
Subject Code: IBDSX6 **Credit: 2**

Course Objectives:
1. Tounderstandoperations,researchtechniquesusedforplanning,schedulingand controlling large and complex projects
2. To get motivation to take up a project to solve real life problems by adopting the techniques of operations research

Unit I

Linear programming Problem: Advanced techniques: Introduction - Revised simplex method - Simplex Method versus Revised simplex method - Bounded variables - parametric linear Programming - linear fractional programming - Application of linear fractional programming – karmarkar Algorithm.

Unit II

Sequencing problem: Introduction - Problem of sequencing - basic terms used in sequencing processing n jobs through two machines - Processing n jobs through k machines- Processing 2 jobs through k machines.

Unit III

Dynamic programming: Introduction - the recursive equation approach - characteristics of Dynamic Programming - Dynamic Programming Algorithm - solution of discrete D.P.P - Some applications - Solution of L.P.P by Dynamic Programming.

Unit IV

Probability: Introduction - uncertainty and probability - sample space and probability -algebra of events - conditional probability - random variables - expectation of random variable - central tendency and dispersion - some probability distributions.

Unit V

Decision analysis: Introduction - decision making problem - decision Making process- decision making environment - decisions under uncertainty - decisions under risk - decision tree analysis - decision making with utilities.

Course Outcomes:

After successful completion of this course, student will be able to

CO 1: Classify the advanced techniques in linear programming problem.

CO 2: Inspect the real life problems and make use of LP techniques to solve the problems.

CO 3: Identify dynamical programming techniques and determine the solution to the given problems.

CO 4: Compare and contrast the concept of uncertainty and probability and assess the problems on random variables.

CO 5: Able to decide a decision in any critical environment.

Text Book:

1. Kanti Swarup, P. K. Gupta, Man Mohan, *Operations Research*, Sultan Chand & Sons, New Delhi, Eighteenth Edition, 2015.

Unit I: Chapter 9
Unit II: Chapter 12(Sec 12:1 – 12:6)
Unit III: Chapter 13
Unit IV: Chapter 14
Unit V: Chapter16

Reference Books:

1. P.K.Gupta and Man Mohan, *Problems in Operations Research*, Sultan Chand & Sons, New Delhi, Fourteenth Edition,2002.

2. Prem Kumar Gupta and D.S. Hira, *Operations Research*, Sultan Chand & Sons, New Delhi First Edition,1993.
3. Hamdy A. Taha, *Operations Research - An Introduction*, Prentice Hall, Eighth Edition, 2007.

E-Resources:

1. https://www.analyticsvidhya.com/blog/2017/02/lintroductory-guide-on-linear-programming- explained-in-simple-english/
2. https://www.hackerearth.com/practice/algorithms/dynamic-programming/introduction- to-dynamic- programming-1/tutorial/
3. https://www.verywellmind.com/problems-in-decision-making-2795486

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	3	9	3	**27**
CO2	9	3	9	3	3	9	9	**45**
CO3	3	3	3	3	3	9	3	**27**
CO4	3	3	3	3	3	9	3	**27**
CO5	9	3	9	3	3	3	9	**39**
Total	**27**	**15**	**27**	**15**	**15**	**39**	**27**	**165**

Low-1 Medium-3 High-9