

**Department of Mathematics**

(For Students admitted from 2023-2024)

**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 2023-24)

**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. Syllabus has been modified for the elective course Graph Theory in the II semester and the core course Linear Algebra in the II semester and both the courses to be changed to I semester
2. The Core Course Measure Theory and Integration in the I Semester is changed to III Semester
3. Divided the Core Course Ordinary and Partial Differential Equations in the I semester into Ordinary Differential Equations in the I Semester and Partial Differential Equations in the II Semester
4. The core course Numerical Methods in the I Semester is changed to II Semester
5. The core course Topology I in the II semester and Topology II in the III semester combined as Topology in the II semester
6. The core course Algebra in the I semester is divided as Algebra-I in the II semester and Algebra-II in the III semester
7. The core course Complex Analysis in the II Semester is changed to III Semester
8. The core course Functional Analysis in the III Semester is changed to IV Semester
9. The Core courses Probability and Statistics in the III semester and Advanced Statistics in the IV semester combined as the core course Mathematical Statistics in the III semester
10. The syllabus has been modified for the elective course Operations research and the course title changed as Optimization Techniques.
11. Introduced the new courses Number Theory in the I Semester and Integral Equations and Calculus of Variations in the III Semester
12. The core courses Number Theory in the I semester and Measure and Integration in the III semester are considered as integrated courses.

## 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
	HMMXC12	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
	HMMXCE11A/ HMMXCE11B	DSE I	Graph Theory/ Stochastic Process	6	5	25	75	100
	HMMXX1/HM MXX1O	Extra credit	Fuzzy Sets and Relations / * Online Course		2		100	100
		<b>Total</b>			<b>30</b>	<b>25+2</b>	<b>125</b>	<b>375+100</b>
II	HMMXC211	Core V	Algebra-I	6	5	25	75	100
	HMMXC22	Core VI	Analysis-II	6	5	25	75	100
	HMMXC231	Core VII	Topology	6	5	25	75	100
	HMMXC241	Core VIII	Partial Differential Equation	6	5	25	75	100
	HMMXE21A/H MMXE2BP	DSE II	Numerical Methods/#Web Designing Lab	6	5	25	75	100
	HMMXX2P/ HMMXX2O	Extra credit	Village Placement Programme / * Online Course		2		100	100
		<b>Total</b>			<b>30</b>	<b>25+2</b>	<b>125</b>	<b>375+100</b>
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/H MMXE31B	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
		<b>Total</b>			<b>30</b>	<b>25+2</b>	<b>125+ 100</b>	<b>375</b>

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
	<b>Total</b>			<b>30</b>	<b>15+2</b>	<b>150</b>	<b>250+100</b>	<b>400+100</b>
	<b>Grand total</b>			<b>120</b>	<b>90+8</b>	<b>525+100</b>	<b>1375+300</b>	<b>1900+400</b>

\* 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 2023-2024)

**Semester: I**

**Subject Code: HMMXC111**

**Hours / week: 6**

**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:**

**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*, Fourth Edition, 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							
	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
<b>Total</b>	<b>21</b>	<b>19</b>	<b>33</b>	<b>13</b>	<b>15</b>	<b>17</b>	<b>45</b>	<b>163</b>

Low-1

Medium-3

High-9

**Core II – Analysis – I**

(For Students Admitted from 2023-24)

**Semester: I****Subject Code: HMMXC12****Hours / week: 6****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)**

**The Real and Complex Number Systems:** Introduction - Ordered Sets - Fields - The Real Field - The Extended Real Number System - The Complex Field - Euclidean Spaces.

**Unit II****(18 Hours)**

**Basic Topology:** Finite, Countable and Uncountable Sets - Metric Spaces - Compact Sets - Perfect Sets - Connected Sets.

**Unit III****(18 hours)**

**Continuity: Limits of Functions** - Continuous Functions - Continuity and Compactness - Continuity and Connectedness - Discontinuities - Monotonic Functions - Infinite Limits and Limits at Infinity.

**Unit IV****(18 hours)**

**Differentiation:** The Derivative of a Real Function - Mean Value Theorems - The Continuity of Derivatives - L' Hospital's Rule - Derivatives of Higher Order - Taylor's Theorem - Differentiation of Vector-valued Functions.

**Unit V****(18 hours)**

The Riemann-Stieltjes Integral: Definition and Existence of the Integral - Properties of the Integral - Integration and Differentiation - Integration of Vector-valued Functions - Rectifiable Curves.

**Course Outcomes:**

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

**CO1:** Classify the basic features of real and complex number system, countable and uncountable sets

**CO2:** Categorize the sets of Basic Topology

**CO3:** Prove the theorem using the concepts of monotonic functions

**CO4:** Examine the different types of derivatives

**CO 5:** Determine the concepts of Riemann-stieltjes integral and properties of the integral

**Text Book:**

1. Walter Rudin, *Principles of Mathematical Analysis*, McGraw-Hill Book Company, Third Edition, 1976.

**Unit I:** Chapter 1

**Unit II:** Chapter 2

**Unit III:** Chapter 4

**Unit IV:** Chapter 5

**Unit V:** Chapter 6

**Reference Books:**

1. S.C. Malik, *Principles of Real Analysis*, New Age International Private Limited, Second Edition, 2018.

2. Apostol, *Mathematical Analysis*, Narosa Publishing House, Second Edition, 2002.

3. V.Ganapathy Iyer, *Mathematical Analysis*, Tata McGraw Hill 1985.

**E-Resources:**

1. [https://www.google.co.in/books/edition/Introduction\\_to\\_Analysis/Izm8AQAAQBAJ?hl=en&gbpv=1&dq=Analysis+Mathematics&printsec=frontcover](https://www.google.co.in/books/edition/Introduction_to_Analysis/Izm8AQAAQBAJ?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](https://www.youtube.com/watch?v=fh1AQkR_4yU)

4. <https://www.youtube.com/watch?v=LUKfrjpDHTk>

Course Outcomes	Programme Outcomes								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total	
CO									
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 2023-2024)

**Semester: I****Subject Code: HMMXC131****Hour / week: 6****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 Non-linear 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 - Properties of Legendre Polynomials and 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 Sturm 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 higher order partial differential equations using exact equations successive approximation and Lipschitz condition
- CO 4:** Solve the first order ordinary and partial differential equation
- CO 5:** Evaluate the solution of first order differential equation using Cauchy's, Charpit's and Jacobi's methods

**Text Books:**

1. G.F. Simmons, *Differential Equations with Applications and Historical Notes*,



3<sup>rd</sup> 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 47)

**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=oKII\\_TIFNPU](https://www.youtube.com/watch?v=oKII_TIFNPU)
4. <https://www.youtube.com/watch?v=BVKyaEu1FWk>
5. <https://www.youtube.com/watch?v=XUmw9KZwg4M>

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>33</b>	<b>33</b>	<b>15</b>	<b>11</b>	<b>33</b>	<b>39</b>	<b>39</b>	<b>203</b>

Low-1

Medium-3

High-9

#### Core IV –Number Theory

(For Students Admitted from 2023-2024)

**Semester: I**

**Subject Code: HMMXC141**

**Hour / week: 6**

**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 – Congruences - Solutions of congruences - The Chinese Remainder theorem.

#### Unit II

**(18 hours)**

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:**

**CO1:** To solve congruences as application of Chinese remainder Theorem

**CO2:** To know the concepts of Primitive roots and Power Residue

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

**CO4:** To know the fundamentals of greatest integer function and recurrence functions

**CO5:** To solve simple simultaneous linear Diophantine equations.

**Text book:**

1. Ivan Niven, Herbert S, Zuckerman and Hugh L, Montgomery, *An Introduction to the Theory of Numbers*, Fifth edition., John Wiley & Sons Inc, 2008.

Unit I : Chapter 1 and Chapter 2 (Sections 2.1 to 2.3)

Unit II: Chapter 2 (Sections 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*, 6<sup>th</sup> 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](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](https://en.wikipedia.org/wiki/Diophantine_equation)

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>21</b>	<b>19</b>	<b>33</b>	<b>13</b>	<b>15</b>	<b>17</b>	<b>45</b>	<b>163</b>

Low-1

Medium-3

High-9

### DSE I - Graph Theory

(For Students Admitted from 2023-2024)

Semester: I

Subject Code: HMMXCE11A

Hours / week: 6

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							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO								
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 2023-2024)

**Semester: I**  
**Subject Code: HMMXCE11B**

**Hours / week: 6**  
**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 Death Process 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 queueing 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.
- U.N.Bhat, *Elements of Applied Stochastic Process*, John Wiley and Sons Limited, Second Edition, 1984.
  - D.R.Cox and H.D.Miller, *Theory of stochastic process*, Methuen, London, 1965.

**E-Resources:**

- [https://www.google.co.in/books/edition/Probability\\_Statistics](https://www.google.co.in/books/edition/Probability_Statistics)
- [https://www.google.co.in/books/edition/Theory\\_of\\_Stochastic\\_Processes](https://www.google.co.in/books/edition/Theory_of_Stochastic_Processes)
- <https://youtu.be/n2y7n6jw5d0>
- <https://youtu.be/54yLcoHIAEA>

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>27</b>	<b>33</b>	<b>25</b>	<b>15</b>	<b>25</b>	<b>31</b>	<b>27</b>	<b>183</b>

Low-1

Medium-3

High-9

**Extra credit - Fuzzy Sets and Relations**

(For Students Admitted from 2023-2024)

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

- To introduce the concept of fuzzy set theory and their basic operations
- 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:**

- 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:**

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

**E Resources:**

- <https://youtu.be/S1By3bsdE5Q>
- [https://youtu.be/a2i-lHS-c\\_I](https://youtu.be/a2i-lHS-c_I)
- <https://youtu.be/tC3K8RLRIZc0>

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>21</b>	<b>21</b>	<b>45</b>	<b>33</b>	<b>21</b>	<b>21</b>	<b>15</b>	<b>177</b>
	Low-1		Medium-3			High-9		



**Core V –Algebra-I**

(For Students Admitted from 2023-2024)

**Semester: II**  
**Subject Code: HMMXC211****Hour / week: 6**  
**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)  
Groupaction 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 over a 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**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>

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO								
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 VI- Analysis – II

(For Students Admitted from 2023-2024)

Semester: II

Subject Code: HMMXC22

Hours / week: 6

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)

Sequences and Series of Functions: Discussion of Main Problem - Uniform Convergence - Uniform Convergence and Continuity - Uniform Convergence and Integration –Uniform Convergence and Differentiation - Equicontinuous Families of Functions - The Stone - Weierstrass Theorem.

#### Unit II

(18 hours)

**Some Special Functions:** Power Series - The Exponential and Logarithmic Functions - The Trigonometric Functions - The Algebraic Completeness of the Complex Field - Fourier Series - The Gamma Function.

#### Unit III

(18hours)

**Functions of Several Variables:** Linear Transformations - Differentiation - The Contraction Principle - The Inverse Function Theorem - The Implicit Function Theorem.

**Unit IV** (18 hours)

**Functions of Several Variables:** The Rank Theorem - Determinants - Derivatives of Higher Order - Differentiation of Integrals. **Integration of Differential Forms:** Primitive Mappings Partitions of Unity - Change of Variables.

**Unit V** (18 hours)

**Integration of Differential Forms:** Differential Forms: Simplexes and Chains - Stokes' Theorem.

**Course Outcomes:**

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

**CO 1:** Apply uniform convergence method to prove the sequences of real functions

**CO 2:** Distinguish the exponential and logarithmic functions

**CO 3:** Analyze the concepts of functions of several variables

**CO 4:** Examine the derivatives of several variables

**CO 5:** Prove the ability to reflect on problems that are quite significant in the field of real analysis

**Text Book:**

1. Walter Rudin, *Principles of Mathematical Analysis*, McGraw-Hill International Editions, Third Edition, 1976.

**Unit I:** Chapter 7

**Unit II:** Chapter 8

**Unit III:** Chapter 9 (Pg. No: 204 - 228)

**Unit IV:** Chapter 9 (Pg.No: 228 - 239) 10 (Pg.No: 245 - 253)

**Unit V:** Chapter 10 (Pg.No: 253 - 275)

**Reference Books:**

1. Apostol, *Mathematical Analysis*, Narosa Publishing House, Second Edition, 2002.
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.

**E-Resources:**

1. [http://ramanujan.math.trinity.edu/wtrench/texts/TRENCH\\_REAL\\_ANALYSIS.PDF](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							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO								
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 2023-2024)

Semester: II

Subject Code: HMMXC231

Hours / week: 6

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  $X \times Y$  - 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.

#### 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 to apply 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 - 32)

**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, 2<sup>nd</sup> Edition, Reprint 2008.

3. Seymour Lipschutz, *General Topology*, Schaum's Outline Series, v Mc Graw Hill Book 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](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&gbpv=1&dq=topology+mathematics&printsec=frontcover](https://www.google.co.in/books/edition/General_Topology/kgxHDgAAQBAJ?hl=en&gbpv=1&dq=topology+mathematics&printsec=frontcover)

5. <https://www.mathematik.hu-erlin.de/~wendl/Winter2018/Topologie2/lecturenotes.pdf>

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO								
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
<b>Total</b>	<b>45</b>	<b>33</b>	<b>33</b>	<b>13</b>	<b>21</b>	<b>7</b>	<b>25</b>	<b>177</b>

Low-1

Medium-3

High-9

**Core VIII – Partial Differential Equations**

(For Students Admitted from 2023-2024)

**Semester: II**

**Subject Code: HMMXC241**

**Hours / week: 6**

**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.

**Text Book:**

1. T. Amarnath, *An Elementary Course in Partial Differential Equations*, 2<sup>nd</sup> 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*, 3<sup>rd</sup> edn, Birkhauser, 2007 .
2. I.N. Snedden, *Elements of Partial Differential Equations*, Dover, 2006.
3. F. Trèves, *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](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](https://en.wikipedia.org/wiki/Partial_differential_equation)
4. [https://en.wikipedia.org/wiki/Laplace%27s\\_equation](https://en.wikipedia.org/wiki/Laplace%27s_equation)
5. <https://www.geeksforgeeks.org/sample-problems-on-heat-conduction/>

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>33</b>	<b>33</b>	<b>15</b>	<b>11</b>	<b>33</b>	<b>39</b>	<b>39</b>	<b>203</b>

Low-1

Medium-3

High-9

**DSE II – Numerical Methods**

(For Students Admitted from 2023-2024)

**Semester: II****Subject Code: HMMXE21A****Hours / week: 6****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 suitable methods

**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/OrtaUUonwkU>
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](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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>33</b>	<b>27</b>	<b>27</b>	<b>15</b>	<b>45</b>	<b>45</b>	<b>45</b>	<b>237</b>

Low-1

Medium-3

High-9

**Core IX - Algebra – II**

(For Students Admitted from 2023-2024)

**Semester: III****Subject Code: HMMXC31****Hour / week: 6****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*, 2<sup>nd</sup> 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, 7<sup>th</sup> 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							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO								
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
<b>Total</b>	<b>39</b>	<b>39</b>	<b>39</b>	<b>13</b>	<b>31</b>	<b>21</b>	<b>39</b>	<b>221</b>

Low-1

Medium-3

High-9

**Core X- Complex Analysis**

(For Students Admitted from 2023-2024)

**Semester: III**

**Subject Code: HMMXC321**

**Hours / week: 6**

**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\_SILaxv1b50Vk&index=2  
 3. <https://math.mit.edu/~jorloff/18.04/notes/topic4.pdf>

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>39</b>	<b>33</b>	<b>15</b>	<b>15</b>	<b>7</b>	<b>15</b>	<b>45</b>	<b>169</b>

Low-1
Medium-3
High-9

### Core XI – Measure and Integration

(For Students Admitted from 2023-2024)

Semester: III

Subject Code: HMMXC331

Hours / week: 6

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, 4<sup>th</sup> 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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>27</b>	<b>27</b>	<b>21</b>	<b>9</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>129</b>

Low-1

Medium-3

High-9

**Core XII - Mathematical Statistics**

(For Students Admitted from 2023-2024)

**Semester: III**

**Subject Code: HMMXC341**

**Hours / week: 6**

**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  $\chi^2$ ,  $s^2$  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 small samples and large samples -  $\chi^2$  test Kolmogorov Theorem - Smirnov Theorem - Tests of Kolmogorov and Smirnov type - The Wald - Wolfowitz 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 Power 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*, Wiley Eastern Ltd., New Delhi, 1988(3<sup>rd</sup> Print).



3. G.G.Roussas, *A First Course in Mathematical Statistics*, Addison Wesley Publishing Company, 1973.
4. B.L.Vander Waerden, *Mathematical Statistics*, G.Allen & Unwin Ltd., London, 19

**E-Resources:**

1. [https://youtu.be/\\_JVzgbKfew](https://youtu.be/_JVzgbKfew)
2. [https://youtu.be/\\_JVzgbKfew](https://youtu.be/_JVzgbKfew)
3. <https://youtu.be/pXVnfUtrhMA>

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>19</b>	<b>27</b>	<b>45</b>	<b>21</b>	<b>39</b>	<b>45</b>	<b>45</b>	<b>241</b>

Low-1

Medium-3

High-9

**DSE III - Optimization Techniques**

(For Students Admitted from 2023-2024)

**Semester: III****Subject Code: HMMXE31B****Hours / week: 6****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=5ZkYEEYsJQvU>
3. <https://www.youtube.com/watch?v=WG0mhsfcqvk>

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>45</b>	<b>45</b>	<b>45</b>	<b>21</b>	<b>39</b>	<b>45</b>	<b>39</b>	<b>279</b>

Low-1

Medium – 3

High - 9

### Core XIII – Differential Geometry

(For Students Admitted from 2023-24)

**Semester: IV****Subject Code: HMMXC41****Hours / week: 6****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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>33</b>	<b>27</b>	<b>15</b>	<b>15</b>	<b>11</b>	<b>25</b>	<b>15</b>	<b>141</b>

Low-1

Medium-3

High-9

**Core XIV -Functional Analysis**

(For Students Admitted from 2023-24)

**Semester: IV**  
**Subject Code: HMMXC421****Hours / week: 6**  
**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](http://calvino.polito.it/~terzafac/Corsi/functional_analysis/pdf/chap1.pdf)

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>27</b>	<b>15</b>	<b>25</b>	<b>5</b>	<b>5</b>	<b>11</b>	<b>27</b>	<b>115</b>

Low-1

Medium-3

High-9

**Core XV - Project**

(For Students Admitted from 2023-24)

**Semester: IV**

**Subject Code: HMMXC43PW**

**Hours/week:12**

**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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>45</b>	<b>45</b>	<b>45</b>	<b>5</b>	<b>9</b>	<b>7</b>	<b>45</b>	<b>201</b>

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 2023-2024)

**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****(18hours)**

**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 (18hours)**

**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 (18hours)**

**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 (18hours)**

**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 Hill Education 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/\\_JVzgbKfew](https://youtu.be/_JVzgbKfew)

2. [https://youtu.be/\\_JVzgbKfew](https://youtu.be/_JVzgbKfew)

3. <https://youtu.be/pXVnfUtrhmA>

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO								
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
<b>Total</b>	<b>19</b>	<b>27</b>	<b>45</b>	<b>21</b>	<b>39</b>	<b>45</b>	<b>45</b>	<b>241</b>

Low-1

Medium-3

High-9

**B Sc MATHEMATICS**  
(Three Year Regular Programme)  
(For Students Admitted from 2023-24)

**Program Specific Outcomes**

- PSO 1: Domain Knowledge:** Propagate the basic knowledge of the concerned 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 one self 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 Core Course on “Foundation Course in mathematics” (III Semester).
2. Combined the courses “Statics” and “Dynamics” and renamed as “Mechanics” (V Semester).
3. Introduced Core Course on “Number Theory” (VI Semester) instead of Astronomy.
4. The Core course “Numerical Analysis” in the III Semester was transferring to VI Semester.
5. Modified the syllabus for the Core courses “Graph Theory” (V Semester) and “Operations Research” (V Semester).
6. The Core course “Real Analysis I” (IV Semester) has been renamed as “Sequence and Series” (III Semester).
7. The Core course “Real Analysis II” (VI Semester) has been renamed as “Real Analysis” (IV Semester).
8. The Core course “Abstract Algebra I” (IV Semester) has been renamed as “Abstract Algebra” (IV Semester).
9. The Core course “Abstract Algebra II” (V Semester) has been renamed as “Linear Algebra” (V Semester).
10. Core courses “Abstract Algebra” and “Operations Research” are integrated courses.
11. Reduced the syllabus for the Ability Enhancement Compulsory Course “Discrete Mathematics (III Semester) for Information Technology.
12. Reduced the syllabus for the Ability Enhancement Compulsory Course “Discrete Mathematics (I Semester) for Cyber Security.
13. Introduced Internship for the course “Foundation Course in Mathematics”.
14. Modified the syllabus for the Core Courses “Mathematical Statistics – I” (I - Semester)

- and “Mathematical Statistics - II” ( II – Semester)
15. Reduced the syllabus for the Ability Enhancement Compulsory Course “Numerical Methods” in the I semester for BCA.
16. Introduced Skill Enhancement Course “Theory of Equation with SCILAB” (I Semester) instead of “Theory of Equation with MATLAB”.

### PROGRAM STRUCTURE

Programme Code: UMX

Sem	Part	Subject code	Course	Subject Title	Hours / Week	Credits	CIA	ESE	Total
I	I	IBLT111/ IBLA11/ IBLH111	Language I	Tamil I / Arabic I / Hindi I	5	3	25	75	100
	II	IBLEI12/ IBLEII12	Language II	English I a or b	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				
				<b>30</b>	<b>21</b>	<b>125</b>	<b>425</b>	<b>550</b>	
II	I	IBLT211/ IBLA21/ IBLH211	Language I	Tamil II / Arabic II /Hindi II	5	3	25	75	100
	II	IBLEI22 IBLEII22	Language II	English II a or b	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
		IBMXX2/ IBMXX2O	Extra Credit	Arithmetic for Competitive Examinations / * Online Course		2		100	100
			Library/ Browsing		1				
			Remedial / Games		1				
		<b>Total</b>			<b>30</b>	<b>23+2</b>	<b>125</b>	<b>475 +100</b>	<b>600+ 100</b>
III	I	IBLT31/ IBLA31/ IBLH31	Language I	Tamil III / Arabic III /Hindi III	5	3	25	75	100
		II	IBLEI32 IBLEII32	Language II	English III a or b	5	3	25	75
	III	IBMXC311	Core V	# Foundation Course in Mathematics	4	4	25	75	100
		IBMXC321	Core VI	Sequence and Series	4	4	25	75	100
		IBMXA33P	AECC III	Programming in "C" Lab	4	4	25	75	100
	IV	IBOE3MX	OEC I	Quantitative Aptitude for Competitive 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
		IBMXX3/ IBMXX3O	Extra Credit	Logical Reasoning /* Online Course		2		100	100
	<b>Total</b>			<b>30</b>	<b>26+2</b>	<b>225</b>	<b>525 +100</b>	<b>750+ 100</b>	
	I	IBLT41/ IBLA41/ IBLH41	Language I	Tamil IV / Arabic IV / Hindi IV	5	3	25	75	100
		II	IBLEI42 IBLEII42	Language II	English IV a or b	5	3	25	75
	III	IBMXC41	Core VII	o Abstract Algebra	4	4	25	75	100
		IBMXC42	Core VIII	Real Analysis	5	4	25	75	100

IV		IBMXA43	AECC IV	Programming in Java	5	4	25	75	100
	IV	IBLVE4	GIC III	Life Skills and Value Education	2	2		50	50
		IBOE4MX	OEC II	Quantitative Aptitude for Competitive Examinations – II	2	2		50	50
		IBMXS44P	SEC IV	R Tool Lab	2	2		50	50
		IBMXX4/ IBMXX4O	Extra Credit	Applications of Group Theory/ *Online Course		2		100	100
	<b>Total</b>				<b>30</b>	<b>24+2</b>	<b>125</b>	<b>525+100</b>	<b>650+100</b>
V	III	IBMXC511	Core IX	Linear Algebra	6	5	25	75	100
		IBMXC521	Core X	Mechanics	6	5	25	75	100
		IBMXC531	Core XI	Graph Theory	6	5	25	75	100
		IBMXCE5A/ IBMXCE5B	DSE I	Fourier and Laplace Transforms / Combinatorics	4	4	25	75	100
		IBMXE51C/ IBMXE51D	DSE II	Operations Research / Fluid Dynamics	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
		IBMXX5O	Extra Credit	Employability Skills / * Online Course		2	100	-	100
		<b>Total</b>				<b>30</b>	<b>27+2</b>	<b>125+100</b>	<b>475</b>
	VI	III	IBMXC611	Core XII	Complex Analysis	6	5	25	75
IBMXC621			Core XIII	Numerical Analysis	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	Lattice theory and Boolean Algebra / Mathematical Modeling	4	4	25	75	100

IV	IBMXS65	SEC VI	Applied Statistics	2	2		50	50
		Library/ Browsing		1				
	IBMXX6/ IBMXX6O	Extra Credit	Quantitative Techniques / *Online Course		2		100	100
	<b>Total</b>			<b>30</b>	<b>24 + 2</b>	<b>125</b>	<b>425 + 100</b>	<b>550 + 100</b>
	<b>Grand Total</b>			<b>180</b>	<b>145 + 10</b>	<b>850 + 100</b>	<b>2850 + 400</b>	<b>3700 + 500</b>

\*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

### 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	IBCYA131	AECC II	Discrete Mathematics	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

**OEC for Students Other than B Sc Mathematics**

Sem	Part	Subject code	Course	Subject Title	Hours / Week	Credit	CIA	ESE	Total Marks
III	IV	IBOE3MX	OEC I	Quantitative Aptitude for Competitive Examinations – I	2	2	-	50	50
IV	IV	IBOE4MX	OEC II	Quantitative Aptitude for Competitive Examinations – II	2	2	-	50	50

AECC - Ability Enhancement Compulsory Course

SEC – Skill Enhancement Course

DSE – Discipline Specific Elective

OEC – Open Elective Course

**Core I - Calculus**

(For Students Admitted from 2023-24)

**Semester: I****Subject Code: IBMXC11****Hours / week: 5****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 - Asymptotes by

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://nitkk.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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO								
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 2023-24)

Semester: I

Subject Code: IBMXC12

Hours / week: 6

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 Numbers and Trigonometry*, New Gamma Publishing House, Edition 2011.
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](https://www.google.co.in/books/edition/Golden_Algebra)
2. [https://www.google.co.in/books/edition/HIGHER\\_ALGEBRA](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](https://youtu.be/uMXcKY_w3w4)

Course Outcomes	Programme Outcomes							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO								
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
<b>Total</b>	<b>15</b>	<b>15</b>	<b>9</b>	<b>15</b>	<b>11</b>	<b>15</b>	<b>21</b>	<b>101</b>

Low-1
Medium-3
High-9

### AECC I –Mathematical Statistics - I

(For Students Admitted from 2023-24)

**Semester: I**

**Subject Code: IBMXA131**

**Hours / week: 5**

**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

**(18hours)**

**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 (18hours)**

**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 (10hours)**

**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 poisson 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, *Fundamentals 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://www.youtube.com/watch?v=JCZAVDTU0hU>
2. [https://www.youtube.com/watch?v=Fvi9A\\_tEmXQ](https://www.youtube.com/watch?v=Fvi9A_tEmXQ)
3. [https://onlinecourses.nptel.ac.in/noc22\\_mg31/preview](https://onlinecourses.nptel.ac.in/noc22_mg31/preview)

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>21</b>	<b>33</b>	<b>39</b>	<b>45</b>	<b>15</b>	<b>33</b>	<b>27</b>	<b>213</b>

Low-1

Medium-3

High-9

**SEC I - Theory of Equations with SCILAB**

(For Students Admitted from 2023-24)

**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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>27</b>	<b>23</b>	<b>25</b>	<b>37</b>	<b>27</b>	<b>9</b>	<b>31</b>	<b>179</b>

Low-1

Medium-3

High-9

### Core III - Analytical Geometry - 3D & Vector Calculus

(For Students Admitted from 2023-2024)

**Semester: II**

**Subject Code: IBMXC21**

**Hours / week: 5**

**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 (3.1 to 3.11)

**Unit III:** Chapter 4 (4.1 to 4.12)

**Unit IV:** Chapter 2, 3(3.1 to 3.10)

**Unit V:** Chapter 4 (4.1 to 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](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](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							
	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
<b>Total</b>	<b>27</b>	<b>27</b>	<b>11</b>	<b>15</b>	<b>31</b>	<b>15</b>	<b>33</b>	<b>159</b>

Low-1

Medium-3

High-9

### Core IV- Differential Equations

(For Students Admitted from 2023-2024)

Semester: II

Subject Code: IBMXC22

Hours / week: 4

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 Transforms*, 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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO								
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
<b>Total</b>	<b>27</b>	<b>27</b>	<b>21</b>	<b>15</b>	<b>9</b>	<b>21</b>	<b>31</b>	<b>151</b>

Low-1

Medium-3

High-9

**AECC II – Mathematical Statistics II**

(For Students Admitted from 2023-2024)

**Semester: II****Subject Code: IBMXA231****Hours / week: 5****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, *Fundamentals 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 Edition, Reprint 2015.

**E-Resources:**

1. [https://udrc.lkouniv.ac.in/Content/DepartmentContent/SM\\_6dc18628-deb8-41c0-b3e0-7f39c1ca0125\\_38.pdf](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							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO								
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
<b>Total</b>	<b>15</b>	<b>27</b>	<b>39</b>	<b>31</b>	<b>39</b>	<b>45</b>	<b>45</b>	<b>241</b>

Low-1
Medium-3
High-9

**SEC II – Analytical Geometry with Geogebra**

(For Students Admitted from 2023-2024)

**Semester: II**

**Subject Code: IBMXS24P**

**Hours / week: 2**

**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 between two 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							
	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
<b>Total</b>	<b>27</b>	<b>23</b>	<b>25</b>	<b>37</b>	<b>27</b>	<b>9</b>	<b>31</b>	<b>179</b>

Low-1

Medium-3

High-9

**Extra Credit- Arithmetic for Competitive Examinations**

(For Students Admitted from 2023-2024)

**Semester: II**

**Subject Code: IBMXX2**

**Credit: 2**

**Course Objectives:**

1. To introduce the basic concepts of mathematics
2. To promote the problem solving ability to attend 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:** Solve the problems using fundamental rules

- CO2:** Solve and simplify the problems  
**CO3:** Compute the average of numbers  
**CO4:** Apply the chain rule for solving the problems  
**CO5:** Make use of Allegation or Mixture in problems

**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 32<sup>nd</sup> Edition.
2. R.S Aggarwal, *Objective Arithmetic (Numerical Ability Test) For Competitive Examinations*, S.Chand and Company limited, 2017.
3. R.S Aggarwal & S.Chand, *Quantitive Aptitude for Competitive Examination*, Seventh Edition, 2008.

**E-Resources:**

1. <https://www.youtube.com/watch?v=yoGq9IGc74E>
2. <https://careerlost.in/aptitude-questions/average-problems>
3. <https://byjus.com/govt-exams/mixture-alligation-questions/>

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>15</b>	<b>15</b>	<b>9</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>45</b>	<b>129</b>

Low-1
Medium-3
High-9

**Core V –Foundation course in Mathematics**

(For Students Admitted from 2023-2024)

**Semester: III**  
**Subject Code: IBMXC311**

**Hours / week: 4**  
**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							
	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
<b>Total</b>	<b>21</b>	<b>21</b>	<b>15</b>	<b>15</b>	<b>21</b>	<b>21</b>	<b>15</b>	<b>129</b>

Low-1

Medium-3

High-9

### Core VI – Sequence and Series

(For Students Admitted from 2023-2024)

Semester: III

Subject Code: IBMXC321

Hours / week: 4

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 infima -The completeness property of  $\mathbb{R}$ - Applications of the supremum property-Functions-Archimedean property - Density of rational numbers in  $\mathbb{R}$ .

#### 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  $\mathbb{R}$  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](https://www.google.co.in/books/edition/Methods_of_Solving_Sequence_and_Series)

2. [https://www.whitman.edu/mathematics/calculus/calculus11\\_Sequences\\_and\\_Series](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							
	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

**OEC I - Quantitative Aptitude for Competitive Examinations-I**

(For Students Admitted from 2023-2024)

**Semester: III****Subject Code: IBOE3MX****Hours / week: 2****Credits: 2**

**Course Objectives:**

1. To use appropriate formulas and methods for a given situation
2. To acquire simple techniques for dealing quantities, business transactions, data analytics and geometrical structures

**Unit I** (6 hours)

**Percentage:** Time and Work.

**Unit II** (6 hours)

**Profit and Loss:** Formulae -Solved Problems.

**Unit III** (6 hours)

**Simple interest:** Formulae - Solved Problems.

**Unit IV** (6 hours)

**Compound interest:** Formulae - Solved Problems.

**Unit V** (6 hours)

**Volume and Area:** Volume and Area of Solid Figures.

**Course Outcomes:**

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

**CO 1:** Solve time and work problems by using the formula

**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 thinking ability skills

**CO 5:** Compute the volume and surface area of solids

**Text Book:**

1. R.S. Aggarwal, *Arithmetic Subjective & Objective for Competitive Examinations* S. Chand & Company Limited, Reprint 2009.

**Unit I:** Chapter 6, 11 ( pg.no 112 - 141 & pg.no 224 - 245)

**Unit II:** Chapter 16 (pg.no 300 - 331 )

**Unit III:** Chapter 18 (pg.no 348 - 361)

**Unit IV:** Chapter 19 (pg.no 362 - 379)

**Unit V:** Chapter 21(pg.no 419 - 453)

**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\\_apititude\\_made\\_easy\\_ugcportal\\_pdf](https://pdfgoal.com/downloads/quantitative_apititude_made_easy_ugcportal_pdf)
4. [https://www.youtube.com/watch?v=\\_cW7\\_BUDYcw](https://www.youtube.com/watch?v=_cW7_BUDYcw)

5. <https://iim-cat-questions-answers.2iim.com/quant/geometry/mensuration/>

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>15</b>	<b>45</b>	<b>23</b>	<b>45</b>	<b>33</b>	<b>45</b>	<b>45</b>	<b>251</b>
	Low-1		Medium-3			High-9		

### SEC III – Fourier Series

(For Students Admitted from 2023-2024)

**Semester: III**

**Subject Code: IBMXS34**

**Hours / week: 2**

**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(sec8)

**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](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](https://youtu.be/LGxE_yZYigI)

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO								
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
<b>Total</b>	<b>27</b>	<b>15</b>	<b>15</b>	<b>9</b>	<b>15</b>	<b>15</b>	<b>13</b>	<b>109</b>

Low-1

Medium-3

High-9

**Extra Credit - Logical Reasoning**

(For Students Admitted from 2023-2024)

**Semester: III**

**Subject Code: IBMXX3**

**Credit: 2**

**Course Objectives:**

1. To correlate an application of acquired knowledge on subjective test questions with linguistically and structurally appropriate answers
2. To gain skill to attend competitive examinations

**Unit I**

Puzzle Test.

**Unit II**

Logical Venn Diagrams.

**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 some techniques to Alphabet test

**CO 4:** Inspect the Alpha Numeric Sequence Puzzle

**CO 5:** Compute the problem quantitatively and use appropriate inserting the missing Character

**Text Book:**

1. Dr R S Aggarwal, *A Modern Approach to Verbal Reasoning*, S. Chand & Company Private Limited, Revised Edition 2018.

**Unit I:** Chapter 6

**Unit II:** Chapter 9

**Unit III:** Chapter 10

**Unit IV:** Chapter 11

**Unit V:** Chapter 16

**Reference Books:**

1. Dr R S Aggarwal, *A Modern Approach to Verbal and Non-verbal Reasoning*, &Company Private Limited, Edition 2012.

2. Dr R S Aggarwal, *A Modern Approach to Logical Reasoning*, S. Chand & Company Private Limited, Edition 2013.

3. P K Agarwal, *Test of Verbal Reasoning for Competitive Examinations*, Edition 2004.

**E-Resources:**

1. <https://youtu.be/3hNmmZBN6jw>

2. <https://youtu.be/xmSSMH6RDBQ>

3. <https://youtu.be/aDPu39j-mBY>

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
<b>CO</b>								
<b>CO1</b>	3	9	1	3	1	3	3	<b>23</b>
<b>CO2</b>	3	9	1	3	3	3	3	<b>25</b>
<b>CO3</b>	3	9	1	3	1	3	3	<b>23</b>
<b>CO4</b>	3	9	1	3	1	3	3	<b>23</b>
<b>CO5</b>	3	9	1	3	1	3	3	<b>23</b>
<b>Total</b>	<b>15</b>	<b>45</b>	<b>5</b>	<b>15</b>	<b>7</b>	<b>15</b>	<b>15</b>	<b>117</b>



Low-1

Medium-3

High-9

**Core VII - Abstract Algebra**

(For Students Admitted from 2023-2024)

**Semester: IV****Subject Code: IBMXC41****Hours / week: 4****Credit: 4****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****(12 hours)****Group Theory:** Definition of a Group - Some Examples of Groups – Some Preliminary Lemmas – Subgroups.**Unit II****(12 hours)****Group Theory:** A counting principle - Normal Subgroups and Quotient Groups - Homomorphisms.**Unit III****(12 hours)****Group Theory:** Automorphisms – Cayley's Theorem – Permutation Groups.**Unit IV****(12 hours)****Ring Theory:** Definition and Examples of Rings - Some Special Classes of Rings – Homomorphisms.**Unit V****(12 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, Inc. 2005.
2. Jimmie Gilbert, Linda Gilbert, *Elements of Modern Algebra*, Cengage Learning, 5<sup>th</sup> Edition, 2004.
3. M.L. Santiago, *Modern Algebra*, Tata McGraw Hill Publishing Company Limited, New Delhi.

**E-Resources:**

1. [https://youtu.be/NJN6cQsu0\\_o](https://youtu.be/NJN6cQsu0_o)
2. [https://youtu.be/\\_RTHvweHlhE](https://youtu.be/_RTHvweHlhE)
3. <https://youtu.be/RatkBWHUSqo>
4. [https://www.youtube.com/watch?v=OjvZxxLb\\_78](https://www.youtube.com/watch?v=OjvZxxLb_78)

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>33</b>	<b>33</b>	<b>45</b>	<b>15</b>	<b>9</b>	<b>15</b>	<b>45</b>	<b>195</b>

Low-1

Medium-3

High-9

**Core VIII – Real Analysis**

(For Students Admitted from 2023-2024)

**Semester: IV****Subject Code: IBMXC42****Hours / week: 5****Credit: 4****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****(15 hours)****Limits:** Limits of functions - Limit theorems - Some extensions of the limit concept.**Unit II****(15 hours)**

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

**Unit III****(15 hours)****Differentiation:** The derivative - The chain rule – Caratheodory's theorem - Inverse functions - The mean value theorem - Interior extremum theorem – Rolle's theorem.**Unit IV****(15 hours)****Differentiation:** 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****(15 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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
<b>CO1</b>	9	9	3	1	9	3	3	<b>37</b>
<b>CO2</b>	3	3	1	1	3	1	1	<b>13</b>
<b>CO3</b>	9	3	1	1	3	3	1	<b>21</b>
<b>CO4</b>	3	3	3	1	3	1	3	<b>17</b>
<b>CO5</b>	9	9	3	1	9	1	1	<b>33</b>
<b>Total</b>	<b>33</b>	<b>27</b>	<b>11</b>	<b>5</b>	<b>27</b>	<b>9</b>	<b>9</b>	<b>121</b>

Low-1

Medium-3

High-9

**OEC II: Quantitative Aptitude for Competitive Examinations II**

(For Students Admitted from 2023-2024)

**Semester: IV****Hours / week: 2****Subject Code: IBOE4MX****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)****Ratio, Proportion, Indices and logarithm:** Ratio - Proportion - Indices - Logarithm.**Unit II****(6 hours)****Basic concepts of Permutations and Combinations:** Fundamental Principles of counting - Factorial - Permutations - Circular Permutations - Combinations.**Unit III****(6 hours)****Sequence and Series:** Progressions - Arithmetic Progression (A.P) - Geometric Progression (G.P) - Harmonic progression (H.P) - Some special sequences.**Unit IV****(6 hours)****Set:** Meaning of a set - Methods of writing a set - Types of sets - Some operations on sets - Some results on complementation - Laws of Operations - Some important results - Venn diagram and some of the Applications of Set Theory.**Unit V****(6 hours)****Probability:** Definition of Probability - Importance of the concept of Probability - Classical or a Priori Probability approach - Modern definition of Probability - Objective approach and Subjective approach to Probability - Experiment - Event - Types of events - Theorems of probability.**Course Outcomes:**

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

**CO 1:** Make use of the concepts of Indices and Logarithms, solve the problems**CO 2:** Identify the concepts of Permutation and Circular Permutation**CO 3:** Discover the basic concepts of Arithmetic Progression and Geometric Progression**CO 4:** Evaluate the skills of the application of set theory**CO 5:** Justify the basic concept of Random events, axioms of probability and independent events**Text Book:**

1. Bharat Jhunjhunwala, *Quantitative Aptitude (Mathematics & Statistics) for CA Common proficiency Test (CPT)*, S. Chand and Company Limited – First Edition, 2008.

**Unit I:** Chapter 1 (1 – 4)**Unit II:** Chapter 5 (1 -5)**Unit III:** Chapter 6 (3 – 7)**Unit IV:** Chapter 7A (1 – 8)

**Unit V:** Chapter 9 section B (Page no. 9.1 – 9.21)

**Reference Books:**

1. R. Gopal, Prof. J. V. Subrahmanyam, *Arithmetic & Quantitative Aptitude for Competitive Exams*, Sura College of Competition, 2009.
2. Ashish Aggarwal, *Quick Arithmetic*, S.Chand Publications, 2<sup>nd</sup> Edition, 2007.
3. Dr.R.S. Aggarwal, *Quantitative Aptitude*, S.Chand Publications.7<sup>th</sup> Edition, 2015.

**E-Resources:**

1. <https://www.youtube.com/watch?v=oGT0AOihPr8>
2. <https://www.youtube.com/watch?v=jxIWNJ1MghA>
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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>9</b>	<b>15</b>	<b>21</b>	<b>105</b>

Low-1

Medium-3

High-9

**SEC IV - R Tool Lab**

(For Students Admitted from 2023-2024)

**Semester: IV**

**Subject Code: IBMXS44P**

**Hours / week: 2**

**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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>27</b>	<b>23</b>	<b>25</b>	<b>37</b>	<b>27</b>	<b>9</b>	<b>31</b>	<b>179</b>

Low-1
Medium-3
High-9

### Extra Credit – Applications of Group Theory

(For Students Admitted from 2023-2024)

**Semester: IV**

**Subject Code: IBMXX4/IBMXX40**

**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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>39</b>	<b>15</b>	<b>33</b>	<b>147</b>

Low-1

Medium-3

High-9

**Core IX- Linear Algebra**

(For Students Admitted from 2023-24)

**Semester: V**

**Subject Code: IBMXC511**

**Hours / week: 6**

**Credit: 5**

**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** (18 hours)

**Vector Spaces:** Elementary Basic Concepts - Linear Independence and Bases.

**Unit II** (18 hours)

**Linear Equations:** Matrices and Elementary Row Operations – Row - Reduced Echelon Matrices – Matrix Multiplication – Invertible Matrices.

**Unit III** (20 hours)

**Inner Product Spaces:** Introduction - Inner products – Linear functions and Adjoints.

**Unit IV** (16 hours)

**Inner Product Spaces:** Unitary operations – Normal operations.

**Unit V** (18 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=ERfbtPB EYVA>

3. <https://gacbe.ac.in/pdf/ematerial/18BMA51C-U4.pdf>

4. <https://nptel.ac.in/courses/111/107/111107105/>

Course Outcomes	Programme Outcomes							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO								
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 XII- Mechanics

(For Students Admitted from 2023-24)

Semester: V

Subject Code: IBMXC521

Hours / week: 6

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 - Varignon'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. Duraipandiyar, *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=jhGYY1wfkE0>

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							
	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
<b>Total</b>	<b>45</b>	<b>27</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>45</b>	<b>5</b>	<b>167</b>

Low-1
Medium-3
High-9

### Core XII - Graph Theory

(For Students Admitted from 2023-24)

**Semester: V**

**Subject Code: IBMXC531**

**Hours / week: 6**

**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 (18 hours)**

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

**Unit II (18 hours)**

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

**Unit III (18 hours)**

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

**Unit IV (19 hours)**

**Colorability:** The Chromatics Number – The Five Color theorem – The Four Color Conjecture – The Heawood map - coloring theorem – Uniquely colorable Graphs – Critical graphs – Homomorphisms – The chromatic polynomial.

**Unit V (17 hours)**

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

**Course Outcomes:**

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 of Blocks and Trees

**CO 3:** Explain the concept of a trees and planarity of the graph and identify its applications to fundamental circuits

**CO 4:** Analyze the concepts of colouring of a graph

**CO 5:** Determine the definitions and basic properties of di c graphs

**Text Book:**

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

**Unit I:** Chapter 2

**Unit II:** Chapter 3, 4

**Unit III:** Chapter 7, 11

**Unit IV:** Chapter 12

**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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO								
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
<b>Total</b>	<b>15</b>	<b>39</b>	<b>33</b>	<b>13</b>	<b>13</b>	<b>13</b>	<b>13</b>	<b>139</b>

Low-1

Medium-3

High-9

**DSE I - Fourier and Laplace Transforms**

(For Students Admitted from 2023-24)

**Semester: V**

**Subject Code: IBMXCE5A**

**Hours / week: 4**

**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, 10<sup>th</sup> 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](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](http://imageprocessingplace.com/downloads_V3/root_downloads/tutorials/Wavelets--An%20eBook%20by%20Charles%20K.%20Chui.pdf)

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>39</b>	<b>15</b>	<b>11</b>	<b>11</b>	<b>5</b>	<b>15</b>	<b>27</b>	<b>123</b>

Low-1

Medium-3

High-9

### DSE I – Combinatorics

(For Students Admitted from 2023 - 24)

Semester: V

Subject Code: IBMXCE5B

Hours / week: 4

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](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](https://www.whitman.edu/mathematics/cgt_online/book/section02.02.html)

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>15</b>	<b>15</b>	<b>13</b>	<b>13</b>	<b>7</b>	<b>15</b>	<b>11</b>	<b>89</b>

Low-1

Medium-3

High-9

**DSE II - Operations Research**

(For Students Admitted from 2023-24)

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

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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO								
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
<b>Total</b>	<b>39</b>	<b>45</b>	<b>33</b>	<b>27</b>	<b>21</b>	<b>45</b>	<b>45</b>	<b>255</b>
	<b>Low-1</b>		<b>Medium-3</b>		<b>High-9</b>			

**DSE II - Fluid Dynamics**  
(For Students Admitted from 2023-24)

**Semester: V**  
**Subject Code: IBMXE51D**

**Hours / week: 4**  
**Credit: 4**

**Course Objectives:**

1. To use the control volume analysis, to develop and solve basic equations
2. To develop two and three dimensional flows

**Unit I** **(12 hours)**

**Vector Analysis:** Relations between Line and Surface Integrals - Conservative Vector Fields - Conservative Fields of Force - General Orthogonal Curvilinear Coordinates - Arc Length, Gradient, Divergence, Laplacian, Curl of a Vector Function in Orthogonal Coordinates.

**Unit II** **(12 hours)**

**Kinematics of fluids in motion:** Real fluids - Ideal fluids - Velocity of a Fluid at a Point - Streamlines and Path lines; Steady and unsteady flows - The Velocity Potential - The Velocity Vector - Local and Particle Rates of Change - The Equation of Continuity - Worked Examples - Acceleration of a Fluid.

**Unit III** **(12 hours)**

**Equations of motion of a fluid:** Pressure at a point in a Fluid at Rest - Pressure at a Point in a Moving Fluid - Conditions at a Boundary of Two Viscid Immiscible Fluids – Euler's Equations of Motions – Bernoulli's Equation - Worked Examples.

**Unit IV** **(12 hours)**

**Some Three dimensional flows:** Introduction - Sources - Sinks and Doublets - Images in a Rigid Infinite Plane - Images in Solid Spheres – Axi-symmetric flows; Stokes Stream Function - some special forms of the Stream Function for Axi - Symmetric Irrotational motions.

**Unit V** **(12 hours)**

**Some Two Dimensional Flows:** Meaning of Two Dimensional Flow - Use of Cylindrical Polar Coordinates - The Stream Function - The Complex Potential for Two - Dimensional, Irrotational Incompressible Flow - Complex Velocity Potentials for Standard Two Dimensional Flows - Uniform Stream - Line Sources and Line Sinks Line Doublets - Line Vortices - Some Worked Examples.

**Course Outcomes:**

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

**CO 1:** Solve the relations between the lines and surface integrals of coordinates

**CO 2:** Identity the fundamental kinematics of fluid elements

**CO 3:** Explain the relation between Bernoulli equation is related to conservation of energy and Euler's equations of motion

**CO 4:** Explicate the concept of axi-symmetric three dimensional flows and stream functions

**CO 5:** Summarize the ideas of two dimensional flow, uniform streams by applying suitable examples

**Text Book:**

1. F. Chorlton, *Fluid Dynamics*, CBS Publishers & Distributors Private Limited, New Delhi, 2018.

**Unit I:** Chapter 1 (sec 1.17 – 1.19)

**Unit II:** Chapter 2 (sec 2.1 – 2.9)

**Unit III:** Chapter 3 (sec 3.1 – 3.6)

**Unit IV:** Chapter 4

**Unit V:** Chapter 5 (sec 5.1 – 5.6)

**Reference Books:**

1. Herbert Goldstein, *Classical Mechanics*, Narosa Publishing House, New Delhi, Second Edition, 2001.
2. Shanti Swarup, *Fluid dynamics*, Krishnan Prakashan Mandir, Meerut, 1992-93.
3. M.D. Raisinghania, *Hydrodynamics*, S. Chand & Co, Limited, 1995.

**E-Resources:**

1. [https://www.google.co.in/books/edition/Classical\\_Mechanics](https://www.google.co.in/books/edition/Classical_Mechanics)
2. <https://www.youtube.com/watch?v=4xTA5MfZRU0>
3. <https://youtu.be/dlOCuYqTEpI>

Course Outcomes	Programme Outcomes							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	3	3	3	1	3	3	3	19
CO2	3	3	3	3	3	3	3	21
CO3	3	3	3	3	3	3	3	21
CO4	3	3	3	1	3	3	1	17
CO5	3	3	3	3	3	3	1	19
<b>Total</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>11</b>	<b>15</b>	<b>15</b>	<b>11</b>	<b>97</b>

Low-1

Medium-3

High-9

**SEC V – Operations Research Lab – LINDO / LINGO Package**

(For Students Admitted from 2023-24)

**Semester: V**

**Subject Code: IBMXS54P**

**Hours / week: 2**

**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							
	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
<b>Total</b>	<b>27</b>	<b>23</b>	<b>25</b>	<b>37</b>	<b>27</b>	<b>9</b>	<b>31</b>	<b>179</b>

Low-1

Medium-3

High-9

**Core XIII- Complex Analysis**

(For Students Admitted from 2023-24)

**Semester: VI****Subject Code: IBMXC611****Hours / week: 6****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****(22hours)**

**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****(22hours)**

**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 - Some consequences of the extension - Liouville's Theorem and the Fundamental Theorem of 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 - Zeros of 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 MediaPrivate 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](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							
	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
<b>Total</b>	<b>33</b>	<b>15</b>	<b>27</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>21</b>	<b>141</b>

Low-1
Medium-3
High-9

### Core XIV- Numerical Analysis

(For Students Admitted from 2023-24)

Semester: VI

Subject Code: IBMXC621

Hours / week: 6

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

(15 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

(15 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's method – The Quotient - Difference method - Solution to Systems of Nonlinear Equations.

#### Unit III

(15 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

(15 hours)

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

#### Unit V

(15 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*, 6<sup>th</sup> 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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>33</b>	<b>33</b>	<b>33</b>	<b>15</b>	<b>39</b>	<b>45</b>	<b>33</b>	<b>231</b>
	Low-1		Medium-3			High-9		

**Core XIV- Number Theory**

(For Students Admitted from 2023-24)

**Semester: VI**

**Subject Code: IBMXC631**

**Hours / week: 5**

**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:** Pierre de 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							
	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
<b>Total</b>	<b>27</b>	<b>33</b>	<b>15</b>	<b>21</b>	<b>9</b>	<b>13</b>	<b>17</b>	<b>135</b>

Low-1

Medium-3

High-9

### Core XV- Project

(For Students Admitted from 2023-2024)

Semester: VI

Subject Code: IBMXC64PW

Hours / week: 6

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 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							
	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
<b>Total</b>	<b>45</b>	<b>45</b>	<b>45</b>	<b>5</b>	<b>9</b>	<b>7</b>	<b>45</b>	<b>201</b>

Low-1

Medium-3

High-9

### DSE III – Lattice Theory and Boolean Algebra

(For Students Admitted from 2023-2024)

**Semester: VI****Hours / week: 4****Subject Code: IBMXE6A****Credit: 4**

#### Course Objectives:

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

#### Unit I

**(15hours)**

**Posets and Lattices:** Diagrammatical representation of a poset - Isomorphisms - Duality - Product of two Posets - Semi Lattices - Complete Lattices - Sub Lattices.

#### Unit II

**(9 hours)**

**Ideals:** Dual Ideals - Principal Ideals - Principal Dual Ideals - Prime Ideals - Complements - Length and Covering Conditions.

#### Unit III

**(15hours)**

**Modular and Distributive Lattices:** Direct Products - Ideal lattice - Isomorphism Theorem - Distributive Lattices - Direct Product.

#### Unit IV

**(12hours)**

**Boolean Algebra:** Boolean Algebra - Boolean Rings - Boolean Functions - Conjunctive Normal Form - Disjunctive Normal Form.

#### Unit V

**(9 hours)**

**Switching circuits:** Representation of Circuits - Simplification of Circuits - Design of Circuits - Don't Care Conditions – Design of n – terminal Circuits – Non – Series - Parallel Circuits.

#### Course Outcomes:

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

**CO 1:** Identify the types of lattices

**CO 2:** Examine the properties of dual ideals and principle ideals

- CO 3:** Categorize ideal lattice and distributive lattice  
**CO 4:** Highlight the characteristics of Boolean algebra  
**CO 5:** Simplify the switching circuits

**Text Book:**

1. Vijay K. Khanna, *Lattices and Boolean Algebras*, Vicas Publishing House Private Limited, Second Edition, 2008.

**Unit I:** Chapter 2

**Unit II:** Chapter 3 (Pages 38 – 57)

**Unit III:** Chapter 4

**Unit IV:** Chapter 5 (Pages 96 – 99 and 107 – 125)

**Unit V:** Chapter 5 (Pages 125 – 145)

**Reference Book:**

1. Mendelson Elliott, *Theory and Problems of Boolean Algebra*, Schaums Outline Series, New York McGraw Hill Publications, 1970.  
 2. Whitesitt. J Eldon, *Boolean Algebra and its Applications*, Massachusetts: Adition Wesley, 1962.

**E- Resources:**

1. <https://youtu.be/A08O-4BdD54>  
 2. <https://youtu.be/PyogbWF3gzo>  
 3. <https://youtu.be/T3CVoEEf4XI>  
 4. [https://youtu.be/vSaCmjIE\\_wM](https://youtu.be/vSaCmjIE_wM)

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO								
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
<b>Total</b>	<b>15</b>	<b>15</b>	<b>39</b>	<b>5</b>	<b>7</b>	<b>5</b>	<b>5</b>	<b>91</b>
	Low-1		Medium-3		High-9			

**DSE III – Mathematical Modeling**

(For Students Admitted from 2023-2024)

**Semester: VI**

**Subject Code: IBMXE6B**

**Hours / week: 4**

**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 diagrams - 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](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](https://www.researchgate.net/publication/317888204_Graphbased_Mathematical_Modelling_-_Concepts)

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO								
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
<b>Total</b>	<b>21</b>	<b>15</b>	<b>27</b>	<b>5</b>	<b>5</b>	<b>15</b>	<b>15</b>	<b>103</b>

Low-1 Medium-3 High-9

**SEC VI - Applied Statistics**

(For Students Admitted from 2023-2024)

**Semester: VI**

**Subject Code: IBMXS65**

**Hours / week: 2**

**Credit: 2**

**Course Objectives:**

1. To learn some common and simple concepts of applied statistics which will be useful to them while analyzing data sets obtained from different scientific experiments
2. To acquaint students with basic concepts of vital Statistics

**Unit I**

**(6 hours)**

**Curve fitting:** Introduction - Principle of least squares.

**Unit II**

**(6 hours)**

**Index numbers:** Introduction – Un weighted index numbers - Weighted index numbers - Solved problems.

**Unit III**

**(6 hours)**

**Analysis of time series:** Introduction -Time series - Components of a time series - Measurement of trends.

**Unit IV**

**(6 hours)**

**Vital Statistics:** Introduction - Vital Statistics Defined - Use of Vital Statistics -Methods of obtaining Vital Statistics - Measurement of Fertility - Reproduction Rates.

**Unit V**

**(6 hours)**

**Measurement of Mortality:** Crude Death Rate - Specific Death Rates - Standardized Death Rates - Infant Mortality Rate - Neo-Natal Mortality Rate - Maternal Mortality Rate – Natural Increase Rate - Net Migration Rate - Vital Index - Life Tables.

**Course Outcomes:**

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

- CO 1:** Understand the concept of curve fitting  
**CO 2:** Make use of index numbers to solve the problems  
**CO 3:** Explain the concept of time series  
**CO 4:** Analyze Vital Statistics, Vital Index and Life tables  
**CO 5:** Measure Specific death rate, Neo- Natal Mortality Rate and Net Migration rate

**Text Books:**

1. Dr. S. Arumugam and A. Thangapandi Issac, *Statistics*, New Gamma Publishing House, Edition, June 2015.

**Unit I:** Chapter 5

**Unit II:** Chapter 9

**Unit III:** Chapter 10

2. S.P.Gupta, *Statistical Method*, Sultan Chand & Sons, 2017.

**Unit IV:** Chapter 16 (Page no.712 -725)

**Unit V:** Chapter 16 (Page no. 725 -736)

**Reference Books:**

- S.C. Gupta & V.K. Kapoor, *Mathematical Statistics*, Sultan Chand & Sons, Eleventh Edition, 2007.
- N.P. Bali, *Statistics*, Lakshmi Publications, 1970.
- D.C.Sancheti, V.K.Kapoor, *Statistics (Theory, Methods and applications)*, Sultan Chand & Sons, 2012.

**E-Resources:**

- <https://www.youtube.com/watch?v=Qtr5z7GBEwY>
- <https://www.youtube.com/watch?v=DEKJq5DapXc>
- <https://www.youtube.com/watch?v=pQbl4kqn98M>

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO1	3	3	1	3	3	3	3	19
CO2	3	3	1	3	1	3	3	17
CO3	3	3	1	3	3	3	3	19
CO4	3	3	3	3	3	3	3	21
CO5	3	1	3	3	3	3	3	19
<b>Total</b>	<b>15</b>	<b>13</b>	<b>9</b>	<b>15</b>	<b>13</b>	<b>15</b>	<b>15</b>	<b>95</b>

Low-1

Medium-3

High-9

**Extra Credit – Quantitative Techniques**

(For Students Admitted from 2023-2024)

**Semester: VI**

**Subject Code: IBMXX6**

**Credit: 2**

**Course Objectives:**

- To understand operations, research techniques used for planning, scheduling and

- controlling large and complex projects
- 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 - 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 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:**

- 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:** Chapter 16

**Reference Books:**

- 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/introductory-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							
	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
<b>Total</b>	<b>27</b>	<b>15</b>	<b>27</b>	<b>15</b>	<b>15</b>	<b>39</b>	<b>27</b>	<b>165</b>

Low-1
Medium-3
High-9

**AECC III –Discrete Mathematics  
For B Sc Information Technology  
(For Students Admitted from 2023-2024)**

**Semester: III**  
**Subject Code: IBITA331**

**Hours / week: 4**  
**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 (12hours)

**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 (12hours)

**Relations** - Operation on relations - equivalence relation - Closure and Warshall's Algorithm - partitions and Equivalence classes.

#### Unit III (12hours)

**Functions & Mathematical induction** - Functions and Operators - One - One, Ontofunctions - special types of functions - invertible functions - composition of functions.

Techniques of proofs - mathematical induction.

**Unit IV (12hours)**

**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 (12hours)**

**Matrix algebra** - Introduction- operations-inverse, Rank of matrix - solution of Simultaneous linear 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](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							
	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
<b>Total</b>	<b>15</b>	<b>27</b>	<b>15</b>	<b>11</b>	<b>15</b>	<b>15</b>	<b>9</b>	<b>107</b>

Low-1

Medium-3

High-9

**AECC IV- Statistics**  
**For B Sc Information Technology**  
 (For Students Admitted from 2023-2024)

**Semester: IV**  
**Subject Code: IBITA43**

**Hours / week: 5**  
**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** (15hours)

**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](https://youtu.be/ztIBfKD_eFg)

2. <https://youtu.be/OfANWrzQE9Q>

3. [https://youtu.be/F\\_2GIheAbtI](https://youtu.be/F_2GIheAbtI)

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>27</b>	<b>33</b>	<b>27</b>	<b>15</b>	<b>9</b>	<b>45</b>	<b>45</b>	<b>201</b>

Low-1

Medium-3

High-9

**AECC III - Statistics**  
**For B Sc Computer Science**  
 (For Students Admitted from 2023-2024)

**Semester: III**

**Subject Code: IBCSA33**

**Hours / week: 4**

**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](https://youtu.be/ztIBfKD_eFg)

2. <https://youtu.be/OfANWrzQE9Q>

3. [https://youtu.be/F\\_2GIheAbtI](https://youtu.be/F_2GIheAbtI)

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>27</b>	<b>33</b>	<b>27</b>	<b>15</b>	<b>9</b>	<b>45</b>	<b>45</b>	<b>201</b>

Low-1

Medium-3

High-9

### AECC IV – Operations Research For B Sc Computer Science

(For Students Admitted from 2023-2024)

**Semester: IV****Subject Code: IBCSA43****Hours / week: 5****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****(15hours)**

**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****(15hours)**

**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****(15hours)**

**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  $2 \times n$  and  $m \times 2$  Games - Dominance Property.

**Unit IV****(15hours)**

**Transportation Model and its Variants:** Definition of the Transportation model - Nontraditional Models- Transportation Model - The Transportation algorithm- The Assignment model.

**Unit V****(15hours)**

**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 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>

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							
	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
<b>Total</b>	<b>27</b>	<b>15</b>	<b>27</b>	<b>15</b>	<b>15</b>	<b>39</b>	<b>27</b>	<b>165</b>

Low-1

Medium-3

High-9

**AECC I - Numerical Methods  
For BCA**

(For Students Admitted from 2023-2024)

**Semester: I**  
**Subject Code: IBCPA131****Hours / week: 4**  
**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 (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 minimum values 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, 4<sup>th</sup> 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							
	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
<b>Total</b>	<b>27</b>	<b>39</b>	<b>27</b>	<b>15</b>	<b>27</b>	<b>39</b>	<b>45</b>	<b>219</b>

Low-1

Medium-3

High-9

**AECC II– Discrete Mathematics  
For B Sc Cyber Security**

(For Students Admitted from 2023-2024)

**Semester: I**

**Subject Code: IBCYA131**

**Hours / week: 5**

**Credit: 4**

**Course Objectives:**

1. To apply the knowledge of abstract mathematical structures
2. To explore the predicate calculus of the statement function and analyse their logical validity

**Unit I**

**(15hours)**

**Set Theory Relations** - Introduction- sets-Venn-Euler diagrams - Operation on sets - Properties of set operations - verification of basic laws of algebra-principle of duality.

**Unit II**

**(15hours)**

**Relations** - Operation on relations - equivalence relation - Closure and Warshall's Algorithm - partitions and Equivalence classes.

**Unit III**

**(15hours)**

**Functions & Mathematical induction** - Functions and Operators - One - One, Ontofunctions - special types of functions - invertible functions - composition of functions. Techniques of proofs - mathematical induction.

**Unit IV** (15hours)

**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** (15hours)

**Matrix algebra** - Introduction- operations-inverse, Rank of matrix - solution of Simultaneous linear 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, Jan 1, 1989.

2. J.K Sharma, *Discrete Mathematics*, Macmillan publishers India Ltd., 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](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							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	3	9	3	3	3	3	1	25
CO2	3	3	3	3	3	3	1	19
CO3	3	3	3	3	3	3	1	19
CO4	3	9	3	3	3	3	3	27
CO5	3	3	3	3	3	3	3	21
<b>Total</b>	<b>15</b>	<b>27</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>9</b>	<b>111</b>

Low-1

Medium-3

High-9

**AECC III –Statistics**  
**For B Sc Cyber Security**  
 (For Students Admitted from 2023-2024)

**Semester: III**  
**Subject Code: IBCYA33**

**Hours / week: 4**  
**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 (12hours)**

**Central Tendencies:** Introduction - Arithmetic Mean - Mode - Geometric Mean and Harmonic Mean.

**Unit II (12hours)**

**Measures of Dispersion:** - Range – Quartile deviation – Mean deviation – Standard deviation -

**Moments, Skewness and Kurtosis:** Moments -Skewness and Kurtosis.

**Unit III (12hours)**

**Correlation and Regression:** Rank correlation Regression - Correlation Coefficient for a Bivariate Frequency Distribution.

**Unit IV (12hours)**

**Index Numbers:** Consumer Price Index Numbers

**Unit V (12hours)**

**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](https://youtu.be/ztIBfKD_eFg)

2. <https://youtu.be/OfANWrzQE9Q>

3. [https://youtu.be/F\\_2GIheAbtI](https://youtu.be/F_2GIheAbtI)

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>27</b>	<b>33</b>	<b>27</b>	<b>15</b>	<b>9</b>	<b>45</b>	<b>45</b>	<b>201</b>

Low-1

Medium-3

High-9

**AECC IV – Operations Research  
For B Sc Cyber Security**

(For Students Admitted from 2023-2024)

**Semester: IV**

**Subject Code: IBCYA43**

**Hours / week: 5**

**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 (15hours)**

**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 (15hours)**

**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  $2 \times n$  and  $m \times 2$  Games – Dominance Property.

**Unit IV (15hours)**

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

**Unit V (15hours)**

**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 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>
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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>27</b>	<b>15</b>	<b>27</b>	<b>15</b>	<b>15</b>	<b>39</b>	<b>27</b>	<b>165</b>

Low-1      Medium-3      High-9

**AECC I – Mathematics-I**  
**For B Sc Chemistry**  
 (For Students Admitted from 2023-2024)

**Semester: I**  
**Subject Code: IBCHA13**

**Hours / week: 5**  
**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** **(15hours)**

**Algebra:** Partial fraction - Binomial series - Application of the binomial theorem to the summation of series - approximation and limits.

**Unit II** **(15hours)**

**Algebra:** Exponential series - Logarithmic series.

**Unit III** **(15hours)**

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** **(15hours)**

**Matrices:** Definition and algebraic operations -Rank of matrix.

**Unit V** **(15hours)**

Trigonometry: Expansions of  $\sin\theta$  and  $\cos n\theta$ - powers of sines and cosines of  $\theta$  in terms of

functions of multiple of  $\theta$ - Expansion of  $\sin\theta$  and  $\cos\theta$  in a series of ascending powers of  $\theta$ - 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(sec1.1-1.2)

**Unit II:** Chapter 1(sec1.3 -1.4)

**Unit III:** Chapter 2(sec2.1 -2.5)

**Unit IV:** Chapter 3(sec3.1-3.2)

**Unit V:** Chapter 5 (sec5.1 -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=x6uB4JfIJHk>
2. <https://www.youtube.com/watch?v=5oDdSb9Jv6c>
3. <https://kanchiuniv.ac.in/coursematerials/expansiontrigonometry.pdf>

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
<b>CO1</b>	9	3	1	3	1	3	1	<b>21</b>
<b>CO2</b>	3	3	1	3	1	3	1	<b>15</b>
<b>CO3</b>	9	9	1	3	3	3	1	<b>29</b>
<b>CO4</b>	9	9	1	3	3	3	3	<b>31</b>
<b>CO5</b>	3	3	1	3	3	3	3	<b>19</b>
<b>Total</b>	<b>33</b>	<b>27</b>	<b>5</b>	<b>15</b>	<b>11</b>	<b>15</b>	<b>9</b>	<b>115</b>
	<b>Low-1</b>		<b>Medium-3</b>			<b>High-9</b>		

**CC II - Mathematics-II**  
**For B Sc Chemistry**

(For Students Admitted from 2023-2024)

**Semester: II**  
**Subject Code: IBCHA23**

**Hours / week: 5**  
**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** **(15hours)**

**Finite Differences:** Forward difference – Backward difference -Interpolation–Newton's Forward interpolation formula – Newton's backward difference formula.

**Unit II** **(15hours)**

**Differential Calculus:** Higher derivatives - Jacobian - polar coordinates.

**Unit III** **(15hours)**

**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  $\int f(x)^n f'(x) dx$ .

**Unit IV** **(15hours)**

**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** **(15hours)**

**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](https://www.youtube.com/watch?v=Gxr3AT4NY_Q)
5. <https://www.maths.usyd.edu.au/MATH2065/r/Week9Lect3.pdf>

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>27</b>	<b>21</b>	<b>9</b>	<b>15</b>	<b>15</b>	<b>21</b>	<b>15</b>	<b>123</b>

Low-1

Medium-3

High-9

### AECC III – Psychological Statistics – Descriptive For B Sc Psychology

(For Students Admitted from 2023-2024)

**Semester: III**  
**Subject Code: IBSYA33**

**Hours / week: 4**  
**Credit: 4**

#### Course Objectives:

1. To analyze data pertaining to discrete and continuous variables and to interpret the results
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 (10hours)**

**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 (12hours)**

**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:** Chapter 1, 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							
	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
<b>Total</b>	<b>15</b>	<b>7</b>	<b>9</b>	<b>9</b>	<b>11</b>	<b>13</b>	<b>27</b>	<b>91</b>

Low-1
Medium-3
High-9

### AECC IV Psychological Statistics-Inferential

#### For B Sc Psychology

(For Students Admitted from 2023-2024)

**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](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](https://www.youtube.com/watch?v=-yQb_ZJnFXw)

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>11</b>	<b>9</b>	<b>15</b>	<b>13</b>	<b>93</b>

Low-1

Medium-3

High-9

**Value Added Programme in LATEX**

(Six Months Regular Programme)  
(For Students Admitted from 2023- 2024)

**PREAMBLE**

1. Reduced the syllabus for the Core Course “Pictures and Colors Lab”.

**PROGRAMME STRUCTURE**

Subject Code	Course	Subject Title	Hours	Credit	ESE
HCLT1	Core I	Documentation Techniques in LATEX	30	5	100
HCLT21P	Core II	Pictures and Colors Lab	50	5	100
		<b>Total</b>	<b>80</b>	<b>10</b>	<b>200</b>

**Core I – Documentation Techniques in LATEX**

(For Students Admitted from 2023-2024)

**Subject Code: HCLT1**

**Hours: 30**

**Credit: 5**

**Course Objectives:**

1. To understand LaTeX, a document preparation system for high – quality typesetting
2. To understand the features of LaTeX

**Unit I**

**(6 hours)**

**Getting Started:** Preparing an Input file-The Input - Sentences and Paragraphs –The Document - Sectioning - Displayed Material - Quotations - Lists - Poetry - Displayed formulas - Declarations - Running LATEX - Helpful hints - Summary.

**Unit II**

**(6 hours)**

**Carrying On:** Changing the Type Style-Symbols from Other Languages - Mathematical formulas - Some common Structures - Mathematical Symbols - Arrays -Delimiters - Multiline formulas - putting one thing above another - Spacing in Math mode -Changing style in Math mode -When all else fails-Defining commands and environments - Figures and Other Floating Bodies - Lining It Up in Columns-Simulating Typed Text.

**Unit III**

**(6 hours)**

**Moving Information Around:** The table of contents – Cross – References -Bibliography and Citation - Splitting Your Input - Making on Index or Glossary - Keyboard Input and Screen Output - Sending Your Document-Other Document Classes: Books - Slides -Letters.

**Unit IV**

**(6 hours)**

**Pictures and Colors:** Pictures - The graphics Package - Color - Errors: Finding the Error - LATEX’s Error Messages –TEX’s Error Messages - LATEX Warnings-TEX Warnings.

**Unit V**

**(6 hours)**

Definitions – Numbering and Programming - Figures and Other Floating Bodies -Lining it up

in Columns - Moving Information Around - Line and Page Breaking - Lengths, Spaces and Boxes - Pictures and Color - Font selection.

**Text Book:**

1. Leslie Lamport, *A Document Preparation System LATEX*, Addison-Wesley, Second Edition, 2009.

**Unit I:** Chapter 2

**Unit II:** Chapter 3

**Unit III:** Chapter 4,5

**Unit IV:** Chapter 7,8

**Unit V:** Chapter Appendix C

**Reference Books:**

1. Helmut Kopka and Patrick W.Daly, *Guide to LATEX*, Addison - Wesley, Fourth Edition, 2003.
2. David F. Griffiths and Desmond J.Higham, *Learning LaTeX*, Siam Society for industrial And Applied mathematics Philadelphia, SecondEdition.
3. Dilip Datta, *LaTeX in 24 Hours - A Practical Guide for Scientific Writing*, Springer2017.

**E- Resources:**

1. <http://www.docs.is.ed.ac.uk/skills/documents/3722/3722-2014.pdf>
2. <https://www.mps.mpg.de/1175947/Graphics-and-Colour-with-LateX.pdf>
3. [https://www.overleaf.com/learn/latex/How\\_to\\_Write\\_a\\_Thesis\\_in\\_LaTeX\\_\(Part\\_2\):\\_Page\\_Layout](https://www.overleaf.com/learn/latex/How_to_Write_a_Thesis_in_LaTeX_(Part_2):_Page_Layout)

**Core II -Pictures and Colors Lab**

(For Students Admitted from 2023-2024)

**Subject Code: HCLT21P**

**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.

XIX ACADEMIC COUNCIL

**B Sc Data Science**

(Three Year Regular Programme)  
(For Students Admitted from 2023-2024)

**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 appropriate, 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

The Board of Studies of Computer Science revamped the curriculum with the following changes

#### Discipline Specific Elective

- “Operating System” in V semester has been removed and “Predictive Analysis” has been introduced
- “Distributed System” in V semester has been removed and “Data Mining” has been introduced
- Modified the syllabus for the Core Courses “ Mathematical Statistics – I” (I - Semester) and “Mathematical Statistics - II” ( II – Semester)
- Reduced the syllabus for the Core Course “ Discrete Mathematics” (II - Semester)

### PROGRAMME STRUCTURE

#### Programme Code: UDS

Sem	Part	Subject code	Course	Subject Title	Hours/Week	Credit	Marks			
							CI A	ES E	Total	
I	I	IBLT11/ IBLA11/ IBLH111	Language I	Tamil I / Arabic I / Hindi I	5	3	25	75	100	
	II	IBLEI12 IBLEII12	Language II	English I a or b	5	3	25	75	100	
	III	IBDSC11	IBDSC11	Core I	o Programming in C	5	4	25	75	100
				Core II	R Programming	6	5	25	75	100
		IBDSA131	AECC I	Mathematical Statistics - I	5	4	25	75	100	
	IV	IBDSS14P	SEC I	Programming in C Lab	2	2		50	50	
			Library / Browsing		1					
			Remedial / Games		1					
			<b>Total</b>		<b>30</b>	<b>21</b>	<b>125</b>	<b>425</b>	<b>550</b>	
II	I	IBLT21/ IBLA21/ IBLH211	Language I	Tamil II / Arabic II / Hindi II	5	3	25	75	100	



	II	IBLEI22/ IBLEII22	Language II	English II a or b	5	3	25	75	100
	III	IBDSC21 1	Core III	Discrete Mathematics	5	5	25	75	100
		IBDSC22	Core IV	Python Programming	4	4	25	75	100
		IBDSA23 1	AECC II	Mathematical Statistics – II	5	4	25	75	100
	IV	IBDSS24 P	SEC II	Data Analytics Lab - I	2	2		50	50
		IBES2	GIC I	Environmental studies	2	2		50	50
		IBDSX2/ IBDSX20	Extra Credit	Arithmetic for Competitive Examinati ons/ *Online Course		2		100	100
			Library/ Browsing		1				
			Remedial/ Games		1				
				<b>Total</b>	<b>30</b>	<b>23+2</b>	<b>125</b>	<b>475 +100</b>	<b>600+ 100</b>
III	I	IBLT31/ IBLA31/ IBLH31	Language I	Tamil III / Arabic III / Hindi III	5	3	25	75	100
	II	IBLEI32/ IBLEII32	Language II	English III a or b	5	3	25	75	100
	III	IBDSC31	Core V	Calculus & Differential Equations	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	IBOE3DS	OEC I		2	2		50	50
		IBDSS34 P	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/ IBDSX3 O	Extra Credit	Logical Reasoning/*Onli ne course		2		100	100
				<b>Total</b>	<b>30</b>	<b>26+2</b>	<b>225</b>	<b>525+ 100</b>	<b>750 + 100</b>
	IV	I	IBLT41/ IBLA41/ IBLH41	Language I	Tamil IV / Arabic IV / Hindi IV	5	3	25	75

	II	IBLEI42 IBLEII42	Language II	English IV a or b	5	3	25	75	100
	III	IBDSC41	Core VII	Matrix Theory & Linear Algebra	4	4	25	75	100
		IBDSC42 1	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
		IBOE4DS	OEC II		2	2		50	50
		IBDSS44 P	SEC IV	Data Analytics Lab - II	2	2		50	50
		IBDSX4/ IBDSX4 O	Extra Credit	Applications of Group Theory /*Online Course		2		100	100
				<b>Total</b>	<b>30</b>	<b>24+2</b>	<b>125</b>	<b>525+ 100</b>	<b>650 + 100</b>
	V	III	IBDSC51	Core IX	Numerical Methods I	6	5	25	75
IBDSC52 1			Core X	o Deep Learning	6	5	25	75	100
IBDSC53			Core XI	Graph Theory	6	5	25	75	100
IBDSE5A / IBDSE51 B			DSE I.a/ DSE I.b	Time series analysis and Forecasting / Predictive Analysis	4	4	25	75	100
IBDSE5C / IBDSE51 D			DSE II.a/ DSE II.b	Operations Research / Data Mining	4	4	25	75	100
IV		IBDSS54 P	SEC V	Programing in Java Lab	2	2		50	50
		IBWE5	GIC IV	Women Entrepreneurship	2	2		50	50
		IBDSX5 O	Extra Credit	Employability Skills/ *Online Course		2	100		100
				<b>Total</b>	<b>30</b>	<b>27+2</b>	<b>125 + 100</b>	<b>475</b>	<b>600 + 100</b>
VI		IBDSC61	Core XII	Numerical Methods II	6	5	25	75	100
	IBDSC62 PW	Core XIII	Project	6	5	25	75	100	

III	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	IBDSS65 P	SEC VI	Data Mining Lab	2	2		50	50
		Library/ Browsing		1				
	IBDSX6/ IBDX6 O	Extra Credit	Quantitative Techniques/* Online Course		2		100	100
			<b>Total</b>	<b>30</b>	<b>24+2</b>	<b>125</b>	<b>425+100</b>	<b>550+100</b>
			<b>Grand Total</b>	<b>180</b>	<b>145 + 10</b>	<b>85+ 100</b>	<b>2850 +400</b>	<b>3700 +500</b>

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

#### Open Elective Course for Students other than B Sc Data Science

Sem	Part	Subject code	Course	Subject Title	Hours / Week	Credit	CIA	ESE	Total Marks
III	IV	IBOE3DS	OEC I	Quantitative Aptitude for Competitive Examinations – I	2	2	-	50	50
IV	IV	IBOE4DS	OEC II	Quantitative Aptitude for Competitive Examinations – II	2	2	-	50	50

**Core I - Programming in C**

(For Students Admitted from 2023-2024)

**Semester: I****Hours/week: 5****Subject Code: IBDSC11****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 statements and program structure of C Language.

**Unit I****(15 hours)**

**Introduction to C Programming:** C Character Set-Writing first program of C - Identifier and- Constants-Variables and Arrays-Declarations-Expressions-Statements-Symbolic constants. **Operators and Expressions:** Arithmetic Operators-Unary Operators-Relational and logical Operators- Assignment Operators- The conditional Operators - Library functions.

**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 – go to statement –

**Functions:** A brief overview – Defining a function – Accessing a function - Function prototypes – Passing arguments to a function – Recursion.

**Unit III****(15 hours)**

**Program Structure:** Storage classes -Automatic - External variables -Static variables- Multi File programs – More about library functions.

**Arrays:** Defining an Array-Processing an Array-Passing arrays to Functions- Multidimensional arrays.

**Unit IV****(15 hours)**

**Strings:** Defining a String – NULL Character – Initialization of Strings – Reading and writing a string – Processing strings – Character arithmetic – Searching and sorting of strings – Some more library Functions forstrings

**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:** Why Files - Opening and closing a Data file -Reading and writing a data file

- Processing a data file - Unformatted data - Concept of binary files - Accessing the file randomly.

### Course Outcomes:

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

**CO 1:** Describe the basic programming knowledge of C, operators and expressions

**CO 2:** Demonstrate data input and output, control statements & functions

**CO 3:** Analyze program structure and arrays

**CO 4:** Evaluate strings and pointers

**CO 5:** Formulate structures, unions and file handling

### Text Book:

1. Byron Gottfried, *Programming with C*, Tata McGraw Hill Education, Fourth Edition, 2018.

### Reference Books:

1. Balagurusamy E, *Programming in ANSI C*, Tata McGraw-Hill Publishing Company, Sixth Edition, 2012.
2. Venugopal K R Sudeep R Prasad, *Programming with C*, Tata McGraw-Hill Publishing Company, 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](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](https://onlinecourses.nptel.ac.in/noc21_cs01/preview)

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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	9	9	45
CO5	9	9	9	3	9	9	9	45
<b>Total</b>	<b>45</b>	<b>21</b>	<b>21</b>	<b>21</b>	<b>45</b>	<b>27</b>	<b>45</b>	<b>225</b>

Low -1

Medium – 3

High – 9

(For Students Admitted from 2023-2024)

**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](https://onlinecourses.nptel.ac.in/noc19_ma33/preview)
2. [https://onlinecourses.nptel.ac.in/noc22\\_ma69/preview](https://onlinecourses.nptel.ac.in/noc22_ma69/preview)
3. [https://onlinecourses.nptel.ac.in/noc22\\_ma34/preview](https://onlinecourses.nptel.ac.in/noc22_ma34/preview)

Course Outcome	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	45	15	15	5	45	45	45	215

Low-1

Medium-3

High-9

**AECC I –Mathematical Statistics - I**

(For Students Admitted from 2023-2024)

**Semester: I**

**Subject Code: IBDSA131**

**Hours / Week: 5**

**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 (18hours)**

**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 (10hours)**

**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 poisson 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, *Fundamentals 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](https://cims.nyu.edu/~cfgranda/pages/stuff/probability%20stats%20for%20DS.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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>21</b>	<b>33</b>	<b>39</b>	<b>45</b>	<b>15</b>	<b>33</b>	<b>27</b>	<b>213</b>

Low-1

Medium-3

High-9

**SEC I- Programming in C Lab**

(For Students Admitted from 2023-2024)

**Semester: I**

**Subject Code: IBDSS14P**

**Hours/week: 2**

**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							Total
	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	
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
<b>Total</b>	45	15	15	5	45	45	45	215

Low-1

Medium-3

High-9

### Core III- Discrete Mathematics

(For Students Admitted from 2023-2024)

**Semester: II**  
**Subject Code: IBDSC211**

**Hours / week: 5**  
**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 (15 hours)**

The Foundation: Logic and Proofs Propositional Logic – Applications of Propositional Logic – Propositional Equivalences – Predicates and Quantifiers – Nested Quantifiers – Rules of Inference – Introduction of proofs.

**Unit II (15 hours)**

**Basic Structures: Sets, Functions, Sequences, Sums and Matrices:** Sets – Set Operations – Functions – Sequences and summations – Cardinality of Sets – Matrices.

**Unit III (15 hours)**

**Induction and Recursion:** Mathematical Induction – Strong induction and well ordering- Recursive Definitions and structural Induction. **Counting:** The Basic of counting –the Pigeonhole Principle - Permutations and combinations – Generalized Permutations and combinations.

**Unit IV (15 hours)**

**Advanced Counting Techniques and Relations:** Applications of Recurrence Relations- Solving Linear Recurrence Relations - Divide and Conquer Algorithms and Recursion Relations - Generating Functions – Inclusion - Exclusion.

**Unit V (15 hours)**

**Relations:** Relations and their Properties –Representing Relations- Closure of Relations- Equivalence Relations–partial ordering.

**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”, Tata Mc Graw- Hill Publishing Company Limited, New Delhi, 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 (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. ThomasKoshy, “Discrete Mathematics with Applications”, Academic Press, 2005.
3. 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](https://en.wikipedia.org/wiki/Discrete_mathematics)

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>27</b>	<b>33</b>	<b>27</b>	<b>15</b>	<b>9</b>	<b>15</b>	<b>15</b>	<b>141</b>

Low-1

Medium-3

High-9

**Core IV – Python Programming**

(For Students Admitted from 2023-2024)

**Semester: II**

**Subject Code: IBDSC22**

**Hours/week: 4**

**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](https://onlinecourses.nptel.ac.in/noc22_cs32/preview)

2. [https://onlinecourses.nptel.ac.in/noc22\\_cs31/preview](https://onlinecourses.nptel.ac.in/noc22_cs31/preview)

Course Outcome	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO								
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
<b>Total</b>	<b>45</b>	<b>15</b>	<b>45</b>	<b>5</b>	<b>45</b>	<b>45</b>	<b>45</b>	<b>245</b>

Low-1

Medium-3

High-9

**AECC II – Mathematical Statistics – II**

(For Students Admitted from 2023-2024)

**Semester: II****Subject Code: IBDSA231****Hours / week: 5****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, *Fundamentals 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 Edition, Reprint 2015.

**E-Resources:**

1. [https://udrc.lkouniv.ac.in/Content/DepartmentContent/SM\\_6dc18628-deb8-41c0-b3e0-7f39c1ca0125\\_38.pdf](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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>15</b>	<b>27</b>	<b>39</b>	<b>31</b>	<b>39</b>	<b>45</b>	<b>45</b>	<b>241</b>

Low-1

Medium-3

High-9

**SEC II - Data Analytics Lab- I**

(For Students Admitted from 2023-2024)

**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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>45</b>	<b>9</b>	<b>45</b>	<b>15</b>	<b>5</b>	<b>45</b>	<b>45</b>	<b>209</b>

Low-1

Medium-3

High-9

**Extra Credit- Arithmetic for Competitive Examinations**

(For Students Admitted from 2023-2024)

**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, 32<sup>nd</sup> Edition.
2. R.S Aggarwal, *Objective Arithmetic (Numerical Ability Test) For Competitive Examinations*, S.Chand and Company Limited.
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://careerdoost.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	3	9	25
CO2	3	3	1	3	3	3	3	9	25
CO3	3	3	1	3	3	3	3	9	25
CO4	3	3	3	3	3	3	3	9	27
CO5	3	3	3	3	3	3	3	9	27
<b>Total</b>	<b>15</b>	<b>15</b>	<b>9</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>45</b>	<b>129</b>

Low-1                  Medium-3                  High-9

**Core V – Calculus & Differential Equations**

(For Students Admitted from 2023-2024)

**Semester: III**  
**Subject Code: IBDSC31**

**Hours / week: 4**  
**Credit: 4**

**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** **(12 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** **(12 hours)**

**Infinite Sequences and Series** : Sequences – Infinite Series - The Integral test – Absolute Convergence - ratio and root tests - Taylor and Maclaurin series.

**Unit III** **(12 hours)**

**Partial Derivatives**: Functions of Several Variables - Partial Derivatives - Extreme Values and Saddle Points.

**Unit IV** **(12 hours)**

**Multiple Integral**: Double integrals in polar form - Triple Integrals in Rectangular Coordinates - Triple Integrals in Cylindrical and Spherical Coordinates.

**Unit V** **(12 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 the problems

**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](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](https://www.youtube.com/watch?v=EzzXTIIX_CU)

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>15</b>	<b>11</b>	<b>5</b>	<b>5</b>	<b>11</b>	<b>15</b>	<b>15</b>	<b>77</b>

Low-1

Medium-3

High-9

**Core VI - Structured Query Language**

(For Students Admitted from 2023-2024)

**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****(12hours)**

**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- Forms of 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, Shamkat B. Navathe, 2013, *Database Systems*, Pearson.
2. Pramod J. Sadalage, Martin Fowler, 2012, *No SQL Distilled*, Addison Wesley.
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](https://onlinecourses.nptel.ac.in/noc21_cs04/preview)

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>45</b>	<b>15</b>	<b>27</b>	<b>5</b>	<b>45</b>	<b>27</b>	<b>15</b>	<b>179</b>

Low-1

Medium-3

High-9

**AECC I -Natural Language Processing**

(For Students Admitted from 2023-2024)

**Semester: III****Subject Code: IBDSA33****Hours/week: 4****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 with 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 Context in 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 Learning Algorithms.

**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							
	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
<b>Total</b>	<b>45</b>	<b>15</b>	<b>15</b>	<b>5</b>	<b>45</b>	<b>15</b>	<b>27</b>	<b>167</b>

Low-1

Medium-3

High-9

**OEC I - Quantitative Aptitude for Competitive Examinations -I**

(For Students Admitted from 2023-2024)

**Semester: III**

**Subject Code: IBOE3DS**

**Hours / week: 2**

**Credit: 2**

**Course Objectives:**

1. To develop analytical and logical skills
2. To manage the crisis of time in aptitude tests

**Unit I**

Percentage - Time and Work.

**(6 hours)**

**Unit II**

Profit and Loss- Formulae -Solved Problems.

**(6 hours)**

**Unit III**

Simple interest - Formulae - Solved Problems.

**(6 hours)**

**Unit IV**

Compound interest - Formulae - Solved Problems.

**(6 hours)**

**Unit V**

Volume and Area of Solid Figures.

**(6 hours)**

**Course Outcomes:**

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

**CO 1:** Solve Time and Work problems by using the formula

**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 thinking ability skills

**CO 5:** Compute the volume and surface area of solids

**Text Book:**

1. R.S.Aggarwal, *Arithmetic Subjective & Objective for Competitive Examinations*, S.Chand & Company Ltd, Reprint, 2009.

**Unit I:** Chapter 6, 11 (Pg. No: 112 - 141 & pg.no 224 -245)

**Unit II:** Chapter 16 (Pg. No: 300 -331)

**Unit III:** Chapter 18 (Pg. No: 348 -361)

**Unit IV:** Chapter 19 (Pg. No: 362 - 379)

**Unit V:** Chapter 21(Pg. No: 419 - 453)

**Reference Books:**

1. Sarvesh Kumar Verma, *The Quantitative Aptitude for CAT*, ArihantPublications Private Limited, Meerut, 1<sup>st</sup> Edition,2009.

2. Chand S *Quantitative Aptitude (Mathematics & Statistics)* S.Chand & Company Ltd., First Edition, 2008.

3. Mark Alan Stewart, *Master the GMAT*, 14<sup>th</sup> 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\\_apititude\\_made\\_easy\\_ugcportal\\_pdf](https://pdfgoal.com/downloads/quantitative_apititude_made_easy_ugcportal_pdf)

4. [https://www.youtube.com/watch?v=\\_cW7\\_BUDYcw](https://www.youtube.com/watch?v=_cW7_BUDYcw)

5. <https://iim-cat-questions-answers.2iim.com/quant/geometry/mensuration>

Course Outcomes	Program Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>15</b>	<b>45</b>	<b>23</b>	<b>45</b>	<b>33</b>	<b>45</b>	<b>45</b>	<b>251</b>

Low-1

Medium-3

High-9

**SEC III – PHP Lab**

(For Students Admitted from 2023-2024)

**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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>45</b>	<b>15</b>	<b>11</b>	<b>13</b>	<b>45</b>	<b>31</b>	<b>13</b>	<b>173</b>

Low-1

Medium-3

High-9

**Extra Credit - Logical Reasoning**

(For Students Admitted from 2023-2024)

**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:** Chapter 16**Reference Books:**

1. Dr R S Aggarwal, *A Modern Approach to Verbal and Non-verbal Reasoning*, S.Chand & Company Private Limited, Edition 2012.
2. Dr R S Aggarwal, *A Modern Approach to Logical Reasoning*, S. Chand & Company Private Limited, Edition 2013.
3. P K Aggarwal, *Test of Verbal Reasoning for Competitive Examinations*, Edition 2004.

**E- Resources:**

1. <https://youtu.be/3hNmmZBN6jw>
2. <https://youtu.be/xmSSMH6RDBQ>
3. <https://youtu.be/aDPu39j-mBY>

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>15</b>	<b>45</b>	<b>5</b>	<b>15</b>	<b>7</b>	<b>15</b>	<b>15</b>	<b>117</b>

Low-1      Medium-3      High-9

**Core VII- Matrix Theory and Linear Algebra**

(For Students Admitted from 2023-2024)

**Semester: IV**  
**Subject Code: IBDSC41**

**Hours / week: 4**  
**Credit: 4**

**Course Objectives:**

1. To understand the basic concepts of matrix algebra and its applications
2. To solve computational problems in linear algebra

**Unit I** **(12hours)**

**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** **(12hours)**

**Determinants:** Basic properties of the determinant - Existence and uniqueness of the determinant - Cofactor expansion – Cramer's rule.

**Unit III** **(12hours)**

**Vector spaces:** The n-space and vector spaces-Subspaces - Bases - Dimensions - Row and column spaces - Rank and nullity - Bases for subspaces - Invertibility.

**Unit IV** **(12hours)**

**Linear Transformations:** Basic properties of linear transformations - Invertible linear transformations - Matrices of linear transformations - vector spaces of linear transformations-change of bases.

**Unit V****(12hours)**

**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](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							
	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
<b>Total</b>	<b>15</b>	<b>33</b>	<b>15</b>	<b>15</b>	<b>7</b>	<b>15</b>	<b>13</b>	<b>113</b>

Low-1

Medium-3

High-9

### Core VIII - Machine Learning & Artificial Intelligence

(For Students Admitted from 2023-2024)

Semester: IV

Subject Code: IBDSC421

Hours/week: 5

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)

**Market 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, Jiawei and Kamber, Micheline, 2012, *Data Mining: Concepts and Techniques*, Morgan Kaufman Publishers.
2. Anand Rajaraman, 2011, *Mining of Massive Data sets*, Cambridge University Press.
3. Mitchell, 2013, *Machine Learning*, McGraw Hill.
4. Stuart Russell, Peter Norvig, 2004, *Artificial Intelligence – A Modern Approach*, Pearson.

**E-Resources:**

1. [https://onlinecourses.nptel.ac.in/noc21\\_cs42/preview](https://onlinecourses.nptel.ac.in/noc21_cs42/preview)
2. [https://onlinecourses.nptel.ac.in/noc22\\_cs24/preview](https://onlinecourses.nptel.ac.in/noc22_cs24/preview)

Course Outcomes	Programme Outcomes							Total	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7		
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	
<b>Total</b>	<b>45</b>	<b>15</b>	<b>45</b>	<b>5</b>	<b>45</b>	<b>45</b>	<b>45</b>	<b>245</b>	
	Low-1		Medium-3			High-9			

**AEEC II -Big Data Analytics**

(For Students Admitted from 2023-2024)

**Semester: IV**  
**Subject Code: IBDSA43****Hours/week: 5**  
**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- Anatomy of 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 with Hive & 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-On Approach*, 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 Your Planet-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							
	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
<b>Total</b>	<b>45</b>	<b>15</b>	<b>27</b>	<b>5</b>	<b>45</b>	<b>39</b>	<b>33</b>	<b>209</b>

Low-1

Medium-3

High-9

**OEC II - Quantitative Aptitude for Competitive Examinations-II**

(For Students Admitted from 2023-2024)

**Semester: IV****Hours/week: 2****Subject Code: IBOE4DS****Credit: 2****Course Objectives:**

1. To get the aptitude knowledge required for competitive examination and provides a well-Knitted path to success
2. To enrich their knowledge and to develop their logical reasoning thinking ability

**Unit I****(6hours)****Ratio, Proportion, Indices and logarithm: Problems.**

**Unit II****(6hours)**

**Basic concepts of Permutations and Combinations:** Fundamental Principles of counting - Factorial - Permutations - Circular Permutations - Combinations.

**Unit III****(6 hours)**

**Sequence and Series:** Progressions - Arithmetic Progression (A.P) - Geometric Progression (G.P) - Harmonic progression (H.P) - Some special sequences.

**Unit IV****(6 hours)**

**Set:** Meaning of a set - Methods of writing a set - Types of sets - Some operations on sets - Some results on complementation - Laws of Operations -Some important results - Venn diagram and some of the Applications of Set Theory.

**Unit V****(6 hours)**

**Probability:** Definition of Probability - Importance of the concept of Probability - Classical or a Priori Probability approach - Modern definition of Probability -Objective approach and Subjective approach to Probability - Experiment - Event - Types of events -theorems of probability.

**Course Outcomes:**

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

**CO 1:** Make use of the concepts of indices and logarithms, solve the problems

**CO 2:** Identify the concepts of permutation and circular permutation

**CO 3:** Discover the basic concepts of arithmetic progression and geometric progression

**CO 4:** Evaluate the skills of the application of set theory

**CO 5:** Justify the basic concept of Random events, axioms of probability and independent events

**Text Book:**

1. Bharat Jhunjhunwala, *Quantitative Aptitude (Mathematics & Statistics) for CA Common Proficiency Test (CPT)*, S. Chand and Company Limited – First Edition, 2008.

**Unit I:** Chapter 1 (1- 4)

**Unit II:** Chapter 5 (1 -5)

**Unit III:** Chapter 6 (3 -7)

**Unit IV:** Chapter 7A (1- 8)

**Unit V:** Chapter 9 section B (Pg.No: 9.1 – 9.21)

**Reference Books:**

1. R. Gopal, Prof. J. V. Subrahmanyam, *Arithmetic & Quantitative Aptitude for Competitive Exams*, Sura College of Competition.
2. Ashish Aggarwal, *Quick Arithmetic*, S.Chand Publications, 2<sup>nd</sup> Edition 2007.
3. Dr.R.S.Aggarwal, *Quantitative Aptitude*, S.Chand publications, 7<sup>th</sup> Edition, 2015.

**E- Resources:**

1. <https://www.youtube.com/watch?v=oGT0AOihPr8>
2. <https://www.youtube.com/watch?v=jxIWNJ1MghA>
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							
	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
<b>Total</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>9</b>	<b>15</b>	<b>21</b>	<b>105</b>

Low-1      Medium-3      High-9

### SEC IV - Data Analytics Lab II

(For Students Admitted from 2023-2024)

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							
	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
<b>Total</b>	45	9	45	15	5	45	45	<b>209</b>

Low-1                      Medium-3                      High-9

### Extra Credit – Applications of Group Theory

(For Students Admitted from 2023-2024)

**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							
	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
<b>Total</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>39</b>	<b>15</b>	<b>33</b>	<b>147</b>

Low-1

Medium-3

High-9

**Core IX - Numerical Methods - I**

(For Students Admitted from 2023-2024)

**Semester: V****Subject Code: IBDSC51****Hours/ week: 6****Credit: 5****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:** Errors and their Computations - A General Error Formula - Error in a Series Approximation. **Solution of Algebraic and Transcendental equations:** Introduction - Bisection method - Method of False position.

**Unit II****(18 hours)**

**Solution of Algebraic and Transcendental equations:** Iteration method - Newton - Raphson method – Ramanujam’s method - Secant method.

**Unit III (18 hours)**

**Solution of Algebraic and Transcendental equations:** Muller’s method – Graeffe’s Root - Squaring method - Lin- Barstow’s method - Quotient - Difference method - Solution to Systems of Nonlinear Equations - Method of Iteration - Newton-Raphson method.

**Unit IV (18hours)**

**Interpolation:** Introduction - Errors in Polynomial Interpolation - Finite Differences: Forward Differences - Backward Differences - Central Differences - Symbolic Relations and Separation of Symbols - Detection of Errors by use of Difference Tables - Differences of a Polynomial – Newton’s Formulae for Interpolation. **Central Difference Interpolation Formulae:** Gauss Central Difference Formulae-Stirling’s formula – Bessel’s formula – Everett’s formula - Relation between Bessel’s and Everett’s Formulae.

**Unit V (18 hours)**

**Interpolation:** Practical Interpolation - Interpolation with Unevenly Spaced Points: Lagrange’s interpolation Formula - Error in Lagrange’s Interpolation Formula – Hermite’s Interpolation Formula - Divided Difference and their properties: Newton’s General Interpolation Formula - Interpolation by Iteration - Inverse Interpolation- Double Interpolation.

**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 solution to systems of Nonlinear Equations

**CO 3:** Apply the concept of finite differences 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 solutions of ordinary differential 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- 2.3)

**Unit II:** Chapter 2 (2.4 – 2.7)

**Unit III:** Chapter 2 (2.8 – 2.12)

**Unit IV:** Chapter 3 (3.1–3.7)

**Unit V:** Chapter 3 (3.8–3.12)

**Reference Books:**

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 6<sup>th</sup> Edition, New age International Publisher, India, 2007.
2. E.Balagurusamy, *Numerical Methods*, TataMcGraw HillPrivateLimited, 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 Outcome	Programme Outcomes							
	PO	PO2	PO3	PO4	PO5	PO6	PO7	Tota
CO 1	3	3	1	3	9	9	9	37
CO 2	3	3	9	3	9	9	9	45
CO 3	3	3	9	3	9	9	9	45
CO 4	3	3	3	3	9	3	3	27
CO 5	3	3	3	3	9	3	3	27
<b>Total</b>	<b>15</b>	<b>15</b>	<b>25</b>	<b>15</b>	<b>45</b>	<b>33</b>	<b>33</b>	<b>181</b>
	Low-1		Medium-3			High-9		

### Core X - Deep Learning

(For Students Admitted from 2023-2024)

**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](https://onlinecourses.nptel.ac.in/noc20_cs62/preview)
2. <https://nptel.ac.in/courses/106106184>

Course Outcome	Programme Outcomes							
	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
<b>Total</b>	<b>45</b>	<b>15</b>	<b>45</b>	<b>5</b>	<b>45</b>	<b>45</b>	<b>45</b>	<b>245</b>

Low-1

Medium-3

High-9

**DSE-II –Graph Theory**

(For Students admitted from 2023-24)

**Semester: V****Subject Code: IBDSC53****Hours/week: 6****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****(18hours)**

**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 International Edition, 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							
	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
<b>Total</b>	<b>15</b>	<b>15</b>	<b>27</b>	<b>13</b>	<b>15</b>	<b>9</b>	<b>15</b>	<b>109</b>
	<b>Low-1</b>		<b>Medium-3</b>			<b>High-9</b>		

**DSE I. a) -Time Series Analysis and Forecasting**

(For Students Admitted from 2023-2024)

**Semester: V**

**Subject Code: IBDSE5A**

**Hours/week: 4**

**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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>45</b>	<b>9</b>	<b>25</b>	<b>9</b>	<b>9</b>	<b>17</b>	<b>45</b>	<b>159</b>

Low-1

Medium-3

High-9

**DSE I - b) Predictive Analysis**

(For Students Admitted from 2023-2024)

**Semester: V****Subject Code: IBDSE51B****Hours/week: 4****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 the 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](https://onlinecourses.nptel.ac.in/noc23_ma46/preview)

Course Outcome	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO								
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
<b>Total</b>	<b>45</b>	<b>9</b>	<b>25</b>	<b>9</b>	<b>9</b>	<b>17</b>	<b>45</b>	<b>159</b>

Low-1

Medium-3

High-9

**DSE II. a) – Operations Research**

(For Students Admitted from 2023-2024)

**Semester: V**  
**Subject Code: IBDSE5C****Hours / week: 4**  
**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****(12hours)**

**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****(12hours)**

**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****(12hours)**

**Transportation Model and Its Variants:** Definition of the Transportation Model - Nontraditional Transportation Models -The Transportation Algorithm - The Assignment Model.

**Unit IV****(12hours)**

**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  $2 \times n$  and  $m \times 2$  Games - Dominance Property.

**Unit V****(12hours)**

**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, 10<sup>th</sup>

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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>15</b>	<b>39</b>	<b>15</b>	<b>27</b>	<b>39</b>	<b>39</b>	<b>33</b>	<b>207</b>

Low-1 Medium-3 High-9

### DSE II - b) Data Mining

(For Students Admitted from 2023-2024)

**Semester: V**

**Subject Code: IBDSE51D**

**Hours/Week: 4**

**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, 3<sup>rd</sup> 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](https://onlinecourses.nptel.ac.in/noc21_cs06/preview)

Course Outcomes	Programme Outcomes							
	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
<b>Total</b>	<b>45</b>	<b>27</b>	<b>15</b>	<b>5</b>	<b>45</b>	<b>27</b>	<b>45</b>	<b>209</b>

Low-1

Medium-3

High-9

**SEC V– Programming in Java Lab**

(For Students Admitted from 2023-2024)

**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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>45</b>	<b>33</b>	<b>27</b>	<b>33</b>	<b>45</b>	<b>33</b>	<b>45</b>	<b>261</b>

Low-1      Medium-3      High-9

**Core XII –Numerical Methods II**

(For Students Admitted from 2023-2024)

**Semester: VI**

**Subject Code: IBDSC61**

**Hours / week: 6**

**Credit: 5**

**Course Objectives:**

1. To derive numerical methods for differentiation and integration
2. To derive appropriate solutions for Numerical Linear Algebra, Numerical solution to Ordinary Differential Equations, Numerical Solution of Partial Differential Equations, and Numerical Solution of Integral Equations

**Unit I**

**(18 hours)**

**Spline Functions:** Introduction - Linear Splines - Quadratic Splines - Cubic Splines:

Minimizing Property of Cubic Splines - Error in the cubic spline and its derivatives - Surface Fitting by Cubic Splines.

**Numerical Differentiation and Integration:** Introduction - Numerical Differentiation:

Errors in numerical differentiation - Cubic Splines method - Differentiation formulae with function values – Maximum and Minimum values of a tabulated function.

**Unit II**

**(18hours)**

**Numerical Differentiation and Integration:** Numerical Integration: Trapezoidal Rule –

Simpson's 1/3-Rule-Simpson's 3/8 -Rule-Boole's and Weddle's Rules – Use of Cubic Splines

-Romberg Integration -Newton - Cotes Integration Formulae - Euler - Maclaurin Formula -

Numerical Integration with different Step Sizes - Gaussian integration - Generalized Quadrature.



**Unit III (18 hours)**

**Numerical Linear Algebra:** Introduction -Triangular Matrices - LU Decomposition of a Matrices - Vector and Matrix Norms - Solution of Linear systems: Direct Methods - Gauss Elimination - Necessity for pivoting - Gauss-Jordan Method - Modification of the Gauss Method to compute the Inverse - Number of Arithmetic Operations - LU Decomposition method –Computational Procedure for LU Decomposition method - LU Decomposition from Gauss Elimination -Solution of Tridiagonal Systems - III-conditioned Linear Systems - Method for III- conditioned Systems.

**Unit IV (18 hours)**

**Numerical solution of Ordinary Differential Equations:** Introduction Solution by Taylor's series– Picard's method of Successive Approximations–Euler's method: Error estimates for the Euler method - Modified Euler's method - Runge-Kutta Methods - Predictor-Corrector Methods - Adams- Moulton Method – Milne's Method – Cubic Spline method.

**Unit V (18 hours)**

**Numerical Solution of Partial Differential Equations:** Introduction – Laplace's Equation - Finite - difference Approximations to Derivatives - Solution of Laplace's Equation: Jacobi method - Gauss - Seidel method - Successive over Relaxation (SOR) method - ADI method.  
**Numerical Solution of Integral Equations:** Introduction - Numerical methods for Fredholm Equations: Method of Degenerate Kernels - Method of Successive Approximations - Quadrature Methods - Use of Chebyshev Series - Cubic Spline Method

**Course Outcomes:**

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

**CO 1:** Assess the solution for Spline functions and Numerical differentiation

**CO 2:** Evaluate the solution to Numerical Integration

**CO 3:** Solve the problem using the methods of Gauss elimination, Gauss- Jordan Methods

**CO 4:** Applying the method of numerical solutions of ordinary differential equation to examine the problem

**CO 5:** Solve the problems in Numerical Solutions of Partial Differential Equations and Integral Equations

**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 5 (5.1 – 5.3), 6 (6.1 – 6.3)

**Unit II:** Chapter 6 (6.4 –6.8)

**UnitIII:** Chapter 7 (7.1–7.5)

**UnitIV:** Chapter 8 (8.1–8.7)

**Unit V:** Chapter 9 (9.1 – 9.4), 10 (10.1 – 10.2)

**Reference Books:**

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering Computation*, 6<sup>th</sup> Edition, New Age International Publisher, India,2007.
2. E. Balagurusamy, *Numerical Method*, Tata McGraw Hill Publication.
3. ShankaraRao 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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
CO1	3	3	9	3	9	9	9	45
CO2	3	3	9	3	9	9	9	45
CO3	3	3	9	3	9	9	9	45
CO4	3	3	3	3	3	3	3	21
CO5	3	3	3	3	3	3	3	21
<b>Total</b>	<b>15</b>	<b>15</b>	<b>33</b>	<b>15</b>	<b>33</b>	<b>33</b>	<b>33</b>	<b>177</b>

Low-1

Medium-3

High-9

**Core XIII – Project**

(For Students Admitted from 2022 -23)

**Semester: VI****Subject Code: IBDS62PW****Hours/Week: 6****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							
	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
<b>Total</b>	<b>45</b>	<b>2</b>	<b>45</b>	<b>3</b>	<b>45</b>	<b>39</b>	<b>45</b>	<b>285</b>

Low-1

Medium-3

High-9

### Core XIV- Computer Vision

(For Students Admitted from 2023-2024)

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. Forsyth and 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. Gonzalez. (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](https://onlinecourses.nptel.ac.in/noc19_cs58/preview)

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>45</b>	<b>15</b>	<b>33</b>	<b>5</b>	<b>45</b>	<b>45</b>	<b>45</b>	<b>233</b>

Low-1

Medium-3

High-9

**Core XV- Regression Analysis**  
(For Students Admitted from 2023-2024)

**Semester: VI**  
**Subject Code: IBDSC64**

**Hours/week: 6**  
**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*, 8<sup>th</sup> Edition, John Wiley & Sons, Inc, 2012.
2. Montgomery. A, *Introduction to Linear Regression Analysis*, John Wiley & Sons Canada Limited, 6<sup>th</sup> Edition.
3. Samprit Chatterjee, Jeffrey S. Simonoff, *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](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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>15</b>	<b>9</b>	<b>21</b>	<b>13</b>	<b>7</b>	<b>15</b>	<b>15</b>	<b>95</b>
	Low-1		Medium-3			High-9		

**DSE III. a) Data Structures and Algorithms**

(For Students Admitted from 2023-2024)

**Semester: VI**

**Subject Code: IBDSE6A**

**Hours / week: 4**

**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 (12hours)**

**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, 4<sup>th</sup> Edition, 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,



- 2<sup>nd</sup> Edition, New Delhi, 1992.
- Alfred V. Aho Johne, Hopcroft, *Data Structures and Algorithm*, 3<sup>rd</sup> Edition, Addison-Wesley, 2012.
  - S.Sridhar, *Design and Analysis of Algorithms*, 2014.

**E-Resources:**

- <http://www.math.tau.ac.il/~matias/ds03.html>
- [https://onlinecourses.nptel.ac.in/noc20\\_cs70/preview](https://onlinecourses.nptel.ac.in/noc20_cs70/preview)
- [https://www.tutorialspoint.com/python\\_data\\_structure/python\\_data\\_structure\\_tutorial.pdf](https://www.tutorialspoint.com/python_data_structure/python_data_structure_tutorial.pdf)

Course Outcomes	Programme Outcomes							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>45</b>	<b>11</b>	<b>23</b>	<b>23</b>	<b>25</b>	<b>15</b>	<b>13</b>	<b>155</b>

Low-1

Medium-3

High-9

**DSE III. b) - Database Security**

(For Students Admitted from 2023-2024)

**Semester: VI**  
**Subject Code: IBDSE6B**

**Hours / week: 4**  
**Credit: 4**

**Course Objectives:**

- To understand the fundamentals of security, and how it relates to information Systems
- 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							
	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

<b>Total</b>	<b>45</b>	<b>15</b>	<b>15</b>	<b>11</b>	<b>45</b>	<b>17</b>	<b>13</b>	<b>161</b>
	<b>Low-1</b>		<b>Medium-3</b>		<b>High-9</b>			

### SEC VI - Data Mining Lab

(For those who joined since 2023-2024)

**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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>45</b>	<b>9</b>	<b>45</b>	<b>15</b>	<b>5</b>	<b>45</b>	<b>45</b>	<b>209</b>

Low-1                      Medium-3                      High-9

### Extra Credit – Quantitative Techniques

(For Students Admitted from 2023-2024)

**Semester: VI**

**Subject Code: IBDSX6**

**Credit: 2**

#### Course Objectives:

1. To understand operations, research techniques used for planning, scheduling and 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:** Chapter 16

### 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/introductory-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							Total
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	
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
<b>Total</b>	<b>27</b>	<b>15</b>	<b>27</b>	<b>15</b>	<b>15</b>	<b>39</b>	<b>27</b>	<b>165</b>

Low-1

Medium-3

High-9

XIX ACADEMIC COUNCIL