Department of Mathematics

(For Students Admitted from 2022-23)

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 2022-23)

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 Algebra (I Semester), Linear Algebra (II Semester), Analysis I (I Semester), Analysis II (II Semester), Classical Mechanics (III Semester) and Functional Analysis (III Semester).
2. The core course Differential Geometry in the II semester is changed to I semester.
3. The core course Complex analysis in the IV semester is changed to II semester.
4. The core course Measure and Integration in the I semester is changed to IV semester.
5. The topic of the Discipline Specific Elective course Numerical Analysis has changed to Numerical Methods (I Semester).
6. The topic of the extra credit course Fuzzy Analysis has changed to Fuzzy Sets and Relations (I Semester).
7. Included second order partial differential equation in the core course Ordinary and Partial Differential Equations (I Semester).
8. The topic of the Discipline Specific Elective course Probability and Statistics has changed to Probability and Applied Statistics (II Semester).
9. Introduced integrated courses Algebra and Probability and Statistics in I and III semesters.
10. Introduced internship for the course Web Designing Lab in the II semester.

PROGRAMME STRUCTURE, Program Code:PMX

Sem	Subject Code	Course	Subject Title	Hours/ Week	Credit	CIA	ESE	Total Marks
I	HMMXC11	Core I	○ Algebra	6	5	40	60	100
	HMMXC12	Core II	Analysis-I	6	5	40	60	100
	HMMXC13	Core III	Ordinary and Partial Differential Equations	6	5	40	60	100
	HMMXC14	Core IV	Measure and Integration	6	5	40	60	100
	HMMXE1A/ HMMXE1B	DSE I	Numerical Methods/ Stochastic Process	6	5	40	60	100
	HMMXX1/ HMMXX1O	Extra credit	Fuzzy Sets and Relations / * Online Course		2		100	100
		Total		**30**	**25+2**	**200**	**300+100**	**500+100**
II	HMMXC21	Core V	Linear Algebra	6	5	40	60	100
	HMMXC22	Core VI	Analysis-II	6	5	40	60	100
	HMMXC23	Core VII	Topology-I	6	5	40	60	100
	HMMXC24	Core VIII	Complex Analysis	6	5	40	60	100
	HMMXE2A/ HMMXE2BP	DSE II	Graph Theory/ # Web Designing Lab	6	5	40	60	100
	HMMXX2P/ HMMXX2O	Extra credit	Village Placement Programme / * Online Course		2		100	100
		Total		**30**	**25+2**	**200**	**300+100**	**500+100**
III	HMMXC31	Core IX	Functional Analysis	6	5	40	60	100
	HMMXC32	Core X	Topology-II	6	5	40	60	100
	HMMXC33	Core XI	Classical Mechanics	6	5	40	60	100
	HMMXC34	Core XII	○ Probability and Statistics	6	5	40	60	100
	HMMXE3AP / HMMXE3B	DSE III	Statistics through R Tool Lab / Operations Research	6	5	40	60	100
	HMMXX3/ HMMXX3O	Extra credit	Employability Skills/ * Online Course		2	100		100
		Total		**30**	**25+2**	**200 + 100**	**300**	**500+100**

IV	HMMXC41	Core XIII	Differential Geometry	6	5	40	60	100
	HMMXC42	Core XIV	Advanced Statistics	6	5	40	60	100
	HMMXC43PW	Core XV	Project	18	5	100	100	200
	HMMXX4/ HMMXX4O	Extra credit	Communication Skills/ * Online Course		2		100	100
	Total			**30**	**15+2**	**180**	**220+100**	**400+100**
	Grand total			**120**	**90+8**	**780+ 100**	**1120+ 300**	**1900+ 400**

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

○ Integrated Course

Internship Training

DSE COURSE FOR OTHER PG PROGRAMME FOR M SC IT

Sem	Subject Code	Course	Subject Title	Hours / Week	Credits	CIA	ESE	Total
II	HMITE2A	DSE II	Probability and Applied Statistics	6	5	40	60	100

DSE - Discipline Specific Elective

DSE COURSE FOR OTHER PG PROGRAMME FOR MCA

Sem	Subject Code	Course	Subject Title	Hours / Week	Credits	CIA	ESE	Total
II	IMCAE2A	DSE II	Probability and Applied Statistics	6	5	40	60	100

DSE - Discipline Specific Elective

Core I –Algebra

(For Students Admitted from 2022-23)

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

Subject Code: HMMXC11 **Credit: 5**

Course Objectives:

1. To understand the fundamental concepts of abstract algebra including sylow theorems and relative concept to the direct products and abelian groups
2. To develop the ability to form and evaluate group theory and ring theory

Unit I **(18 hours)**

Group Theory: Another Counting Principle – Sylow's Theorem.

Unit II **(16 hours)**

Group Theory: Direct Products - Finite Abelian Groups.

Unit III **(17 hours)**

Ring Theory: Euclidean Rings - A Particular Euclidean Ring - Polynomial Rings - Polynomials over the Rational Field.

Unit IV **(21 hours)**

Ring Theory: Polynomial Rings over Commutative Rings - **Vector Space and Modules:** Dual Spaces - Modules.

Unit V **(18 hours)**

Fields: Extension Fields - The Transcendence of e - Roots of polynomials - More about Roots.

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. I.N. Herstein, *Topics in Algebra,* Wiley Eastern Limited, New Delhi, Second Edition, Sixteenth Reprint, 2015.

Unit I: Chapter 2 (Sections 2.11 & 2.12)
Unit II: Chapter 2 (Sections 2.13 & 2.14)
Unit III: Chapter 3 (Sections 3.7 – 3.10)
Unit IV: Chapter 3 (Sections 3.11) & Chapter 4 (Sections 4.3, 4.5).
Unit V: Chapter 5 (Sections 5.1 - 5.3, 5.5)

Reference Books:

1. Surjeet Singh and Zameerudin, *Modern Algebra,* Wiley India New Delhi, First Edition, 2008.
2. William J. Gilbert, *Modern Algebra with Applications,* Wiley India Private Limited, 2008.
3. M.L. Santiago, *Modern Algebra,* Tata McGraw Hill Publishing Co. Ltd., New Delhi.
4. Vivek Sahai and Vivek Bist, *Algebra,* Nulrosa Publishing House, 1999.

E-Resources:

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

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

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

Core II – Analysis – I

(For Students Admitted from 2022-23)

Semester: I **Hours / week: 6**
Subject Code: HMMXC12 **Credit: 5**

Course Objectives:

1. To know the genuine differences that appear when we pass from real functions to vector valued ones
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

CO 1: Classify the basic features of real and complex number system, countable and uncountable sets

CO 2: Categorize the sets of Basic Topology

CO 3: Prove the theorem using the concepts of monotonic functions

CO 4: 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 Publising 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/lZm8AQAAQBAJ?hl=en&gbpv=1&dq=Analysis+Mathematics&printsec=frontcover
2. https://www.youtube.com/watch?v=kOa6qhgYrI0
3. https://www.youtube.com/watch?v=fh1AQkR_4yU
4. https://www.youtube.com/watch?v=LUKfrjpDHTk

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

Low-1 Medium-3 High-9

Core III - Ordinary and Partial Differential Equations

(For Students Admitted from 2022-23)

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

Subject Code: HMMXC13 **Credit: 5**

Course Objectives:

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

Unit I **(18 hours)**

Linear Equations with Variable Coefficients: Introduction - Initial value Problems for the homogeneous equation - Solutions of the homogeneous equation - The Wronskian and linear independence - Reduction of the order of a homogeneous equation - The non-homogeneous equation - Homogeneous equations with analytic coefficients - The Legendre equation - Justification of the power series method.

Unit II **(18 hours)**

Linear Equations with Regular Singular Points: The Euler equation - Second order equations with regular singular points-an example - Second order equations with regular singular points - the general case - A convergence proof - The exceptional cases - The Bessel equation - Regular Singular points at infinity.

Unit III **(18 hours)**

Existence and Uniqueness of Solutions to First Order Equations: Equations with variables separated - Exact equations -The method of successive approximations - The Lipschitz condition - Convergence of the successive approximations - Non-local existence of solutions - Approximation to and uniqueness of solutions - Equations with complex-valued functions.

Unit IV **(18 hours)**

Partial Differential Equations of the First Order: Origins of First - Order Partial Differential Equations – Cauchy's Problem for First-order Equations - Linear Equations of the First Order - **Partial Differential Equations of the Second Order:** The Origin of Second order Equations - Linear Partial Differential Equations with Constant Coefficients - Equations with Variable Coefficients.

Unit V **(18 hours)**

Partial Differential Equations of the First Order: Integral surfaces passing through a Given Curve - Surfaces Orthogonal to a Given System of Surfaces - Nonlinear Partial Differential Equations of the First Order – Cauchy's Method of Characteristics - Compatible Systems of First Order Equations - Special Types of First order Equations - Solutions Satisfying Given Conditions – Jacobi's Method.

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. Earl A. Coddington, *An Introduction to Ordinary Differential Equations,* Prentice Hall of India Private Limited, 2001.

Unit I: Chapter 3 Full
Unit II: Chapter 4 Full
Unit III: Chapter 5 Full

2. Ian Sneddon, *Elements of Partial Differential Equations,* McGraw Hill International Edition, 2006.

Unit IV: Chapter 2 (Section 1 – 4) & Chapter 3 (Section 1, 4, 5)
Unit V: Chapter 2 (Section 5 – 9 & 11 – 13)

Reference Books:

1. Phoolan Prasad and Renuka Ravindran, *Partial Differential Equations,* New Age International (P) Ltd., First Edition, 1996.
2. Nita H.Shah, *Ordinary and Partial Differential Equations Theory and Applications,* PHI Learning Pvt., Ltd., New Delhi, 2010.
3. B Rai D P Choudhury, *Ordinary Differential Equations An Introduction,* Naroso Publishing House Pvt., Ltd., New Delhi, First Edition, 2006.

E-Resources:

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

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

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

Core IV –Measure and Integration

(For Students Admitted from 2022-23)

Semester: I **Hours / week: 6**
Subject Code: HMMXC14 **Credit: 5**

Course Objectives:

1. To understand the abstract measure theory, definition and main properties of the integral

2. To construct Lebesgue's measure on the real line and in n-dimensional Euclidean space

Unit I **(18 hours)**

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

Unit II **(18 hours)**

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

Unit III **(18 hours)**

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

Unit IV **(18 hours)**

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

Unit V **(18 hours)**

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

Course Outcomes:

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

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

Text Book:

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

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

Reference Books:

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

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

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

Low-1 Medium-3 High-9

DSE I - Numerical Methods

(For Students Admitted from 2022-23)

Semester: I **Hours / week: 6**
Subject Code: HMMXE1A **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)**

System of Linear Algebraic Equations and Eigen value problems: Iteration Methods: Jacobi Iteration Method - Gauss Seidel Iteration Method - Successive over Relaxation (SOR) 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 and Integration: Numerical Differentiation - Interpolation - Partial differentiation - Numerical 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/0rtaUUonwkU
3. https://www.google.com/url?sa=t&source=web&rct=j&url=https://en.m.wikipedia.org/wiki/Numerical_methods_for_ordinary_differential_equations&ved=2ahUKEwj-rdSN9v_wAhU_7HMBHSisD7YQFjAPegQIKhAC&usg=AOvVaw3WOZRQgzKnThjh3zh_UVv4.

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

Low-1 Medium-3 High-9

DSE I - Stochastic Process

(For Students Admitted from 2022-23)

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

Subject Code: HMMXE1B **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 queuing theory

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

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

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

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

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

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

Extra credit - Fuzzy Sets and Relations

(For Students Admitted from 2022-23)

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

Course Objectives:
1. To introduce the concept of fuzzy set theory and their basic operations

2. To understand the concepts and properties of fuzzy relations and fuzzy graphs

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

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

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

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

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

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Categorize the Crisp sets and fuzzy sets
CO 2: Apply the Basic Concepts of fuzzy logic in fuzzy sets
CO 3: Analyze the application of fuzzy logic to real time systems
CO 4: Make use of operations on fuzzy sets
CO 5: Compute fuzzy relations on a single set

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

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

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

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

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

Low-1 Medium-3 High-9

Core V – Linear Algebra

(For Students Admitted from 2022-23)

Semester: II **Hours / week: 6**
Subject Code: HMMXC21 **Credit: 5**

Course Objectives:
1. To comprehend matrices as linear transformations between vector spaces
2. To introduce the basic concepts and methods in the study of Linear Transformation on finite dimensional Vector spaces and Canonical forms

Unit I **(16 hours)**
Linear Transformations: Isomorphism - Representation of Linear Transformations by Matrices - Linear Functionals.

Unit II **(16 hours)**
Polynomials: Algebras - The Algebra of Polynomials - Lagrange Interpolation - Polynomial Ideals - The Prime Factorization of a Polynomial.

Unit III **(18 hours)**
Determinants: Commutative Rings - Determinant Functions - Permutations and the Uniqueness of Determinants - Additional Properties of Determinants.

Unit IV **(19 hours)**
Elementary Canonical Forms: Annihilating Polynomials - Invariant Subspaces - Simultaneous Triangulation; Simultaneous Diagonalization - Direct-Sum Decompositions.

Unit V **(21 hours)**
Elementary Canonical Forms: Invariant Direct sums - The Primary Decomposition theorem. **Bilinear forms**: Introduction - Symmetric Bilinear Forms.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Analyze the concept of linear transformation
CO 2: Compute the solution of the problems in polynomials
CO 3: Recapitulate the theoretical concepts of Determinants
CO 4: Explore the concept of Elementary Canonical Forms
CO 5: Infer on the different forms of Bilinear forms

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

Unit I: Chapter 3 (Sections 3.3 – 3.5)
Unit II: Chapter 4 (Sections 4.1 - 4.5)
Unit III: Chapter 5 (Sections 5.1 - 5.4)
Unit IV: Chapter 6 (Sections 6.3 - 6.6)
Unit V: Chapter 6 (Sections 6.7 & 6.8) Chapter 10 (Sections 10.1 &10.2)

Reference Books:
1. Dr M K Venkataraman, *Linear Algebra*, The National Publishing Company, 1999.
2. Gilbert Strang, *Linear Algebra and its Applications*, Cengage Learning India Private Limted, Fourth Edition, 2014.
3. I.N. Herstein, *Topics in Algebra*, Wiley Eastern Limited, New Delhi, 2015.

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

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

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

Core VI- Analysis – II

(For Students Admitted from 2022-23)

Semester: II **Hours / week: 6**
Subject Code: HMMXC22 **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: Probe 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 Publising 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
2. http://www.trillia.com/dA/zakon-analysisI-a4-one.pdf
3. https://www.youtube.com/watch?v=QS-zUSu-nxA
4. https://www.youtube.com/watch?v=XzaeYnZdK5o

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

Low-1 Medium-3 High-9

Core VII - Topology I

(For Students Admitted from 2022-23)

Semester: II **Hours / week: 6**
Subject Code: HMMXC23 **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 XxY - 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, 2nd Edition, Reprint 2008.
3. Seymour Lipschutz, *General Topology*, Schaum's Outline Series, McGraw 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
4. https://www.google.co.in/books/edition/General_Topology/kgxHDgAAQBAJ?hl=en&gbpv1&dq=topology+mathematics&printsec=frontcover
5. https://www.mathematik.hu-erlin.de/~wendl/Winter2018/Topologie2/lecturenotes.pdf

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

Low-1 Medium-3 High-9

Core VIII- Complex Analysis

(For Students Admitted from 2022-23)

Semester: II **Hours / week: 6**
Subject Code: HMMXC24 **Credit: 5**

Course Objectives:

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

Unit I **(22 hours)**

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

Unit II **(18 hours)**

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

Unit III **(16 hours)**

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

Unit IV **(16 hours)**

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

Unit V **(18 hours)**

Power Series Expansions: Weierstrass's Theorem - The Taylor series - The Laurent Series -

Partial Fractions and Factorization: Partial Fractions - Infinite Products - Canonical Products. Entire Functions: Jensen's Formula.

Course Outcomes:

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

CO 1: Examine the solution of complex-valued functions, analytic function and conformal mapping

CO 2: Show the series expansions, singularities, Cauchy's theorem and its consequences

CO 3: Identify the location and nature of a singularity of a function and calculate the order and the residue

CO 4: Analyze the results associated to Definite Integrals and Cauchy' s Integral formulae

CO 5: Evaluate the region of convergence by applying Taylor's Series – Laurent's Series

Text Book:

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

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

Reference Books:

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

E-Resources:

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

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

Low-1 Medium-3 High-9

DSE II - Graph Theory

(For Students Admitted from 2022-23)

Semester: II **Hours / week: 6**
Subject Code: HMMXE2A **Credit: 5**

Course Objectives:

1. To 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)**

Trees - Connectivity - Blocks - Construction of Reliable Communication Networks.

Unit II **(18 hours)**

Euler tour - Hamilton cycle - Applications.

Unit III **(18 hours)**

Matching - Perfect Matching - Edge colouring – Vizing's Theorem.

Unit IV **(18 hours)**

Independent sets - Cliques – Turan's Theorem.

Unit V **(18 hours)**

Vertex Colouring - Girth and Chromatic Number.

Course Outcomes:

After successful completion of this course, student will be able to
CO 1: Construct reliable communication network
CO 2: Apply the concept of direction path to Euler tour
CO 3: Explicate matching and edge colouring in the solutions of their problems
CO 4: Prove the theorems in Independent Set
CO 5: Use the chromatics numbers in real life situations for diagrammatic representations

Text Book:

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

Unit I: Chapter 2(2.1 - 2.4) & Chapter 3(3.1 - 3.3)
Unit II: Chapter 4(4.1 - 4.3)
Unit III: Chapter 5(5.1 - 5.3) & Chapter 6(6.1 - 6.2)
Unit IV: Chapter 7(7.1 - 7.3)
Unit V: Chapter 8(8.1 – 8.5)

Reference Books:

1. R R. Balakrishnan, K. Ranganathan, *A Textbook of Graph Theory,* Springer International Edition, First Indian Reprint 2008.
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=TBYNkgvnU2s
3. https://nptel.ac.in/courses/111/106/111106050/

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

Low-1 Medium-3 High-9

Core IX -Functional Analysis

(For Students Admitted from 2022-23)

Semester: III **Hours / week: 6**
Subject Code: HMMXC31 **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 - Orthogonal Complements and Direct Sums - Orthonormal Sets and Sequences - 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 - Adjoint Operator - Reflexive Spaces - Category Theorem - Uniform Boundedness Theorem.

Unit V **(18 hours)**

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, 2008.

Unit I: Chapter II (Sec: 2.2-2.8 & 2.10)
Unit II: Chapter III (Sec: 3.1-3.6)
Unit III: Chapter III (Sec: 3.8-3.10)
Unit IV: Chapter IV (Sec: 4.2, 4.3, 4.5, 4.6, 4.7)
Unit V: Chapter IV (Sec: 4.8, 4.9, 4.12, 4.13)

Reference Books:

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

E-Resources:

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

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

Low-1 Medium-3 High-9

Core X - Topology II

(For Students Admitted from 2022-23)

Semester: III **Hours / week: 6**
Subject Code: HMMXC32 **Credit: 5**

Course Objectives:

1. To understand the concept of Metrization and paracompactness of topology of real functions
2. To acquire knowledge on Nowhere differentiable functions

Unit I **(18 hours)**

The Urysohn Lemma: Uryshon lemma theorem - The Urysohn Metrization Theorem - The Tietze Extension Theorem - Imbeddings of Manifolds.

Unit II **(18 hours)**

The Tychonoff Theorem: Tychonoff Theorem - The Stone- □ Compactification.

Unit III **(18 hours)**

Metrization Theorems and Para compactness: Local Finiteness - The Nagata-Smirnov - Metrization Theorem - Para Compactness - The Smirnov Metrization Theorem.

Unit IV **(20 hours)**

Complete Metric Spaces and Function Spaces: Complete metric spaces - A Space-Filling Curve - Compactness in Metric spaces - Point wise and Compact Convergence**.**

Unit V **(16 hours)**

Ascoli's Theorem: Ascoli's Theorem - Baire Spaces - A Nowhere-Differentiable Function.

Course Outcomes:

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

CO 1: Examine the concepts of separation axioms in proving Urysohn lemma and Urysohn Metrization theorem
CO 2: Make use of compactness and connectedness in proving Tychonoff theorem
CO 3: Explain Para compactness and apply its related theorems
CO 4: Explore the concepts of complete metric space with illustrations

CO 5: Conceptualize and apply the concept of compactness and completeness in Baire Spaces

Text Book:

1. James R. Munkres, *Topology*, PHL Learning Private Limited, New Delhi, 2nd Edition, 2017.

Unit I: Chapter 4 (Sec: 33 - 36)
Unit II: Chapter 5 (Sec: 37 - 38)
Unit III: Chapter 6 (Sec:39 - 42)
Unit IV: Chapter 7 (Sec:43 - 46)
Unit V: Chapter 7, 8 (Sec: 47 & 48 - 49)

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, Second Edition Reprint, 2008.
3. Seymour Lipschutz, *General Topology*, Schaum's Outline Series, McGraw Hill Book Company, 2004.

E-Resources:

1. https://nptel.ac.in/courses/111/106/111106054/
2. http://epgp.inflibnet.ac.in/Home/ViewSubject?catid=25
3. https://www.google.co.in/books/edition/Introduction_to_Topology/n97CAgAAQBAJ?hl=en&gbpv=1&dq=topology+mathematics&printsec=frontcover
4. http://web.math.ku.dk/~moller/e03/3gt/notes/gtnotes.pdf
5. http://bass.math.uconn.edu/v41.pdf

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	1	1	1	1	**13**
CO2	3	3	3	1	1	1	1	**13**
CO3	3	3	9	1	1	1	3	**21**
CO4	9	3	9	1	1	3	3	**29**
CO5	3	3	9	1	1	1	1	**19**
Total	**21**	**15**	**33**	**5**	**5**	**7**	**9**	**95**

Low-1 Medium-3 High-9

Core XI - Classical Mechanics

(For Students Admitted from 2022-23)

Semester: III **Hours / week: 6**
Subject Code: HMMXC33 **Credit: 5**

Course Objectives:

1. Understand the fundamental concepts in mechanics such as force, energy, momentum etc. more rigorously as needed for further studies in physics, engineering and technology
2. An advanced mathematical techniques and methods of use to physicists in solving problems. Develop some Capabilities for numerical/ computational methods, in order to obtain solution to problems too difficult or impossible to solve analytically

Unit I **(18 hours)**

Mechanical System- Generalized Coordinates - Constraints -Virtual Work - Energy and momentum- Kinetic Energy of a System.

Unit II **(18 hours)**

Lagrange's Equations: Derivation of Lagrange's equations - Examples - Integrals of motion.

Unit III **(18 hours)**

Hamilton's principle – Hamilton's equation - Other variational principle.

Unit IV **(18 hours)**

Hamilton Jacobi Theory - Hamilton principle function - Hamilton-Jacobi equation - Separability.

Unit V **(18 hours)**

Canonical Transformation: Differential forms and generating functions – Special transformations – Lagrange and Poisson brackets.

Course Outcomes:

After successful completion of this course, student will be able to
CO 1: Compute the solutions of the problems using DAlembert's Principle
CO 2: Evaluate the differential equation of motion by using lagrangian method
CO 3: Analyze the Hamilton's equation and variational principles
CO 4: Evaluate the canonical integral associated with Hamilton's principle
CO 5: Examine the transformations are Canonical or not

Text Book:

1. Greenwood D. T, *Classical Dynamics*, New Delhi, Prentice Hall of India, (1985).

Unit I: Chapter 1 (1.1 - 1.6)
Unit II: Chapter 2 (2.1 – 2.7)
Unit III: Chapter 3 (3.1 – 3.6)
Unit IV: Chapter 3 (3.7 – 3.12)
Unit V: Chapter 8 (8.1 – 8.6)

Reference Books:

1. Chandra S, *Classical Mechanics*, A Textbook. UK: Alpha Science International, 2009.
2. Goldstein H, *Classical Mechanics*. New Delhi, Narosa Publishing House, 2001.
3. John Taylor, R, *Classical Mechanics*, California University Science Books, Sausalito, Second Edition, 2005.
4. Rane N.C., Joag P.S.C, *Classical Mechanics*. New Delhi: Tata McGraw Hill, 1991.
5. Synge J.L., Griffth B.A, *Principles of Mechanics*. New York: McGraw Hill Book Co, 1970.

E- Resources:

1. https://slideplayer.com/slide/10122414/
2. https://nptel.ac.in/courses/115/105/115105098/
3. https://books.google.co.in/books?id=u2JKuF1nM0wC&printsec=frontcover#v=onepage&q&f=false
4. https://static1.squarespace.com/static/570e7b14e707ebd28d391286/t/57b1184520099e871dd8416a/1471223879739/classical-2.pdf.

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	1	1	3	3	**23**
CO2	9	3	3	1	1	3	3	**23**
CO3	9	9	9	3	1	9	3	**43**
CO4	9	3	9	1	1	3	3	**20**
CO5	3	3	3	1	1	9	3	**23**
Total	**39**	**21**	**27**	**7**	**5**	**27**	**15**	**141**

Low-1 Medium-3 High-9

Core XII - Probability and Statistics

(For Students Admitted from 2022-23)

Semester: III **Hours / week: 6**
Subject Code: HMMXC34 **Credit: 5**

Course Objectives:

1. To calculate the probability for any event and use it to estimate certain possibilities
2. To identify the distributions depending on the nature of the data and derive inferences

Unit I **(20 hours)**

Probability and Distribution: Introduction - Set Theory - The Probability Set Function - Conditional Probability and Independence - Random Variables of the Discrete type - Random variables of the Continuous type - Properties of the distribution function - Expectation of a random variable - Some special expectations - Chebyshev‟ s Inequality.

Unit II **(16 hours)**

Multivariate Distributions: Distributions of Two Random Variables - Conditional Distributions and Expectations - The Correlation Coefficient - Independent Random Variables - Extension to Several Random Variables.

Unit III **(18 hours)**

Some special Distributions: The Binomial and Related Distributions - The Poisson Distribution - The Gamma and Chi-Square Distributions - The Normal Distributions - The Bivariate Normal Distribution.

Unit IV **(21 hours)**

Distributions of Functions of Random Variables: Sampling Theory - Transformations of Variables of the Discrete Type - Transformations of Variables of the Continuous Type - The Beta, t and F Distributions - Extensions of the Change of Variable Technique - Distributions of the Order Statistics - The Moment Generating Function Technique - The Distributions of and n Expectations of Functions of Random Variables**.**

Unit V **(15 hours)**

Limiting Distributions: Convergence in Distribution - Convergence in Probability - Limiting Moment Generating Functions - The Central Limit Theorem - Some Theorems on Limiting Distributions.

Course Outcomes:

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

CO 1: Identify basic concept of Random events, axioms of probability and independent events

CO 2: Identify the concepts of multivariate distribution and the Correlation coefficient

CO 3: Analyze the Binomial distribution, Poisson distribution, Gamma and Chi-square distribution and Normal distribution

CO 4: Examine and describe the beta, t and F distribution of various applications in statistics.

CO 5: Estimate the concepts in multivariate distribution

Text Book:

1. Robert V. Hogg and Allen T. Craig, *Introduction to Mathematical Statistics*, Pearson Education Asia, Fifth Edition, 2004.

Unit I: Chapter 1 (1.1 - 1.10)
Unit II: Chapter 2 (2.1 – 2.5)
Unit III: Chapter 3 (3.1 – 3.5)
Unit IV: Chapter 4 (4.1 – 4.9)
Unit V: Chapter 5 (5.1 – 5.5)

Reference Books:

1. S.C Gupta & V.K Kapoor, *Fundamental of Mathematical Statistics*, Sultan Chand & Sons, Educational Publisher, New Delhi, Tenth Edition, 2002.
2. A.P Baisnab and M Jas, *Elements of Probability and Statistics*, Tata McGraw Hill Publishing Company Limited, Thirteen Edition, 2006.

3. Hoel. P.G, *Introduction to Mathematical Statistics*, Willey, 1971.

E-Resources:

1. https://www.bauer.uh.edu/rsusmel/phd/sR-7.pdf
2. https://www.khanacademy.org/math/statistics-probability/inference-categorical-data-chi-square-tests/chi-square-goodness-of-fit-tests/v/chi-square-distribution-introduction
3. http://www.utstat.toronto.edu/mikevans/jeffrosenthal/book.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	9	3	9	9	**57**
CO2	9	9	9	9	3	9	9	**57**
CO3	9	9	9	9	9	9	9	**63**
CO4	9	9	9	9	9	9	9	**63**
CO5	3	3	9	9	9	9	9	**51**
Total	**39**	**39**	**45**	**45**	**33**	**45**	**45**	**291**

Low-1 Medium-3 High-9

DSE III - Operations Research

(For Students Admitted from 2022-23)

Semester: III **Hours / week: 6**
Subject Code: HMMXE3B **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)**

Decision Analysis and Games: Decision Making under Certainty - Decision Making under Risk- Decision under Uncertainty.

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

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

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: Solve the problems using the concepts of Decision analysis

CO 4: Analyze Pure Birth and Death Model

CO 5: Determine the solution of the inventory problem using Inventory models

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 15 (15.1 - 15.3)
Unit IV: Chapter 18 (18.2 - 18.6)
Unit V: Chapter 13 (13.1 - 13.4)

Reference Books:

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

E-Resources:

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

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

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

Core XIII – Differential Geometry

(For Students Admitted from 2022-23)

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

Course Objectives:

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

Unit I **(20 hours)**

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

Unit II **(16 hours)**

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

Unit III **(18 hours)**

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

Unit IV **(20 hours)**

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

Unit V **(16 hours)**

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

Course Outcomes:

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

CO 1: Explain the concept of space curves
CO 2: Describe the structures of curves and surfaces and find its involutes and evolutes of the curves
CO 3: Determine the properties of helicoids
CO 4: Make use of Geodesic curvature, to solve the problems
CO 5: Illustrate the fundamental concepts in Normal property of geodesic and intrinsic values

Text Book:

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

Unit I: Chapter 1(Pg. No: 1 - 18)
Unit II: Chapter 1(Pg. No: 18 - 27)

Unit III: Chapter 2(Pg. No: 31 - 54)
Unit IV: Chapter 2(Pg. No: 54 - 80)
Unit V: Chapter 3(Pg. No: 95 - 101)

Reference Books:

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

E-Resources:

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

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

Low-1 Medium-3 High-9

Core XIV – Advanced Statistics

(For Students Admitted from 2022-23)

Semester: IV **Hours / week: 6**
Subject Code: HMMXC42 **Credit: 5**

Course Objectives:

1. To familiarize the applications of various tests of significance
2. To understand the methods of finding estimates, sample moment and their functions

Unit I **(18 hours)**

Introduction to Statistical Inference: Point Estimation - Confidence Intervals for Means - Confidence Intervals for Differences of Means - Test of Statistical Hypothesis - Additional Comments About Statistical Tests - Chi-Square Tests**.**

Unit II **(18 hours)**

Sufficient Statistics: Measures of Quality of Estimators - A Sufficient Statistic for a Parameter - Properties of a Sufficient Statistics - Completeness and Uniqueness - The

Exponential class of Probability Density Functions - Functions of a Parameter.

Unit III **(18 hours)**

More about Estimation: Bayesian Estimation - Fisher Information and the Rao-Cramer Inequality - Limiting Distributions of Maximum Likelihood Estimators.

Unit IV **(18 hours)**

Theory of Statistical Tests: Certain Best Tests - Uniformly Most Powerful Tests - Likelihood Ratio Tests - The Sequential Probability Ratio Test.

Unit V **(18 hours)**

Inferences about Normal Models: The Distributions of Certain Quadratic Forms - A Test of the Equality of Several Means - Noncentral χ^2 and Noncentral F - Multiple Comparisons - The Analysis of Variance - A Regression Problem - A Test of Independence.

Course Outcomes:

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

CO 1: Solve the knowledge of applicable large sample theory of estimators and tests
CO 2: Assume conceptual understanding of completeness and uniqueness
CO 3: Analyze the comprehensive idea about the Bayesian Estimations
CO 4: Evaluate the functions by using various significance test
CO 5: Conclude the relationship between two quantitative variables with the use of linear regression

Text Book:

1. Robert V. Hogg and Allen T.Craig, *Introduction to Mathematical Statistics*, Pearson Education Asia, Fifth Edition, 2004.

Unit I: Chapter 6 (6.1 – 6.6)
Unit II: Chapter 7 (7.1 – 7.6)
Unit III: Chapter 8 (8.1 - 8.3)
Unit IV: Chapter 9 (9.1 – 9.4)
Unit V: Chapter 10 (10.1 - 10.7)

Reference Books:

1. A.P Baisnab and M. Jas, *Elements of Probability and Statistics*, Tata McGraw Hill Publishing Company Limited, New Delhi, Thirteenth Edition, 2006.
2. S.C.Gupta, *Fundamentals of Statistics*, Himalaya publishing house, Sixth Edition, 2004.
3. John E.Freund, *Mathematical statistics*, Prentice Hall of India, Fifth Edition, 1994.

E-Resources:

1. https://youtu.be/tFRXsngz4UQ
2. https://youtu.be/IT-0oCOQrBY
3. https://youtu.be/jrqVTSdyvr8

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	9	3	9	9	9	**45**
CO2	3	3	3	3	9	9	9	**39**
CO3	3	3	9	3	9	9	9	**45**
CO4	3	3	9	3	9	9	9	**45**
CO5	3	3	9	3	3	9	3	**33**
Total	**15**	**15**	**39**	**15**	**39**	**45**	**39**	**207**

Low-1 Medium-3 High-9

Core XV - Project

(For Students Admitted from 2022-23)

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

Course Objectives:

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

Project Outline:

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

Course Outcomes:

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

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

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

Low-1 Medium-3 High-9

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

(For Students Admitted from 2022-23)

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

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

Unit I **(18 hours)**

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

Unit II **(18 hours)**

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

Unit III **(18 hours)**

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

Unit IV **(18 hours)**

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

Unit V **(18 hours)**

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

Course Outcomes:

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

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

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

CO 3: Evaluate the mean and variance of special probability distribution

CO 4: Determine exact and approximate confidence intervals

CO 5: Make use of chi square test to evaluate the best fit of hypothesized distribution

Text Book:

1. T.Veerarajan, *Probability, Statistics and Random Processes*, Tata McGraw 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/_JVzgkBkfew
2. https://youtu.be/_JVzgkBkfew
3. https://youtu.be/pXVnfUtrhmA

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

Low-1 Medium-3 High-9

B Sc MATHEMATICS

(Three Year Regular Programme)
(For Students Admitted from 2022-23)

Program Specific Outcomes

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

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

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

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

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

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

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

PREAMBLE

1. Syllabus has been modified for Abstract Algebra I (IV Semester), Abstract Algebra II (V Semester) and Complex Analysis (VI Semester) for core courses.
2. Syllabus has been modified for Mathematical Statistics I (I Semester), Mathematical Statistics II (II Semester) for Ability Enhancement Compulsory Courses.
3. Modified the syllabus for the core courses Differential Equations (II Semester), Statics (IV Semester), Dynamics (V Semester) and Real Analysis II (VI Semester).
4. Introduced skill enhancement courses are Theory of Equations with MAT Lab (I Semester), Analytical Geometry with Geogebra (II Semester), R- Tool Lab (IV Semester), Operations Research Lab-Lindo / Lingo Package (V Semester).
5. Introduced Discipline Specific Elective course is Lattice theory and Boolean Algebra (VI Semester).
6. Syllabus has been modified for Discipline Specific Elective course Operations Research (V Semester).
7. Combined the courses Theory of Equations & Trigonometry (I Semester), Graph Theory I & Graph Theory II (V Semester).
8. The core course Numerical analysis in the VI semester is transfer to III Semester.
9. The skill Enhancement course Fourier Series in the II semester is transfer to III Semester.
10. The skill Enhancement course Applied statistics in the III semester is changed to VI Semester.
11. The syllabus has been modified for Astronomy and changed from V semester to VI

Semester.

12. Syllabus has been modified for the Discipline Specific Elective course Fourier and Laplace transforms (V Semester).
13. Syllabus has been modified for Ability Enhancement Compulsory Courses Basic statistics, Operations Research, Discrete Mathematics and Numerical Methods.
14. Ability Enhancement Compulsory Course Psychological statistics splitted into two courses Descriptive Statistics (III Semester) and Inferential Statistics (IV Semester).
15. Introduced integrated courses Numerical Analysis and Abstract Algebra-I in the III and IV semesters.
16. Introduced internship for the course Mathematical Statistics – II in the II semester.
17. Introduced project instead of the course Number Theory in the VI semester.

PROGRAMME STRUCTURE, Program Code:UMX

Sem	Part	Subject code	Course	Subject Title	Hours / Week	Credits	CIA	ESE	Total
I	I	IBLT11/ IBLA11/ IBLH11	Language I	Tamil I / Arabic I / Hindi I	5	3	40	60	100
	II	IBLEI12/ IBLEII12	Language II	English I a or b	5	3	40	60	100
	III	IBMXC11	Core I	Calculus	5	4	40	60	100
		IBMXC12	Core II	Theory of Equations &Trigonometry	6	5	40	60	100
		IBMXA13	AECC I	Mathematical Statistics – I	5	4	40	60	100
	IV	IBMXS14P	SEC I	Theory of Equations with MAT Lab	2	2		50	50
			Library/ Browsing		1				
			Remedial / Games		1				
		Total			**30**	**21**	**200**	**350**	**550**
II	I	IBLT21/ IBLA21/ IBLH21	Language I	Tamil II / Arabic II /Hindi II	5	3	40	60	100
	II	IBLEI22 IBLEII22	Language II	English II a or b	5	3	40	60	100
	III	IBMXC21	Core III	Analytical Geometry - 3D & Vector Calculus	5	5	40	60	100
		IBMXC22	Core IV	Differential Equations	4	4	40	60	100

		IBMXA23	AECC II	# Mathematical Statistics - II	5	4	40	60	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				
		Total			**30**	**23+2**	**200**	**400 +100**	**600+ 100**
III	I	IBLT31/ IBLA31/ IBLH31	Language I	Tamil III / Arabic III /Hindi III	5	3	40	60	100
	II	IBLEI32 IBLEII32	Language II	English III a or b	5	3	40	60	100
	III	IBMXC31	Core V	○ Numerical Analysis	4	4	40	60	100
		IBMXC32	Core VI	Real Analysis I	4	4	40	60	100
		IBMXA33P	AECC III	Programming in "C" Lab	4	4	40	60	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
		Total			**30**	**26+2**	**300**	**450 + 100**	**750+ 100**
	I	IBLT41/ IBLA41/ IBLH41	Language I	Tamil IV / Arabic IV / Hindi IV	5	3	40	60	100
	II	IBLEI42 IBLEII42	Language II	English IV a or b	5	3	40	60	100
		IBMXC41	Core VII	○Abstract Algebra – I	4	4	40	60	100

IV	III	IBMXC42	Core VIII	Statics	5	4	40	60	100
		IBMXA43	AECC IV	Programming in Java	5	4	T-20 P-20	60	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
		Total			**30**	**24+2**	**200**	**450+ 100**	**650+ 100**
V	III	IBMXC51	Core IX	Abstract Algebra – II	6	5	40	60	100
		IBMXC52	Core X	Graph Theory	6	5	40	60	100
		IBMXC53	Core XI	Dynamics	6	5	40	60	100
		IBMXE5A/ IBMXE5B	DSE I	Fourier and Laplace Transforms / Combinatorics	4	4	40	60	100
		IBMXE5C/ IBMXE5D	DSE II	Fluid Dynamics / # Operations Research	4	4	40	60	100
	IV	IBMXS54P	SEC V	Operations Research Lab- LINDO / LINGO Package	2	2		50	50
		IBWE5	GIC IV	Women Entrepreneurship	2	2		50	50
		IBMXX5/ IBMXX5O	Extra Credit	Employability Skills / * Online Course		2	100	-	100
		Total			**30**	**27+2**	**200+ 100**	**400**	**600+ 100**
VI	III	IBMXC61	Core XII	Real Analysis – II	6	5	40	60	100
		IBMXC62	Core XIII	Complex Analysis	6	4	40	60	100
		IBMXC63	Core XIV	Astronomy	5	4	40	60	100
		IBMXC64PW	Core XV	Project	6	5	40	60	100

		IBMXE6A/ IBMXE6B	DSE III	Lattice theory and Boolean Algebra / Mathematical Modeling	4	4	40	60	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
		Total			**30**	**24+2**	**200**	**350+ 100**	**550 + 100**
		Grand Total			**180**	**145 + 10**	**1300 + 100**	**2400 + 400**	**3700 + 500**

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

○ Integrated Course

Internship Training

AECC for other UG Programme (B Sc Information Technology)

Sem	Part	Subject code	Course	Subject Title	Hours / Week	Credit	CIA	ESE	Total Marks
III	III	IBITA33	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	Subject code	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	IBCPA13	AECC I	Numerical Methods	5	4	40	60	100
I	III	IBCYA13	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 2022-23)

Semester: I **Hours / week: 5**
Subject Code: IBMXC11 **Credit: 4**

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

Unit I **(15 hours)**
Tangent and Normal: Subtangent 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, subtangent, subnormal, polar subtangent, polar subnormal of a curve
CO 2: Evaluate envelope, radius and centre of curvature, evolute of a curve and polar equation
CO 3: Analyze the concept of Asymptotes and Properties of definite integrals
CO 4: Examine the techniques of integration
CO 5: Compute the area and centroid of curvature by using double and triple integrals

Text Books:
1. S. Narayanan, T. K. Manicavachagom Pillay, *Calculus - Volume I***,** S. Viswanathan Printers & Publishers Private Limited, 2017.
Unit I: Chapter 9
Unit II: Chapter 10
Unit III: Chapter 11
2. S. Narayanan, T. K. Manicavachagom Pillay, *Calculus - Volume II*, S. Viswanathan

Printers & Publishers Private Limited, 2017.
Unit IV: Chapter 1(sec 11 - 15.1)
Unit V: Chapter 5(sec 1 - 5.4)

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

E-Resources:
1. https://www.mathcentre.ac.uk/resources/uploaded/mc-ty-tannorm-2009-1.pdf
2. https://nitkkr.ac.in/docs/5-Multiple%20Integrals%20and%20their%20Applications.pdf
3. https://www.khanacademy.org/math/multivariable-calculus/integrating- multivariable-functions/double-integrals-a/v/polar-coordinates-1

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

Low-1 Medium-3 High-9

Core II- Theory of Equations & Trigonometry

(For Students Admitted from 2022-23)

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

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

Unit I **(18 hours)**
Theory of Equations: Introduction about polynomials, equations - Remainder theorem - Imaginary roots - Irrational roots - Relation between roots and coefficients of equations - Symmetric functions of the roots - Sum of the powers of the roots of an equation - Newton's Theorem.

Unit II **(18 hours)**
Theory of Equations: Transformations of equations - Roots with signs changed - Roots multiplied by a given number - Reciprocal roots - Reciprocal equation - Increase and decrease the roots of a given equation by a given quantity - Removal of terms – Equations

whose roots are any power of the roots of a given equation.

Unit III **(18 hours)**

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

Unit IV **(18 hours)**

Theory of Equations: General solution of cubic equations – Cardon's Method – Solution of biquadratic equations – **Expansions:** Expansions of sinnθ, cosnθ and tannθ - 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(Full) 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
2. https://www.google.co.in/books/edition/HIGHER_ALGEBRA
3. https://youtu.be/oXslbssVBgQ
4. https://youtu.be/zSvo9Qy6-vE

5. https://youtu.be/uMXcKY_w3w4

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

Low-1 Medium-3 High-9

AECC I –Mathematical Statistics - I

(For Students Admitted from 2022-23)

Semester: I **Hours / week: 5**
Subject Code: IBMXA13 **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 **(15 hours)**

Theory of Probability: Random Experiment – Event – Probability: Mathematical Notion – Probability function – Laws of Addition of probabilities – Laws of multiplication or Theorem of Compound Probability – Independent Events – Pairwise Independent Events – Mutually Independent Events – Baye's Theorem.

Unit II **(17 hours)**

Random Variables and Distribution Functions: Random Variables - Distribution Function – Properties of Distribution Function – Discrete Random variable – Probability mass function – Discrete distribution function – Continuous random variable – Probability density function – Continuous distribution function – Joint p.m.f and marginal and conditional probability function – Joint p.d.f – Joint density function, marginal density function – Independent random variable – The conditional distribution function and conditional p.d.f.

Unit III **(13 hours)**

Mathematical Expectation and Generating Functions: Mathematical Expectation – Additional theorem of expectation – Multiplication theorem of expectation – Covariance – Expectation of linear combination of random variables – Variables of a linear combination of random variables – Expectation of continuous random variables – Moment generating function – Theorems on moment generating functions.

Unit IV **(17 hours)**

Theoretical Discrete Distributions: Binomial Distribution: Recurrence relation for the moments of Binomial Distribution – Moments Generating functions of Binomial Distribution

– Recurrence relation for the probabilities of Binomial Distribution.
Poisson Distribution: Moments of the Poisson Distribution – Mode of the Poisson Distribution – Recurrence relation for the moments of the Poisson Distribution – Moment generating function of Poisson Distribution – Additive property of independent Poisson variates– Recurrence formula for the probability of Poisson distribution.

Unit V **(13 hours)**
Theoretical Continuous Distributions: Normal Distribution: Chief characteristics of the Normal Distribution and Normal probability curve – M.G.F of Normal Distribution – Moments of Normal Distribution – A linear combination of independent Normal variates is also a Normal variate– Area property – Importance of Normal Distribution – Fitting of Normal Distribution.

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

Text Book:
1. S.C.Gupta, V. K. Kapoor, *Elements of Mathematical Statistics***,** Sultan Chand and Sons, Third Editon, Reprint 2015.

Unit I: Chapter 4 (4.5-4.5.2, 4.6-4.6.2, 4.7, 4.7.2-4.7.4, 4.8);
Unit II: Chapter 5 (5.1-5.4.1, 5.4.3, 5.5.1-5.5.5)
Unit III: Chapter 6 (6.1-6.9.1);
Unit IV: Chapter 7 (7.2, 7.2.2, 7.2.6, 7.2.10, 7.3.1-7.3.5, 7.3.8-7.3.9)
Unit V: Chapter 8 (8.1, 8.2.2, 8.2.5, 8.2.7-8.2.8, 8.2.11, 8.2.13-8.2.14)

Reference Books:
1. S. Arumugam and A. Thangapandi Isaac, *Statistics***,** New Gamma Publishing Houses, Edition 2009.
2. S.C.Gupta, V.K. Kapoor, *Fundamental of Mathematical Statistics***,** Sultan Chand and Sons, Eleventh Edition, Reprint 2019.

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

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

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

SEC I - Theory of Equations with MAT Lab

(For Students Admitted from 2022-23)

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

Course Objectives:

1. To impart knowledge on solving problems on Theory of equations using computer with MATLAB
2. To use MATLAB 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

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 MATLAB to solve problems in theory of equations
CO 3: Apply the acquired knowledge on MATLAB to find roots of polynomials
CO 4: Use MATLAB to solve algebraic equation
CO 5: Make use of MATLAB for Horner's Method and Newton's Method of evaluating a real root

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

Low-1 Medium-3 High-9

Core III - Analytical Geometry - 3D & Vector Calculus

(For Students Admitted from 2022-23)

Semester: II **Hours / week: 5**
Subject Code: IBMXC21 **Credit: 5**

Course Objectives:

1. To develop the skill of solving problems related to plane, straight line, spheres in three dimensional
2. To understand the fundamental concepts of vector differentiation and integration

Unit I **(15 hours)**

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 vector differentiations

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: Chapter2 (2.1 to 2.13)

Unit II: Chapter3 (3.1to 3.11)

Unit III: Chapter4 (4.1to 4.12)

Unit IV: Chapter2, 3(3.1 to 3.10)

Unit V: Chapter4 (4.1to 4.4)

Reference Books:

1. Dr**.**S**.** Arumugam & A**.**Thangapandi Isaac, *Analytical Geometry-3D and Vector Calculus***,** New Gamma Publishing House**,** 2006.

2. T.K. Manicavachagom Pillay and T. Natarajan, *A Text Book of Analytical Geometry Part II– Three Dimensions*, S.Viswanathan (Printers &Publishers) Private Limited, 2010.

3. P.K. Jain and Khalil Ahmad, *Analytical geometry of Three Dimensions***,** Wiley Eastern Limited, 1994.

E-Resources:

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

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

Low-1 Medium-3 High-9

Core IV- Differential Equations

(For Students Admitted from 2022-23)

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

Course Objectives:

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

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 variable co-efficient.

Unit IV **(12 hours)**

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 **(12 hours)**

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; standard forms – Charpit's method.

Course Outcomes:

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

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

Text Book:

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

Unit I: Chapter V(Pg.no: 68 - 88)
Unit II: Chapter V (Pg.no: 89- 102)

Unit III: Chapter VI (Pg.no: 119 - 134)
Unit IV: Chapter VIII (Pg.no: 145 - 160)
Unit V: Chapter XII (Pg.no: 219 - 249)

Reference Books:

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

E-Resources:

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

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

Low-1 Medium-3 High-9

AECC II – Mathematical Statistics II

(For Students Admitted from 2022-23)

Semester: II **Hours / week: 5**
Subject Code: IBMXA23 **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 **(15 hours)**

Correlation and Regression: Bivariate distribution, Correlation - Scatter diagram - Karl Pearson Coefficient of Correlation - Limits for correlation coefficient - Rank Correlation - Repeated Ranks - Regression - Lines of Regression - Regression coefficients - Properties of regression coefficient - Angle between two lines of regression.

Unit II **(15 hours)**

Theory of Attributes: Introduction - Notations - Dichotomy - Classes and Class frequencies - Order of classes and class frequencies - Relation between class frequencies - Class symbols as operators - Consistence of data - Conditions for consistency of data - Independence of attributes - Criterion of independence - Symbols and - Association of Attributes – Yule's Coefficient of association - Coefficient of Colligation.

Unit III **(15 hours)**

Sampling and Large Sample Test: Types of Sampling- Parameters and statistic -Sampling distribution - Standard Error: Tests of Significance - Null hypothesis - Error in sampling - Critical Region and Level of significance - Tests of significance for large samples - Test for single proportion - Test of significance for difference of proportions - Test of significance for single mean - Test of significance for difference of means.

Unit IV **(15 hours)**

Exact Sampling Distribution: Chi-square variate - M.G.F of distribution - Additive property of Chi-square variates - Chi- square test of goodness of fit - Independence of attributes.

Unit V **(15 hours)**

Exact sampling distribution: Student's t (Definition) - Derivation of Student's t-distribution - Application of t-distribution - Test for single mean - t-Test for difference of means - t-Test for testing significance of an observed - F-statistic (Definition) - Applications of F - distribution.

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, *Elements of Mathematical Statistics***,** Sultan Chand and Sons, Third Editon, Reprint 2015.

Unit I: Chapter 10 (10.1-10.3.1, 10.6-10.7.1, 10.7.3-10.7.5)
Unit II: Chapter 11
Unit III: Chapter 12 (12.2-12.8, 12.9.1, 12.9.2, 12.13, 12.14)
Unit IV: Chapter 13 (13.1, 13.3, 13.3.3, 13.5.2, 13.5.3)
Unit V: Chapter 14(14.2, 14.2.1, 14.2.5-14.3.1)

Reference Books:

1. S. Arumugam and A. Thangapandi Isaac, *Statistics***,** New Gamma Publishing Houses, Edition, 2009.
2.S.C.Gupta, V.K.Kapoor, *Fundamental of Mathematical Statistics***,** Sultan Chand and Sons, Eleventh Edition, Reprint, 2019.

E-Resources:

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

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

Low-1 Medium-3 High-9

SEC II – Analytical Geometry with Geogebra

(For Students Admitted from 2022-23)

Semester: II **Hours / week: 2**

Subject Code: IBMXS24P **Credit: 2**

Course Objectives:

1. To develop and share classroom materials, and to continually improve and extend the dynamic mathematics software Geogebra
2. To use the Geogebra software to solve the equations, plane, line and Sphere

List of Programmes:

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

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

Low-1 Medium-3 High-9

Extra Credit- Arithmetic for Competitive Examinations

(For Students Admitted from 2022-23)

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 32nd 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://careerdost.in/aptitude-questions/average-problems
3. https://byjus.com/govt-exams/mixture-alligation-questions/

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

Low-1 Medium-3 High-9

Core V -Numerical Analysis

(For Students Admitted from 2022-23)

Semester: III **Hours / week: 4**
Subject Code: IBMXC31 **Credit: 4**

Course Objectives:
1. To derive appropriate numerical methods to solve algebraic and transcendental equations
2. To provide the numerical methods of solving the non-linear equations, interpolation, differentiation and integration

Unit I **(12 hours)**
Algebraic and Transcendental Equations: Errors in numeric computations -Iteration method – Aitken's method-Bisection method-Regula-falsi method - Newton-Raphson method.

Unit II **(12 hours)**
Finite Differences: Difference operators - Other difference operators.

Unit III **(12 hours)**

Interpolation: Newton's interpolation formula - Central difference interpolation formulae – Lagrange's interpolation formula - Divided difference- Divided difference formula - Inverse interpolation.

Unit IV **(12 hours)**

Numerical Differentiation: Derivatives using Newton's forward difference formula- Derivatives using Newton's backward difference formula - Derivatives using Newton's central difference formula-Maxima and minima of the interpolating polynomial-**Numerical integration:** Newton's Cote's quadrature formula - Trapezoidal Rule – Simpson's one third rule – Simpson's three eighth rule – Weddle's rule.

Unit V **(12 hours)**

Numerical solution of Differential Equation: Taylor series method – Picard's method – Euler's method-Runge-kutta method - Predictor - corrector formula.

Course Outcomes:

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

CO 1: Identify the efficient numerical solutions of algebraic and transcendental equation
CO 2: Classify finite differences
CO 3: Analyze the concept of interpolation
CO 4: Verify the numerical methods for various mathematical operations and tasks such as differentiation, integration
CO 5: Find Numerical solutions by using Taylor Series, Euler's method and Runge Kutta method

Text Book:

1. Dr S Arumugam**,** A Thangapandi Isaac & Dr A.Somasundaram, *Numerical Analysis with Programming in C*, New Gamma Publishing House, Palayamkottai, June 2013.

Unit I: Chapter 1
Unit II: Chapter 3 (sec3.1 – 3.2)
Unit III: Chapter 4
Unit IV: Chapter 5, 6
Unit V: Chapter 7

Reference Books:

1. S. Sastry, *Introductory Methods of Numerical Analysis*, PHI Learning Private Limited, Fourth Edition, 2009.
2. H.C. Saxena, *Finite Differences and Numerical Analysis*, S. Chand & Company Limited, 2001.
3. T. K.Manicavachagom pillay, S. Narayanan, *Numerical Analysis*, S.Viswanathan (Printer&Publisher), Private Limited, Edition 2001.

E-Resources:

1. http://www.math.iitb.ac.in/~baskar/book.pdf
2. https://www.math.ust.hk/~machas/numerical-methods.pdf

3. https://www.youtube.com/watch?v=qhUIx096afA

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	9	3	9	9	9	**51**
CO2	3	3	3	3	9	9	3	**33**
CO3	3	9	3	3	9	9	9	**45**
CO4	9	3	9	3	9	9	9	**51**
CO5	9	9	9	3	9	9	9	**57**
Total	**27**	**33**	**33**	**15**	**45**	**45**	**39**	**237**

Low-1 Medium-3 High-9

Core VI - Real Analysis - I

(For Students Admitted from 2022-23)

Semester: III **Hours / week: 4**
Subject Code: IBMXC32 **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 R-Applications of the supremum property-Functions-Archimedean property- Density of rational numbers in R.

Unit III **(12 hours)**

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

Unit IV **(12 hours)**

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

Unit V **(12 hours)**

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

Course Outcomes:

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

CO 1: Compute the direct, inverse images and composition of functions

CO 2: Make use of completeness property of R in the real line

CO 3: Evaluate the limit of the sequence

CO 4: Analyze the concepts of subsequences, series and their application in various fields of sciences

CO 5: Apply various tests to find the absolute convergence of an infinite series of real numbers

Text Book:

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

Unit 1: Chapter 1 (1.1.1 -1.1.14 and 1.3.1 -1.3.13)

Unit 2: Chapter 2 (2.2.7-2.2.9, 2.3.1 -2.3.6 and 2.4.1 -2.4.6, 2.4.8)

Unit 3: Chapter 3 (3.1.1-3.1.11, 3.2.1 -3.2.11 and 3.3.1 -3.3.6)

Unit 4: Chapter 3 (3.4.1-3.4.9, 3.5.1-3.5.6, and 3.7.1 -3.7.9)

Unit 5: Chapter 9 (9.1.1 -9.1.2, 9.2.1 -9.2.10, and 9.3.1 -9.3.5)

Reference Books:

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

E-Resources:

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

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

Low-1 Medium-3 High-9

OEC I - Quantitative Aptitude for Competitive Examinations-I

(For Students Admitted from 2022-23)

Semester: III **Hours / week: 2**
Subject Code: IBOE3MX **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_aptitude_made_easy_ugcportal_pdf
4. https://www.youtube.com/watch?v=_cW7_BUDYcw
5. https://iim-cat-questions-answers.2iim.com/quant/geometry/mensuration/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	1	9	3	9	9	**43**
CO2	3	9	1	9	9	9	9	**49**
CO3	3	9	3	9	3	9	9	**45**
CO4	3	9	9	9	9	9	9	**57**
CO5	3	9	9	9	9	9	9	**57**
Total	**15**	**45**	**23**	**45**	**33**	**45**	**45**	**251**

Low-1 Medium-3 High-9

SEC III – Fourier Series

(For Students Admitted from 2022-23)

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

Course Objectives:

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

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

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

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

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

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

Course Outcomes:

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

CO1: Find the solution of problem using trigonometric series

CO2: Evaluate Fourier series using properties of odd and even function

CO3: Classify trigonometric functions of sine and cosine and solve problems

CO4: Evaluate Fourier series using change of Interval

CO5: Compute the solution of Harmonic Analysis

Text Book:

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

Unit I: Chapter 6(sec 1, 2)

Unit II: Chapter 6(sec 3, 4)

Unit III: Chapter 6(sec 5.1, 5.2)

Unit IV: Chapter 6(sec 6, 7)

Unit V: Chapter 6(sec8)

References:

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

E-Resources:

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

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

Low-1 Medium-3 High-9

Extra Credit - Logical Reasoning

(For Students Admitted from 2022-23)

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							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	1	3	1	3	3	**23**
CO2	3	9	1	3	3	3	3	**25**
CO3	3	9	1	3	1	3	3	**23**
CO4	3	9	1	3	1	3	3	**23**
CO5	3	9	1	3	1	3	3	**23**
Total	**15**	**45**	**5**	**15**	**7**	**15**	**15**	**117**

Low-1 Medium-3 High-9

Core VII - Abstract Algebra-I

(For Students Admitted from 2022-23)

Semester: IV **Hours / week: 4**
Subject Code: IBMXC41 **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, lnc.2005.
2. Jimmie Gilbert**,** Linda Gilbert, *Elements of Modern Algebra***,** Cengage Learning, 5th Edition, 2004.
3. M.L. Santiago, *Modern Algebra*, Tata McGraw Hill Publishing Company Limited, New Delhi.

E-Resources:

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

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

Low-1 Medium-3 High-9

Core VIII - Statics

(For Students Admitted from 2022-23)

Semester: IV **Hours / week: 5**
Subject Code: IBMXC42 **Credit: 4**

Course Objectives:

1. To determine the resultant of the system of forces acting on the body, moment of forces and the motion of inertia of the body
2. To explore and analyze the behavior of a Friction and its problems

Unit I **(15 hours)**

Forces acting at a point: Resultant and components - Parallelogram of forces - Analytical expression for the resultant of two forces acting at a point - The polygon of forces - Lami's theorem - An Extended form of the parallelogram law of forces - Resolution of a force - Theorem on resolved parts - Resultant of any number of forces acting at a point - Conditions of equilibrium of any number of forces acting upon a particle.

Unit II **(15 hours)**

Parallel forces and moments: Resultant of two like and unlike parallel forces acting on a rigid body - Conditions of equilibrium of three coplanar parallel forces – Varigon's theorem of moments - Moment of a force about an axis.

Unit III **(15 hours)**

Couples: Equilibrium of two couples - Couples in parallel planes - Representation of a couple by a vector - Resultant of a couple and a forces.

Unit IV **(15 hours)**

Coplanar forces: Reduction of any number of coplanar forces - Conditions for a system of forces to reduce to a single force or to a couple - Change of the base point - Equation to the line of action of the resultant - Conditions of equilibrium of a system of coplanar force.

Unit V **(15 hours)**

Friction: Experimental results - Statical**,** Dynamical and Limiting friction - Laws of friction - A passive force - Angle of friction - Cone of friction - Equilibrium of a particle on a rough inclined plane - Equilibrium of a body on a rough inclined plane under a force parallel to the plane - Equilibrium of a body on a rough inclined plane under any force - Problems.

Course Outcomes:

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

CO 1: Explain the concept of the forces and to categorize its forces
CO 2: Evaluate the parallel forces, moments and equilibrium
CO 3: Examine the properties of Couples of forces
CO 4: Illustrate the insides of coplanar forces and its conditions of equilibrium
CO 5: Defend the experimental results on Friction

Text Book:

1. Dr. M.K.Venkataraman - *A Text book of Statics,* Agasthiar Publications – 19th edition, 2018.

Unit I: Chapter 2
Unit II: Chapter 3
Unit III: Chapter 4
Unit IV: Chapter 6
Unit V: Chapter 7

Reference Books:

1. P. Duraipandiyan, *Mechanics (Vector Treatment),* S.Chand and Co, 2007.
2. S. Ramsey, *Statics*, CBS publishers and Distributers, Delhi, First Indian Edition, 1985.
3. A.V. Dharmapadam, *Statics*, S. Viswanathan (Printers &Publishers) Private Limited,

Reprint 2011.

E-Resources:

1. https://www.youtube.com/watch?v=jhGYYlwfkE0
2. https://www.youtube.com/watch?v=UABd38mEzsw
3. https://www.youtube.com/watch?v=FnnQhNxWz48
4. https://byjus.com/physics/static-friction/

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	1	3	3	3	3	**19**
CO2	3	3	1	3	3	3	3	**19**
CO3	3	3	1	3	3	3	3	**19**
CO4	3	1	3	3	3	3	3	**19**
CO5	3	1	3	3	3	3	3	**19**
Total	**15**	**11**	**9**	**15**	**15**	**15**	**15**	**95**

Low-1 Medium-3 High-9

OEC II: Quantitative Aptitude for Competitive Examinations II

(For Students Admitted from 2022-23)

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, 2nd Edition, 2007.
3. Dr.R.S. Aggarwal**,** *Quantitative Aptitude***,** S.Chand Publications.7th Edition, 2015.

E-Resources:

1. https://www.youtube.com/watch?v=oGT0AOihPr8
2. https://www.youtube.com/watch?v=jxlWNJ1MghA
3. https://www.youtube.com/watch?v=PfHOs4ukM5g
4. https://www.youtube.com/watch?v=Qz-WBXsLkos
5. https://www.youtube.com/watch?v=JBNUfNpm35Y

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	1	3	3	**19**
CO2	3	3	3	3	1	3	3	**19**
CO3	3	3	3	3	1	3	3	**19**
CO4	3	3	3	3	3	3	3	**21**
CO5	3	3	3	3	3	3	9	**27**
Total	**15**	**15**	**15**	**15**	**9**	**15**	**21**	**105**

Low-1 Medium-3 High-9

SEC IV - R Tool Lab

(For Students Admitted from 2022-23)

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

Course Objectives:

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

Course Outcomes:

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

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

List of Program

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

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

Low-1 Medium-3 High-9

Extra Credit – Applications of Group Theory

(For Students Admitted from 2022-23)

Semester: IV
Subject Code: IBMXX4 **Credit: 2**
Course Objectives:
1. To use group theory in information theory
2. To recognize the concept of error correcting group codes

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

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

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

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

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

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

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

Reference Books:
1. Dr. M.K. Venkatraman, Dr. N. Sridharan & Dr. N. Chandrasekaran, *Discrete Mathematics*,

Edition, 2006.
2. Arumugam S & Issac. A.T, *Modern Algebra*, Scitech Publications (India) Private Limited, 2007.
3. JK Sharma, *Discrete Mathematics*, Macmillan India Limited, Second Edition, 2005.

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

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

Low-1 Medium-3 High-9

Core IX- Abstract Algebra-II

(For Students Admitted from 2022-23)

Semester: V **Hours / week: 6**
Subject Code: IBMXC51 **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=ERfbtPBEYVA
3. https://gacbe.ac.in/pdf/ematerial/18BMA51C-U4.pdf
4. https://nptel.ac.in/courses/111/107/111107105/

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

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

Core X – Graph Theory

(For Students Admitted from 2022-23)

Semester: V **Hours / week: 6**
Subject Code: IBMXC52 **Credit: 5**

Course Objectives:
1. To introduce the fundamental concepts in graph theory, in a sense of some its modern applications
2. To solve real life problems through the diagrammatic representation of the problems

Unit I **(18 hours)**
Graphs and subgraphs: Introduction - Definition and Examples – Degrees - Subgraphs– Isomorphism - Ramsey Numbers- Independent Sets and Coverings –Intersection Graphs and Line Graphs – Matrices - Operations on Graphs.

Unit II **(18 hours)**
Degree sequences: Introduction-Degree Sequences-Graphic Sequences- **Connectedness**: Introduction-Walks-Trails-Paths- Connectedness and Components-Blocks-Connectivity.

Unit III **(18 hours)**
Trees: Introduction – Characterisation of trees – Center of a tree – **Planarity:** Introduction – Definition and Properties – Characterization of Planar graphs Thickness**.** Crossing and outer Planarity.

Unit IV **(18 hours)**
Colourability: Introduction – Chromatic Number and Chromatic Index – The Five Colour Theorem – Four Colour Problem – Chromatic Polynomials.

Unit V **(18 hours)**
Directed Graphs: Introduction – Definitions and Basic Properties –Paths and Connections – 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 graph for a given graphical degree sequence
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 directed graphs

Text Book:
1. Dr. S. Arumugam, S. Ramachandran**,** *Invitation to graph theory* – Scitech Publications Private Limited, First published July 2015.

Unit I: Chapter 2 (2.0 – 2.9)
Unit II: Chapter 3 (3.0 – 3.2) & Chapter 4 (4.0 – 4.4)
Unit III: Chapter 6 (6.0 – 6.2) & Chapter 8 (8.0 – 8.3)

Unit IV: Chapter 9 (9.0 – 9.4)
Unit V : Chapter 10 (10.0 – 10.4)

Reference Books:

1. Harary, *Graph theory*, Narosa publishing House, First edition
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://www.whitman.edu/mathematics/cgt_online/book/section05.08.html
4. https://nptel.ac.in/courses/111/106/111106102/
5. https://www.maths.ed.ac.uk/~v1ranick/papers/wilsongraph.pdf
6. https://d3gt.com/unit.html

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	9	3	9	**51**
CO2	9	9	9	3	9	3	9	**51**
CO3	9	3	9	3	9	9	9	**51**
CO4	3	9	9	3	9	9	9	**51**
CO5	9	9	9	3	9	9	9	**57**
Total	**39**	**39**	**45**	**15**	**45**	**33**	**45**	**261**

Low-1 Medium-3 High-9

Core XI - Dynamics

(For Students Admitted from 2022-23)

Semester: V **Hours / week: 6**
Subject Code: IBMXC53 **Credit: 5**

Course Objectives:

1. To apply the concept of collision, direct impact and oblique impact of two smooth spheres on a fixed smooth plane
2. To explore and analyze the behavior of a projectile and its trajectory

Unit I **(16 hours)**

Kinematics : Speed – Displacement – Velocity – Resolution of Velocities – Triangle of Velocities – Polygon of Velocities – Relative Velocity – Angular Velocity – Change of Velocity – Acceleration - Relative Acceleration – Examples – **The Laws of motion:** Newton‟ s Laws of Motion Composition of forces – Weight – Distinction between Mass and Weight – Force of Friction.

Unit II **(20 hours)**

Projectiles: Definitions – Two fundamental Principles - Path of a Projectile – Characteristics of the Motion of a Projectile – Horizontal Range – The Velocity of the Projectile – Range, Greatest Distance, Time of Flight – Motion on the surface of a smooth inclined Plane.

Unit III **(20 hours)**

Impulsive Forces: Impulse Impulsive force – Impact of Two Bodies – Loss of Kinetic Energy Impact- **Collision of Elastic Bodies**: Fundamental Laws of Impact- Impact of a Smooth Sphere on a fixed Smooth Plane– Direct Impact of Two Smooth Spheres – Loss of Kinetic Energy due to Direct Impact of Two Smooth Spheres – Oblique Impact of Two Smooth Spheres – Loss of Kinetic Energy due to Oblique Impact of Two Smooth Spheres.

Unit IV **(20 hours)**

Simple harmonic motion: Simple harmonic motion in a straight line – general solution of the SHM equation – geometrical representation of a SHM – change of origin – composition of two simple harmonic motion – motion of a particle suspended by a spiral spring – horizontal oscillations of a particle tied to an elastic spring – Simple pendulum –Period of oscillation of a simple pendulum – Equivalent simple pendulum - The seconds pendulum – loss or gain in the number of oscillations made by a pendulum.

Unit V **(14 hours)**

Motion under the action of central forces: Velocity and acceleration in polar coordinates – equations of motion in polar coordinates – Note on the equiangular spiral – Motion under a central force – differential equation of central orbits – Perpendicular from the pole on the tangent formulae in polar coordinates - Pedal equation of the central orbit – Pedal equation of some of the well-known curves - Velocities in a central orbit – Two fold problems in the central orbits.

Course Outcomes:

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

CO 1: Inspect the concept of laws, mass and weight.
CO 2: Recapitulate the concepts of projectiles.
CO 3: Illustrate the knowledge of Collision of Elastic Bodies and loss of kinetic energy.
CO 4: Determine the general solutions of problems using Simple Harmonic Motion.
CO 5: Evaluate polar coordinates and pedal equations of the central orbits.

Text Book:

1. Dr. M.K.Venkataraman - *A Text book of Dynamics*, Agasthiar Publications 18th Edition, 2017.

Unit I: Chapter 3, 4(Pg.no: 14 – 64 & 77 – 91)
Unit II: Chapter 6 (Pg.no: 139 – 184)
Unit III: Chapter 7, 8 (Pg.no: 201 – 256)
Unit IV: Chapter 10 (Pg.no: 309 – 355)
Unit V: Chapter 11 (Pg.no: 356 – 384)

Reference Books:

1. A.V. Dharmapadam, *Dynamics***,** S.Viswanathan Publishers Private Limited, 2006.
2. P. Duraipandian, Laxmi Duraipandian and Muthamizh Jayapragasam, *Mechanics*, S.Chand

& Company Private Limited, First Edition, 2014.

E-Resources:

1. https://www.physicsclassroom.com/Physics-Tutorial/1-D-Kinematics
2. https://openstax.org/books/university-physics-volume-1/pages/4-3-projectile-motion
3. https://www.youtube.com/watch?v=JqkwmJtjfBk

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	1	9	9	**43**
CO2	3	3	3	3	3	3	3	**21**
CO3	3	3	9	3	3	9	3	**33**
CO4	3	3	3	3	1	9	3	**25**
CO5	3	3	9	3	1	9	3	**31**
Total	**21**	**21**	**27**	**15**	**9**	**39**	**21**	**153**

Low-1 Medium-3 High-9

DSE I - Fourier and Laplace Transforms

(For Students Admitted from 2022-23)

Semester: V **Hours / week: 4**
Subject Code: IBMXE5A **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 **(12 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 **(12 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 **(12 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: Analyse the initial and final value theorems of Laplace transforms

Text Books:

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

Reference Books:

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

E- Resources:

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

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

Low-1 Medium-3 High-9

DSE I – Combinatorics

(For Students Admitted from 2022-23)

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

Course Objectives:

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

Unit I **(12 hours)**

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

Unit II **(12 hours)**

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

Unit III **(12 hours)**

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

Unit IV **(12 hours)**

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

Unit V **(12 hours)**

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

Course Outcomes:

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

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

CO 2: Solve difference equations using generating functions technique

CO 3: Examine the solutions of Permutations with forbidden problems

CO 4: Estimate the number of derangements using the principle of inclusion and exclusion

CO 5: Solve the problems by using Burnside and Polya's theorem

Text Book:

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

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

Reference Books:

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

E- Resources:

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

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

Low-1 Medium-3 High-9

DSE II - Fluid Dynamics

(For Students Admitted from 2022-23)

Semester: V **Hours / week: 4**

Subject Code: IBMXE5C **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-symmertric three dimensional flows and stroke 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 Publishinig 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
2. https://www.youtube.com/watch?v=4xTA5MfZRU0
3. https://youtu.be/dlOCuYqTEpI

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	1	3	3	3	**19**
CO2	3	3	3	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**
Total	**15**	**15**	**15**	**11**	**15**	**15**	**11**	**97**

Low-1 Medium-3 High-9

DSE II - Operations Research

(For Students Admitted from 2022-23)

Semester: V **Hours / week: 4**
Subject Code: IBMXE5D **Credit: 4**

Course Objectives:

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

Unit I **(12 hours)**

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 **(12 hours)**

Use of Artificial variables: Degeneracy in L.P.P.- Duality in Linear Programming - Introduction - General Primal - Dual Pair - Formulating a Dual Problem - Primal-Dual Pair in Matrix Form - Dual Simplex method.

Unit III **(12 hours)**

Games and Strategies: Introduction - Two-Person Zero-Sum Games - Some Basic terms - The Maximin - Minimax Principle - Games without Saddle Points - Mixed Strategies - Graphic Solution of 2 x n and m x 2 Games - Dominance Property.

Unit IV **(12 hours)**

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

Unit V **(12 hours)**

Network Model: Scope and Definition of network Models- Minimal Spanning Tree Algorithm- Shortest-Route Problem- maximal Flow Model- CPM and PERT.

Course Outcomes:

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

CO1: Apply Graphical and Simplex method to get optimality of Linear Programming Problem

CO2: Analyze artificial variable to make effective mathematical formulation

CO3: Make use of different strategies and find the solutions for games and events

CO4: Assess Transportation Model for optimal solutions

CO5: Adapt CPM / PERT techniques to plan schedule and control project activities

Text Books:

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

Unit I: Chapter 2(2.3 – 2.4), Chapter 3(3.2 – 3.5) & Chapter 4(4.1 – 4.3)

Unit II: Chapter 4(4.4 – 4.5), Chapter 5(5.1 – 5.4 & 5.9)

Unit III: Chapter 17(17.1 – 17.7)

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

Unit IV: Chapter 5 (5.1-5.4)

Unit V: Chapter 6(6.1-6.5)

Reference Books:

1. S.D. Sharma, *Operations Research*, Dedar Nath Ram Nath, 2009.
2. Srinivasan, *Operations Research - Principles and Appplications*, PHI Learning Private Limited, Second Edition, 2012.

E- Resources:

1. https://www.youtube.com/watch?v=YPn4yHM1YsU
2. http://www.math.wsu.edu/faculty/genz/364/lessons/l3067.pdf

3. https://www.youtube.com/watch?v=fSuqTgnCVRg
4. Transportation problem||vogel's approximation[VAM]|Northwest corner||Least cost||Using Simple Method - YouTube
4. https://www.youtube.com/watch?v=b1btzVsKp8E

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	9	9	3	**51**
CO2	3	9	9	9	9	9	3	**51**
CO3	3	3	9	9	3	9	9	**45**
CO4	9	9	9	9	9	9	9	**63**
CO5	9	9	9	9	9	9	9	**63**
Total	**33**	**39**	**45**	**39**	**39**	**45**	**33**	**273**

Low-1 Medium-3 High-9

SEC V – Operations Research Lab – LINDO / LINGO Package

(For Students Admitted from 2022-23)

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

Course Objectives:

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

List of Programmes:

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

Course Outcomes:

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

CO 1: Identify the basic concepts of LINDO / LINGO Package
CO 2: Apply commands in LINDO / LINGO Package to solve L.P.P and transportation problems
CO 3: Discover the LINDO / LINGO Package for solving problems on assignment problems
CO 4: Examine the problems on project scheduling and Games & Strategies by using LINDO / LINGO Package

CO 5: Discover the commands in LINDO / LINGO Package to solve problems on Shortest – Route Algorithms

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

Low-1 Medium-3 High-9

Core XII- Real Analysis - II

(For Students Admitted from 2022-23)

Semester: VI **Hours / week: 6**
Subject Code: IBMXC61 **Credit: 5**

Course Objectives:

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

Unit I **(18 hours)**

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

Unit II **(18 hours)**

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

Unit III **(18 hours)**

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

Unit IV **(18 hours)**

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

Unit V **(18 hours)**

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

Course Outcomes:

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

CO 1: Describe the concepts of limits, continuity, differentiability and integrability of real functions

CO 2: Make use of continuity in Bolzano intermediate value theorem

CO 3: Examine the derivative of L' Hospital's rules and Taylor's theorem

CO 4: Illustrate the concept of Riemann integral and its Properties

CO 5: Differentiate closed set and open set

Text Book:

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

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

Reference Books:

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

E- Resources:

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

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

Low-1 Medium-3 High-9

Core XIII- Complex Analysis

(For Students Admitted from 2022-23)

Semester: VI **Hours / week: 6**
Subject Code: IBMXC62 **Credit: 4**

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

Unit I **(22 hours)**
Complex Numbers: Regions in the complex plane - **Analytic Functions:** Functions of a complex variable - Mappings - Mappings by the Exponential function - Limits - Theorems on Limits - Continuity - Derivatives - Differentiation Formulas - Cauchy Riemann Equations - Sufficient conditions for Differentiability - polar co-ordinates - Analytic Functions - Harmonic Functions.

Unit II **(22 hours)**
Integrals: Derivatives of functions w(t) - Definite integrals of functions w(t) - contours - contour Integrals - Some Examples - Examples with branch cuts - upper bounds for moduli of contour integrals - Cauchy Integral Formula - An Extension of the Cauchy integral formula - Some consequences of the extension – Liouville's Theorem and the Fundamental Theorem of Algebra - Maximum modulus Principle.

Unit III **(17 hours)**
Series: Convergence of Sequences and series - Taylor Series - Proof of Taylor's theorem - Examples - Laurent Series - Proof of Laurent's theorem - Examples.

Unit IV **(17 hours)**
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 **(12 hours)**
Mapping by Elementary Functions: Linear Transformations - The transformation w = 1/z - Mappings by 1/z - Linear Fractional Transformations - An implicit form.

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

Text Book:
1. James Ward Brown and Ruel.V. Churchill - *Complex Variables and Applications,* Eighth Edition, Mc Graw Hill, Inc, 2016.
Unit I: Chapter 1 (section 11 only) Chapter 2 (sections 12 - 16, 18 - 26)

Unit II: Chapter 4 (sections 37 – 43 & 50 - 54)
Unit III: Chapter 5 (Sections 55 - 62)
Unit IV: Chapter 6 (Sections 68 - 77)
Unit V: Chapter 8 (sections 90 - 94)

Reference Books:

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

E- Resources:

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

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

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

Core XIV- Astronomy

(For Students Admitted from 2022-23)

Semester: VI **Hours / week: 5**
Subject Code: IBMXC63 **Credit: 4**

Course Objectives:

1. To understand the reasons for celestial events
2. To emphasis on the formation of universe

Unit I **(17 hours)**

Spherical Trigonometry: Sphere - Great Circles and Small Circles - Axis and Poles of a Circle - Distance between Two points on a Sphere - Angle between Two Circles Secondaries - Angular radius or Spherical Radius- Spherical Figures - Spherical Triangle - Polar Triangle - Cosine Formula - Sine Formula - Cotangent formula- Five Parts Formula - Functions of Half an Angle - Functions of Half a Side – Delambre's Analogies – Napier's Analogies - Spherical Co-ordinates - General Proof of the Cosine Formula - Formulae in Plane Trigonometry.

Unit II **(13 hours)**

Celestial Sphere, Diurnal Motion: Celestial Sphere - Celestial coordinates - Sidereal time.

Unit III **(15 hours)**

Refraction: Laws of Refraction - Astronomical Refraction - Tangent formula for Refraction- General Effects of Refraction – Cassini's Formula - Horizontal Refraction.

Unit IV **(13 hours)**

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

Unit V **(17 hours)**

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

Course Outcomes:

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

CO 1: Determine the concepts of Spherical trigonometry
CO 2: Find celestial time
CO 3: Illustrate the laws of refractions and formulae
CO 4: Summarize the path of the Moon, Solar and lunar and Structures of Moon
CO 5: Examine the concept of the eclipses and conditions for the occurrences

Text Book:

1. S. Kumaravelu, and Susheela Kumaravelu, *Astronomy*, A Bhaskara Selvan, Sivakasi, 2009.

Unit I: Chapter I (Pg.no: 1 – 8 & 12 – 37)
Unit II: Chapter II (Pg.no: 38 – 71)
Unit III: Chapter IV (Pg.no: 140 – 157)
Unit IV: Chapter XII (Pg.no: 334 – 357)
Unit V: Chapter XIII (Pg.no: 367 – 417 & 425 – 430)

Reference Books:

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

E-Resources:

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

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

Low-1 Medium-3 High-9

Core XV- Project

(For Students Admitted from 2022-23)

Semester: VI **Hours / week: 6**

Subject Code: IBMXC64PW **Credit: 5**

Course Objectives:

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

Project Outline:

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

Course Outcomes:

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

CO 1: Make use of research methodology and techniques of the literature applicable to their own research

CO 2: Determine solutions to the unsolved problems

CO 3: Analyze the abilities and techniques in the critical evaluation of current research

CO 4: Apply new ideas in the respective field of study and environment

CO 5: Design innovative projects with the application of mathematical concepts towards scientific and societal development

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

Low-1 Medium-3 High-9

DSE III – Lattice Theory and Boolean Algebra

(For Students Admitted from 2022-23)

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 **(15 hours)**

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 **(15 hours)**

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

Unit IV **(12 hours)**

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

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

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

DSE III – Mathematical Modeling

(For Students Admitted from 2022-23)

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

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

Unit I **(12 hours)**

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

Unit II **(12 hours)**

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

Unit III **(12 hours)**

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

Unit IV **(12 hours)**

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

Unit V **(12 hours)**

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

Course Outcomes:

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

CO 1: Examine the techniques of mathematical modeling

CO 2: Identify appropriate mathematical modeling through ordinary differential equations with relevant parameters and conditions

CO 3: Analyze the concept of mathematical modeling through differential equations in economics and finance

CO 4: Illustrate the concept of mathematical modeling through graph

CO 5: Gain the knowledge on calculus of variations and dynamic programming

Text Book:

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

Unit I: Chapter 1 (sec 1.3 – 1.9)

Unit II: Chapter 2 (sec 2.1 – 2.6)

Unit III: Chapter 5 (sec 5.1 – 5.3, 5.5)

Unit IV: Chapter 7 (sec 7.1 – 7.5)

Unit V: Chapter 9 (sec 9.1 – 9.3)

Reference Books:

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

E- Resources:

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

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

Low-1 Medium-3 High-9

SEC VI - Applied Statistics

(For Students Admitted from 2022-23)

Semester: VI **Hours / week: 2**
Subject Code: IBMXS65 **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 - Unweighted 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:

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

E-Resources:

1. https://www.youtube.com/watch?v=Qtr5z7GBEwY
2. https://www.youtube.com/watch?v=DEKJq5DapXc
3. https://www.youtube.com/watch?v=pQbl4kqn98M

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
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**
Total	**15**	**13**	**9**	**15**	**13**	**15**	**15**	**95**

Low-1 Medium-3 High-9

Extra Credit – Quantitative Techniques
(For Students Admitted from 2022-23)

Semester: VI
Subject Code: IBMXX6 **Credit: 2**

Course Objectives:
1. To understand operations, research techniques used for planning, scheduling and controlling large and complex projects
2. To get motivated 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 a 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: Take a decision in any critical environment

Text Book:
1. Kanti Swarup, P. K. Gupta, Man Mohan, *Operations Research*, Sultan Chand & Sons, New Delhi, Eighteenth Edition, 2015.

Unit I: Chapter 9
Unit II: Chapter 12(Sec 12:1 – 12:6)
Unit III: Chapter 13
Unit IV: Chapter 14
Unit V: Chapter16

Reference Books:
1. P.K. Gupta and Man Mohan, *Problems in Operations Research*, Sultan Chand & Sons, New Delhi, Fourteenth Edition, 2002.
2. Prem Kumar Gupta and D.S. Hira, *Operations Research*, Sultan Chand & Sons, New Delhi, First Edition, 1993.
3. Hamdy A. Taha, *Operations Research: An Introduction*, Prentice Hall, Eighth Edition, 2007.

E- Resources:
1. https://onlinecourses.swayam2.ac.in/cec22_ma03/preview
2. https://www.youtube.com/watch?v=nqowUJzG-M&list=PL_z_8CaSLPWekqhdCPmFohncHwz8TY2Go

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	3	9	3	**27**
CO2	9	3	9	3	3	9	9	**45**
CO3	3	3	3	3	3	9	3	**27**
CO4	3	3	3	3	3	9	3	**27**
CO5	9	3	9	3	3	3	9	**39**
Total	**27**	**15**	**27**	**15**	**15**	**39**	**27**	**165**

Low-1 Medium-3 High-9

AECC III –Discrete Mathematics
For B Sc Information Technology
(For Students Admitted from 2022-23)

Semester: III **Hours / week: 4**
Subject Code: IBITA33 **Credit: 4**

Course Objectives:

1. To motivate the students to think logically and apply the techniques in solving problems
2. To analyse the outcomes of mathematical arguments using logical laws

Unit I **(12 hours)**

Set Theory & Relations - Introduction- sets-Venn-Euler diagrams - Operation on sets - Properties of set operations - verification of basic laws of algebra-principle of duality. Relations - Operation on relations - equivalence relation - Closure and Warshall's Algorithm - partitions and Equivalence classes.

Unit II **(12 hours)**

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

Unit III **(12 hours)**

Recurrence relations and Generating functions - Recurrence - an introduction- polynomial and their relations -Solutions of finite order homogeneous (linear) relations- Solutions of non-homogeneous relations- generating functions- Primitive recursive function.

Unit IV **(12 hours)**

Matrix algebra - Introduction- operations-inverse, Rank of matrix - solution of Simultaneous linear equations - Eigen values and Eigen vectors.

Unit V **(12 hours)**

Graph Theory - Basic concepts - Matrix representation of graphs - trees, spanning tree - shortest path problem.

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, 2
Unit II: Chapter 3,4
Unit III: Chapter 5
Unit IV: Chapter 6
Unit V: Chapter 11

Reference Books:

1. Alan Doerr & Kenneth Levasseur, *Applied Discrete Structures for Computer Science*, Asian Student Edition, 1989.

2. J.K Sharma, *Discrete Mathematics*, Macmillan Publishers India Limited, Third Edition, 2013.
3. C.L. Liu, *Elements of Discrete Mathematics*, Mc Graw Hill Book Company, New Delhi, 1986.

E- Resources:
1. https://www.google.co.in/books/edition/Applied_Discrete_Structures
2. https://youtu.be/JVpggpCUNO4
3. https://youtu.be/IPeHcdX-Tvw

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	3	3	3	3	1	**25**
CO2	3	3	3	1	3	3	1	**17**
CO3	3	3	3	1	3	3	1	**17**
CO4	3	9	3	3	3	3	3	**27**
CO5	3	3	3	3	3	3	3	**21**
Total	**15**	**27**	**15**	**11**	**15**	**15**	**9**	**107**

Low-1 Medium-3 High-9

AECC IV- Statistics
For B Sc Information Technology
(For Students Admitted from 2022-23)

Semester: IV **Hours / week: 5**
Subject Code: IBITA43 **Credit: 4**

Course Objectives:
1. To gain knowledge on correlation and regression.
2. To know about index numbers and time series

Unit I **(15 hours)**
Central Tendencies: Introduction - Arithmetic Mean - Mode - Geometric Mean and Harmonic Mean - Measures of Dispersion.

Unit II **(15 hours)**
Moments, Skewness and Kurtosis: Curve fitting - Principle of least squares.

Unit III **(15 hours)**
Correlation and Regression: Rank correlation Regression - Correlation Coefficient for a Bivariate Frequency Distribution.

Unit IV **(15 hours)**
Interpolation: Finite Differences – Newton's Formula – Lagrange's Formula - Attributes -

Consistency of Data - Independence and Association of Data.

Unit V **(15 hours)**

Index Numbers: Consumer Price Index Numbers - Analysis of Time series - Time series - Components of a Time series - Measurement of Trends.

Course Outcomes:

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

CO 1: Build the skills in basic statistical concepts

CO 2: Apply the various measures of statistical parameters in real life

CO 3: Estimate the correlation coefficient for a bivariate frequency distribution and regression

CO 4: Make use of Newton's and lagrange's formula for solving the finite difference statistical problem

CO 5: Analyze the time series and measure the trends of statistical data

Text Book:

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

Unit I: Chapter 2, 3
Unit II: Chapter 4, 5
Unit III: Chapter 6
Unit IV: Chapter 7, 8
Unit V: Chapter 9, 10

Reference Books:

1. R.S.N.Pillai and Bagavathi, *Statistics - Theory and Practice*, S.Chand and Company Private Limited, New Delhi, 2007.
2. S.C. Gupta & V.K. Kapoor, *Mathematical Statistics*, Sultan Chand & Sons, Eleventh Edition 2007.
3. D.C.Sancheti, V.K.Kapoor, *Statistics (Theory, Methods and Applications)*, Sultan Chand & Sons, 2012.

E-Resources:

1. https://youtu.be/ztIBfKD_eFg
2. https://youtu.be/OfANWrzQE9Q
3. https://youtu.be/F_2GIheAbtI

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	9	3	3	1	9	9	43
CO2	9	9	3	3	3	9	9	45
CO3	3	9	3	3	1	9	9	37
CO4	3	3	9	3	1	9	9	37
CO5	3	3	9	3	3	9	9	39
Total	27	33	27	15	9	45	45	201

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

AECC III - Statistics

For B Sc Computer Science

(For Students Admitted from 2022-23)

Semester: III **Hours / week: 4**
Subject Code: IBCSA33 **Credit: 4**

Course Objectives:
1. To gain knowledge on correlation and regression
2. To know about index numbers and time series

Unit I **(12 hours)**
Central Tendencies: Introduction - Arithmetic Mean - Mode - Geometric Mean and Harmonic Mean.

Unit II **(12 hours)**
Measures of Dispersion: - Range – Quartile deviation – Mean deviation - Standard deviation - **Moments, Skewness and Kurtosis:** Moments - Skewness and Kurtosis.

Unit III **(12 hours)**
Correlation and Regression: Rank correlation Regression - Correlation Coefficient for a Bivariate Frequency Distribution.

Unit IV **(12 hours)**
Index Numbers: Consumer Price Index Numbers

Unit V **(12 hours)**
Analysis of Time series: - Time series - Components of a Time series - Measurement of Trends.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Build the skills in basic statistical concepts
CO 2: Apply the various measures of statistical parameters in real life
CO 3: Estimate the correlation coefficient for a bivariate frequency distribution and regression
CO 4: 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
Uni t II: Chapter 3, 4
Unit III: Chapter 6
Unit IV: Chapter 9

Unit V: Chapter 10

Reference Books:

1. R.S.N.Pillai and Bagavathi, *Statistics Theory and Practice*, S.Chand and Company Private Limited, New Delhi, 2007.
2. S.C. Gupta & V.K. Kapoor, *Mathematical Statistics*, Sultan Chand & Sons, Eleventh Edition, 2007.
3. D.C.Sancheti, V.K.Kapoor, *Statistics (Theory, Methods and applications),* Sultan Chand & Sons, 2012.

E-Resources:

1. https://youtu.be/ztIBfKD_eFg
2. https://youtu.be/OfANWrzQE9Q
3. https://youtu.be/F_2GIheAbtI

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	1	9	9	**43**
CO2	9	9	3	3	3	9	9	**45**
CO3	3	9	3	3	1	9	9	**37**
CO4	3	3	9	3	1	9	9	**37**
CO5	3	3	9	3	3	9	9	**39**
Total	**27**	**33**	**27**	**15**	**9**	**45**	**45**	**201**

Low-1 Medium-3 High-9

AECC IV – Operations Research
For B Sc Computer Science

(For Students Admitted from 2022-23)

Semester: IV **Hours / week: 5**
Subject Code: IBCSA43 **Credit: 4**

Course Objectives:

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

Unit I **(15 hours)**

Linear Programming Problem - Mathematical formulation of the problem - Illustrations on Mathematical Formulation of LPPs - Graphical solution and Extension: Graphical solution method - some exceptional cases - General L.P.P - Canonical and standard forms of L.P.P- Linear Programming - Simplex method- Introduction - Fundamental properties of solutions - The computational procedure.

Unit II **(15 hours)**

Use of Artificial variables - Degeneracy in L.P.P - Duality in Linear Programming -

Introduction - General Primal - Dual Pair - Formulating a Dual Problem - Primal-Dual Pair in Matrix Form - Dual Simplex method.

Unit III **(15 hours)**

Games and Strategies - Introduction - Two-Person Zero-Sum Games - Some Basic terms - The Maximin - Minimax Principle - Games without Saddle Points - Mixed Strategies - Graphic Solution of 2 x n and m x 2 Games - Dominance Property.

Unit IV **(15 hours)**

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

Unit V **(15 hours)**

Network Model: Scope and Definition of network Models- Minimal Spanning Tree Algorithm- Shortest-Route Problem- maximal Flow Model- CPM and PERT.

Course Outcomes:

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

CO1: Apply Graphical and Simplex method to get optimality of Linear Programming Problem

CO2: Analyze Assignment problem technique to make effective business decisions

CO3: Make use of different strategies to find the solutions for games and events

CO4: Assess Transportation Model for optimal solutions

CO5: Adapt CPM/ PERT techniques to plan schedule and control project activities

Text Books:

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

Unit I: Chapter 2(2.3 – 2.4), Chapter 3(3.2 – 3.5) & Chapter 4(4.1 – 4.3)

Unit II: Chapter 4(4.4 – 4.5), Chapter 5(5.1 – 5.4 & 5.9)

Unit III: Chapter 17(17.1 – 17.7)

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

Unit IV: Chapter 5 (5.1-5.4)

Unit V: Chapter 6(6.1-6.5)

Reference Books:

1. S.D. Sharma, *Operations Research*, Dedar Nath Ram Nath, 2009.
2. Srinivasan, *Operations Research - Principles and Appplications***,** PHI Learning Private Limited, Second Edition, 2012.

E-Resources:

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

5. https://www.youtube.com/watch?v=b1btzVsKp8E

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	3	9	3	**27**
CO2	9	3	9	3	3	9	9	**45**
CO3	3	3	3	3	3	9	3	**27**
CO4	3	3	3	3	3	9	3	**27**
CO5	9	3	9	3	3	3	9	**39**
Total	**27**	**15**	**27**	**15**	**15**	**39**	**27**	**165**

Low-1 Medium-3 High-9

AECC I - Numerical Methods
For BCA

(For Students Admitted from 2022-23)

Semester: I **Hours / week: 5**
Subject Code: IBCPA13 **Credit: 4**

Course Objectives:

1. To provide the numerical methods of solving the non-linear equations, interpolation, differentiation, and integration
2. To apply numerical methods to obtain approximate solutions to mathematical problems

Unit I **(15 hours)**

Solution of Algebraic and Transcendental equations: The Bisection method - The Method of False position - Iteration method - Newton - Raphson method.

Unit II **(15 hours)**

Interpolation: Finite differences - Forward Differences - Backward Differences - Central Differences - Symbolic Relations and Separation of Symbols. Newton's Formulae for Interpolation – Gauss's central difference formulae – Stirling's formula - Interpolation with unevenly spaced points: Lagrange's interpolation formula - Inverse Interpolation.

Unit III **(15 hours)**

Numerical Differentiation: Derivatives using Newton's Forward Difference Formula - Derivatives using Newton's Backward Difference Formula - Derivatives using Stirling's Formula - Maxima and Minima of Tabulated Function. Numerical Integration: General Quadrature Formula - Trapezoidal Rule – Simpson's 1/3 Rule - Simpsons 3/8 Rule.

Unit IV **(15 hours)**

Numerical Solutions of System of Linear Equations: Gauss elimination method - Gauss - Jordan method - Solution of linear systems-iterative methods.

Unit V **(15 hours)**

Numerical Solutions of Ordinary Differential Equations: Solution by Taylor's series – Picard's method of successive approximations - 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, 5th Edition, 2012.

Unit I : Chapter 2(2.1- 2.5)
Unit II: Chapter 3(3.3, 3.6, 3.7(3.7.1, 3.7.2), 3.9(3.9.1), 3.11)
Unit III: Chapter5 (5.2, 5.3, 5.4(5.4.1 - 5.4.3))
Unit IV: Chapter6 (6.3.2,6.3.3,6.4)
Unit V: Chapter7 (7.2, 7.3, 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, *Numerical Method*, Tata McGraw Hill, Education Private Limited, 2009.
3. ShankaraRao K, *Numerical Methods for Scientists and Engineers*, Prentice Hall of India, 2001.

E-Resources:

1. https://www.youtube.com/watch?v=YPn4yHM1YsU
2. http://www.math.wsu.edu/faculty/genz/364/lessons/l3067.pdf
3. https://www.youtube.com/watch?v=fSuqTgnCVRg

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	3	3	9	9	9	**51**
CO2	3	9	3	3	3	3	9	**33**
CO3	3	9	3	3	3	9	9	**39**
CO4	9	9	9	3	9	9	9	**57**
CO5	3	3	9	3	3	9	9	**39**
Total	**27**	**39**	**27**	**15**	**27**	**39**	**45**	**219**

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

AECC II– Discrete Mathematics
For B Sc Cyber Security
(For Students Admitted from 2022-23)

Semester: I **Hours / week: 5**
Subject Code: IBCYA13 **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 **(15 hours)**
Set Theory & Relations - Introduction- sets-Venn-Euler diagrams-Operation on sets-Properties of set operations- verification of basic laws of algebra-principle of duality. Relations - Operation on relations - equivalence relation – Closure and Warshall's Algorithm-partitions and Equivalence classes.

Unit II **(15 hours)**
Functions & Mathematical induction - Functions and Operators - One - One, Onto functions - special types of functions- invertible functions - composition of functions. Techniques of proofs - mathematical induction.

Unit III **(15 hours)**
Recurrence relations and Generating functions - Recurrence - an introduction - polynomial and their relations - Solutions of finite order homogeneous (linear) relations - Solutions of non-homogeneous relations - generating functions- Primitive recursive function.

Unit IV **(15 hours)**
Matrix algebra – Introduction – operations - inverse, Rank of matrix – solution of Simultaneous linear equations - Eigen values and Eigen vectors.

Unit V **(15 hours)**
Graph Theory - Basic concepts - Matrix representation of graphs - trees, spanning tree - shortest path problem.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Verify the basic laws of algebra and compute the principle of duality
CO 2: Evaluate the mathematical induction and invertible function
CO 3: Build the skill of matrix algebra and its applications in systems
CO 4: Analyze the recurrence relation and generating functions
CO 5: Apply the concept of graph theory in the study of shortest path algorithms

Text Book:
1. Dr M.K. Venkataraman, Dr N. Sridharan, Dr N. Chandrasekaran, *Discrete Mathematics*,

The National Publishing Company, 2012.

Unit I: Chapter 2
Unit II: Chapter 3,4
Unit III: Chapter 5
Unit IV: Chapter 6
Unit V: Chapter 11

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
2. https://youtu.be/JVpggpCUNO4
3. https://youtu.be/IPeHcdX-Tvw

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	3	3	3	3	1	**25**
CO2	3	3	3	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**
Total	**15**	**27**	**15**	**15**	**15**	**15**	**9**	**111**

Low-1 Medium-3 High-9

AECC III –Statistics
For B Sc Cyber Security

(For Students Admitted from 2022-23)

Semester: III **Hours / week: 4**
Subject Code: IBCYA33 **Credits: 4**

Course Objectives:

1. To find moments skewness and kurtosis from the given data and to fit the curve
2. To gain knowledge about correlation and regression

Unit I **(12 hours)**

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

Unit II **(12 hours)**

Measures of Dispersion: - Range – Quartile deviation – Mean deviation – Standard deviation **- Moments, Skewness and Kurtosis:** Moments -Skewness and Kurtosis.

Unit III **(12 hours)**

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

Unit IV **(12 hours)**

Index Numbers: Consumer Price Index Numbers

Unit V **(12 hours)**

Analysis of Time series: Time series - Components of a Time series - Measurement of Trends.

Course Outcomes:

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

CO 1: Build the skills in basic statistical concepts
CO 2: Apply the various measures of statistical parameters in real life
CO 3: Estimate the correlation coefficient for a bivariate frequency distribution and regression
CO 4: Make use of Index numbers for solving the statistical problem
CO 5: Analyze the time series and measure the trends of statistical data

Text Book:

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

Unit I: Chapter 2
Unit II: Chapter 3, 4
Unit III: Chapter 6
Unit IV: Chapter 9
Unit V: Chapter 10

Reference Books:

1. R.S.N. Pillai and Bagavathi, *Statistics Theory and Practice*, S. Chand and Company Private Limited, New Delhi, 2007.
2. S.C. Gupta & V.K. Kapoor, *Mathematical Statistics*, Sultan Chand & Sons, Eleventh Edition, 2007.
3. D.C. Sancheti, V.K. Kapoor, *Statistics (Theory, Methods and Applications)*, Sultan Chand & Sons, 2012.

E-Resources:

1. https://youtu.be/ztIBfKD_eFg
2. https://youtu.be/OfANWrzQE9Q
3. https://youtu.be/F_2GIheAbtI

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	9	3	3	1	9	9	33
CO2	9	9	3	3	3	9	9	45
CO3	3	9	3	3	1	9	9	37
CO4	3	3	9	3	1	9	9	37
CO5	3	3	9	3	3	9	9	39
Total	27	33	27	15	9	45	45	201

Low-1 Medium-3 High-9

AECC IV – Operations Research
For B Sc Cyber Security

(For Students Admitted from 2022-23)

Semester: IV **Hours / week: 5**
Subject Code: IBCYA43 **Credit: 4**

Course Objectives:

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

Unit I **(15 hours)**

Linear Programming Problem - Mathematical formulation of the problem - Illustrations on Mathematical Formulation of LPPs - Graphical solution and Extension: Graphical solution method - some exceptional cases - General L.P.P - Canonical and standard forms of L.P.P- Linear Programming - Simplex method- Introduction - Fundamental properties of solutions - The computational procedure.

Unit II **(15 hours)**

Use of Artificial variables - Degeneracy in L.P.P - Duality in Linear Programming - Introduction - General Primal - Dual Pair - Formulating a Dual Problem - Primal-Dual Pair in Matrix Form - Dual Simplex method.

Unit III **(15 hours)**

Games and Strategies - Introduction - Two-Person Zero-Sum Games - Some Basic terms - The Maximin - Minimax Principle - Games without Saddle Points - Mixed Strategies - Graphic Solution of 2 x n and m x 2 Games - Dominance Property.

Unit IV **(15 hours)**

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

Unit V **(15 hours)**

Network Model: Scope and Definition of network Models- Minimal Spanning Tree

Algorithm- Shortest-Route Problem- maximal Flow Model- CPM and PERT.

Course Outcomes:

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

CO1: Apply Graphical and Simplex method to get optimality of Linear Programming Problem

CO2: Analyze Assignment problem technique to make effective business decisions

CO3: Make use of different strategies to find the solutions for games and events

CO4: Assess Transportation Model for optimal solutions

CO5: Adapt CPM/ PERT techniques to plan schedule and control project activities

Text Books:

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

Unit I: Chapter 2(2.3 – 2.4), Chapter 3(3.2 – 3.5) & Chapter 4(4.1 – 4.3)

Unit II: Chapter 4(4.4 – 4.5), Chapter 5(5.1 – 5.4 & 5.9)

Unit III: Chapter 17(17.1 – 17.7)

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

Unit IV: Chapter 5 (5.1-5.4)

Unit V: Chapter 6(6.1-6.5)

Reference Books:

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

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

E-Resources:

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

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	3	9	3	**27**
CO2	9	3	9	3	3	9	9	**45**
CO3	3	3	3	3	3	9	3	**27**
CO4	3	3	3	3	3	9	3	**27**
CO5	9	3	9	3	3	3	9	**39**
Total	**27**	**15**	**27**	**15**	**15**	**39**	**27**	**165**

Low-1 Medium-3 High-9

AECC I – Mathematics-I
For B Sc Chemistry

(For Students Admitted from 2022-23)

Semester: I **Hours / week: 5**
Subject Code: IBCHA13 **Credit: 4**

Course Objectives:
1. To acquire knowledge about the rank of a matrix
2. To acquire basic knowledge in Algebra and Trigonometry

Unit I **(15 hours)**
Algebra: Partial fraction - Binomial series - Application of the binomial theorem to the summation of series - approximation and limits.

Unit II **(15 hours)**
Algebra: Exponential series - Logarithmic series.

Unit III **(15 hours)**
Theory of Equations: Nature of Roots-Relation between the coefficients and the roots of an algebraic equation -Transformation of equations - Reciprocal equations - Transformation of equation in general.

Unit IV **(15 hours)**
Matrices: Definition and algebraic operations -Rank of matrix.

Unit V **(15 hours)**
Trigonometry: Expansions of $\sin n\theta$ and $\cos n\theta$ - powers of sines and cosines of θ in terms of functions of multiple of θ- Expansion of $\sin\theta$ and $\cos\theta$ in a series of ascending powers of θ - Hyperbolic functions.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Establish the applications of Binomial theorem in terms of series
CO 2: Classify exponential series and logarithmic series
CO 3: Solve the roots of the given equation by adopting different methods
CO 4: Use algebraic operations to find the rank of the matrices
CO 5: Examine the concept of trigonometric function and hyperbolic functions

Text Book:
1. S. Narayanan, R. Hanumantha Rao**,** T.K. Manicavchagam Pillay and Dr. P. Kandaswamy, *Ancillary Mathematics - Volume–I*, S.Viswanathan (Printers & Publishers) Private Limited, 2015.

Unit I: Chapter 1(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=x6uB4JflJHk
2. https://www.youtube.com/watch?v=5oDdSb9Jv6c
3. https://kanchiuniv.ac.in/coursematerials/expansiontrignometry.pdf

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	3	1	3	1	**21**
CO2	3	3	1	3	1	3	1	**15**
CO3	9	9	1	3	3	3	1	**29**
CO4	9	9	1	3	3	3	3	**31**
CO5	3	3	1	3	3	3	3	**19**
Total	**33**	**27**	**5**	**15**	**11**	**15**	**9**	**115**

Low-1 Medium-3 High-9

AECC II - Mathematics-II
For B Sc Chemistry

(For Students Admitted from 2022-23)

Semester: II **Hours / week: 5**
Subject Code: IBCHA23 **Credit: 4**

Course Objectives:

1. To acquire knowledge in Differential calculus and integral calculus
2. To solve the basic problems in numerical methods and Laplace Transform

Unit I **(15 hours)**

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

Unit II **(15hours)**

Differential Calculus: Higher derivatives - Jacobian - polar coordinates.

Unit III **(15 hours)**

Integration: Integrals of functions containing linear functions of x - Integrals of functions Involving $a^2 \pm b^2$ - Integrals of functions of the form $\int f(x^n)\, x^{n-1} dx$ -Integrals of functions

of the form $\int\{f(x)\}^n$ f´(x)dx.

Unit IV **(15 hours)**

Fourier series: Introduction - Even and Odd functions – Half range fourier series - Development in cosine series - Development in sine series - Change of interval- Combination of series.

Unit V **(15 hours)**

Laplace Transform: Definition - Method 1, 2 and 3 –some general theorems-The inverse transform.

Course Outcomes:

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

CO 1: Examine the solutions of problem using forward difference formula and backward difference formula

CO 2: Find the derivatives for higher order equations

CO 3: Simplify different forms of integral concepts

CO 4: Apply the construction of Fourier Series in different environment

CO 5: Describe the different concept of Laplace transformations

Text Books:

1. S. Narayanan, R. Hanumantha Rao, T.K. Manicavchagam Pillay, Dr. P. Kandaswamy, *Ancillary Mathematics - Volume I*, S.Viswanathan Printers and Publishers, Private Limited, 2015.

Unit I: Chapter 4 (Pg.no: 172-202)

Unit II: Chapter 6 (Pg.no:266 – 295)

2. S.Narayanan, R. Hanumantha Rao, T.K. Manicavchagam Pillay, Dr. P Kandaswamy, *Ancillary Mathematics - Volume II*, S. Viswanathan Printers and Publishers, Private Limited, 2015.

Unit III: Chapter 1 (Pg.no: 1 -18)

Unit IV: Chapter 2 (Pg.no: 123-159)

Unit V: Chapter 7 (Pg.no: 289 -317)

Reference Books:

1. K. Thilagavathy and P. Kandaswamy, *Allied Mathematics paper I*, S. Chand and Company Limited**,** Reprint, 2010.
2. Dr.M.K. Venkataraman and Mrs. Manorama Sridhar *Allied Mathematics*, Agasthiar Publications, First Edition, 2015.
3. Prof.P. Duraipandian and Dr.S. Udayabaskaran, *Allied Mathematics Vol-2*, S. Chand & Company, Private Limited, Reprint, 2016.

E- Resources

1. https://nptel.ac.in/courses/111/107/111107105/
2. https://www.youtube.com/watch?v=TS9V9OfBggI
3. https://www.youtube.com/watch?v=RDtITuZDZi4
4. https://www.youtube.com/watch?v=Gxr3AT4NY_Q
5. https://www.maths.usyd.edu.au/MATH2065/r/Week9Lect3.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	1	3	3	9	3	**37**
CO2	3	3	1	3	3	3	3	**19**
CO3	9	3	1	3	3	3	3	**25**
CO4	3	3	3	3	3	3	3	**21**
CO5	3	3	3	3	3	3	3	**21**
Total	**27**	**21**	**9**	**15**	**15**	**21**	**15**	**123**

Low-1 Medium-3 High-9

AECC III – Psychological Statistics – Descriptive
For B Sc Psychology

(For Students Admitted from 2022-23)

Semester: III **Hours / week: 4**
Subject Code: IBSYA33 **Credit: 4**

Course Objectives:

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

Graphical Representation of Data: Meaning of Graphical Representation of Data - Advantages of Graphical Representation of Data - Mode of Graphical Representation of Data - Smoothing of frequency Curve - Polygon and Ogive.

Unit III **(12 hours)**

Measures of Central Tendency: Meaning of the Measures of Central Tendency - Arithmetic Mean, Median & Mode - Computation of Median and Mode from the Curve of Frequency Distribution - When to use the Mean, Median and Mode.

Unit IV **(12 hours)**

Measure of Variability: Meaning and Importance of the Measure of Variability - Types of Measure of Variability - When and Where to use the Various Measure of Variability.

Unit V **(15 hours)**

Linear Correlation: Meaning and Types - Coefficient of Correlation - Construction of

Scatter Diagram.

Course Outcomes:

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

CO 1: Understand the scales of measurements

CO 2: Analyze the results of graphical representation of data

CO 3: Apply the formula to compute the solution of mean, median, mode

CO 4: Apply the formula and analyze when and where to use the measures of variability

CO 5: Construct scatter diagram using linear correlation concept

Text Book:

1. Mangal S.K., *Statistics in Psychology and Education*, PH Learning Private Limited, New Delhi, Second Edition, 2016.

Unit I: Chapter1, 2

Unit II: Chapter 3

Unit III: Chapter 4

Unit IV: Chapter6

Unit V: Chapter7

Reference Books:

1. Henry E. Garrett**,** *Statistics in Psychology and Education*, Surjeet Publications, Second Edition, 2012.
2. Arthur Aron, Elliot J. Coups, Elaine N. Aron, *Statistics for Psychology*, Sixth Edition, 2019.
3. K.R. Gupta, *Statistical Methods in Education and Psychology*, 2017.

E- Resources:

1. https://www.yourarticlelibrary.com/education/statistics/graphic-representation-of-data-meaning-principles-and-methods/64884
2. https://www.scribbr.com/statistics/central-tendency/
3. https://m.youtube.com/watch?v=qb3X01m4H68

Course Outcomes	**Programme Outcomes**							
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**Total**
CO1	3	1	1	1	1	1	3	**11**
CO2	3	1	3	1	3	3	3	**17**
CO3	3	3	3	3	3	3	9	**27**
CO4	3	1	1	1	1	3	9	**19**
CO5	3	1	1	3	3	3	3	**17**
Total	**15**	**7**	**9**	**9**	**11**	**13**	**27**	**91**

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

AECC IV Psychological Statistics -Inferential

For B Sc Psychology

(For Students Admitted from 2022-23)

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: Chapter9
Unit III: Chapter 10
Unit IV: Chapter 11(Page No: 181-196)
Unit V: Chapter 17(Page No: 319 – 334)

Reference Books:

1. Henry E. Garrett, *Statistics in Psychology and Education***,** Surjeet Publications, Second Edition, 2012.
2. Arthur Aron, Elliot J. Coups, Elaine N. Aron, *Statistics for Psychology*, Sixth Edition, 2019.
3. K.R. Gupta, *Statistical Methods in Education and Psychology*, 2017.

E- Resources:

1. https://www.youtube.com/watch?v=wRfL_EhC-E8
2. https://www.youtube.com/watch?v=LXTCbOyDIlo
3. https://www.youtube.com/watch?v=-yQb_ZJnFXw

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	3	3	3	**21**
CO2	3	3	3	1	1	3	3	**17**
CO3	3	3	3	1	1	3	1	**15**
CO4	3	3	3	3	1	3	3	**19**
CO5	3	3	3	3	3	3	3	**21**
Total	**15**	**15**	**15**	**11**	**9**	**15**	**13**	**93**

Low-1 Medium-3 High-9

Certificate Programme in LATEX

(Six Months Regular Programme)
(For Students Admitted from 2022-23)

PROGRAMME STRUCTURE

Subject Code	Course	Subject Title	Hours	Credit	ESE
HCLT1	Core I	Documentation Techniques in LATEX	30	5	100
HCLT2P	Core II	Pictures and Colors Lab	50	5	100
		Total	**80**	**10**	**200**

Core I – Documentation Techniques in LATEX

(For Students Admitted from 2022-23)

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*, Addition - Wesley, Fourth Edition, 2003.
2. David F. Griffiths and Desmond J.Higham, *Learning LaTeX*, Siam Society for industrial And Applied mathematics Philadelphia, Second Edition.
3. Dilip Datta, *LaTeX in 24 Hours* - A Practical Guide for Scientific Writing, Springer 2017.

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

Core II -Pictures and Colors Lab Practical

(For Students Admitted from 2022-23)

Subject Code: HCLT2P **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.
7. Create a document using commands and environments.
8. Create a document using mathematical formulas.
9. Create a document using mathematical symbols.
10. Create a document using arrays.
11. Create a document using table.
12. Create a document using bibliography
13. Create a document using page style.
14. Create a document using pictures.
15. Create a document using colors.
16. Create a document using basic of the math index.

17. Create a document using fine print.
18. Create a document using bibliography database.
19. Create a document using math mode environment.
20. Create a document using tabbing environment.
21. Create a document using line and page breaking.
22. Create a document using boxes.
23. Create a document using graphics packages.

B Sc Data Science

(Three Year Regular Programme)
(For Students Admitted from 2022-23)

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 Life long learning through self-paced and self - directed learning to meet out the change in life

Programme Specific Outcomes:

PSO 1: Disciplinary Knowledge: Apply computing theory, languages and algorithms, as well as mathematical and statistical models and the principles of optimization to appropriates, formula and use data analyze. Formulate and use appropriate models of data analysis to solve hidden solution to business related challenges

PSO 2: Effective Communication: Organize, visualize and analyze large, complex datasets using descriptive statistics and graphs to make decisions

PSO 3: Research Skill and Critical Thinking: Critically apply the theories and methodologies of data science to new research in their primary area of study.

PSO 4: Ethical Awareness: Develop and implement data analysis Strategies base on theoretical principles, ethical considerations and detailed knowledge of the underlying data

PSO 5: Digital Literacy: Demonstrate an ability to articulate, assess and apply appropriate theories and principles of information management. Student can construct complex statistical models, assess the fit of such models to the data and apply the models in real-world contexts

PSO 6: Problem Solving Skill: Identify, assess and select appropriate among data analytics methods and models for solving a particular real-world problem, weighing their advantages and disadvantages.

PSO 7: Self-Learning: Recognize the need for lifelong learning and have the ability to engage independent learning keeping in mind the rapid technological changes

Programme Code: UDS
PROGRAMME STRUCTURE

Sem	Part	Subject code	Course	Subject Title	Hours/ Week	Credit	Marks		
							CIA	ESE	Total
I	I	IBLT11/ IBLA11/ IBLH11	Language I	Tamil I / Arabic I / Hindi I	5	3	40	60	100
	II	IBLEI12 IBLEII12	Language II	English I a or b	5	3	40	60	100
	III	IBDSC11	Core I	○Programming in C	5	4	40	60	100
		IBDSC12	Core II	R Programming	6	5	40	60	100
		IBDSA13	AECC I	Mathematical Statistics - I	5	4	40	60	100
	IV	IBDSS14P	SEC I	Programming in C Lab	2	2		50	50
			Library / Browsing		1				
			Remedial / Games		1				
				Total	**30**	**21**	**200**	**350**	**550**
II	I	IBLT21/ IBLA21/ IBLH21	Language I	Tamil II / Arabic II / Hindi II	5	3	40	60	100
	II	IBLEI22 IBLEII22	Language II	English II a or b	5	3	40	60	100
	III	IBDSC21	Core III	Discrete Mathematics	5	5	40	60	100
		IBDSC22	Core IV	Python Programming	4	4	40	60	100
		IBDSA23	AECC II	Mathematical Statistics - II	5	4	40	60	100
	IV	IBDSS24P	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 Examinations/ *Online Course		2		100	100
			Library/ Browsing		1				
			Remedial/ Games		1				
				Total	**30**	**23+2**	**200**	**400 +100**	**600+ 100**
III	I	IBLT31/ IBLA31/	Language I	Tamil III / Arabic III / Hindi III	5	3	40	60	100

		IBLH31							
	II	IBLEI32 IBLEII32	Language II	English III a or b	5	3	40	60	100
	III	IBDSC31	Core V	Calculus & Differential Equations	4	4	40	60	100
		IBDSC32	Core VI	Structured Query language	4	4	40	60	100
		IBDSA33	AECC I	Natural Language Processing	4	4	40	60	100
	IV	IBOE3DS	OEC I		2	2		50	50
		IBDSS34P	SEC III	PHP Lab	2	2		50	50
		IBHR3	GIC II	Human Rights	2	2		50	50
	V	IBXTN3	Extension	NSS/CSS	2	2	100		100
		IBDSX3/ IBDSX3O	Extra Credit	Logical Reasoning/*Online course		2		100	100
				Total	**30**	**26+2**	**300**	**450+ 100**	**750+ 100**
IV	I	IBLT41/ IBLA41/ IBLH41	Language I	Tamil IV / Arabic IV / Hindi IV	5	3	40	60	100
	II	IBLEI42 IBLEII42	Language II	English IV a or b	5	3	40	60	100
	III	IBDSC41	Core VII	Matrix Theory & Linear Algebra	4	4	40	60	100
		IBDSC42	Core VIII	○ Machine Learning & Artificial Intelligence	5	4	40	60	100
		IBDSA43	AECC II	Big Data Analytics	5	4	40	60	100
	IV	IBLVE4	GIC III	Life Skills and Value Education	2	2		50	50
		IBOE4DS	OEC II		2	2		50	50
		IBDSS44P	SEC IV	Data Analytics Lab - II	2	2		50	50
		IBDSX4/ IBDSX4O	Extra Credit	Applications of Group Theory /*Online Course		2		100	100
				Total	**30**	**24+2**	**200**	**450+ 100**	**650+ 100**
V	III	IBDSC51	Core IX	Numerical Methods I	6	5	40	60	100
		IBDSC52	Core X	#Deep Learning	6	5	40	60	100
		IBDSC53	Core XI	Graph Theory	6	5	40	60	100
		IBDSE5A/ IBDSE5B	DSE I.a/ DSE I.b	Time series analysis and Forecasting / Operating Systems	4	4	40	60	100
		IBDSE5C/ IBDSE5D	DSE II.a/ DSE II.b	Operations Research / Distributed systems	4	4	40	60	100
	IV	IBDSS54P	SEC V	Programming in Java Lab	2	2		50	50
		IBWE5/	GIC IV	Women Entrepreneurship	2	2		50	50

		IBDSX5O	Extra Credit	Employability Skills/ *Online Course		2	100		100
				Total	**30**	**27+2**	**200+ 100**	**400**	**600+ 100**
VI	III	IBDSC61	Core XII	Numerical Methods II	6	5	40	60	100
		IBDSC62PW	Core XIII	Project	6	5	40	60	100
		IBDSC63	Core XIV	Computer Vision	5	4	40	60	100
		IBDSC64	Core XV	Regression Analysis	6	4	40	60	100
		IBDSE6A/ IBDSE6B	DSE III.a/ DSE III.b	Data Structures and Algorithms /Data base Security	4	4	40	60	100
	IV	IBDSS65P	SEC VI	Data Mining Lab	2	2		50	50
			Library/ Browsing		1				
		IBDSX6/ IBDSX6O	Extra Credit	Quantitative Techniques/* Online Course		2		100	100
				Total	**30**	**24+2**	**200**	**350+ 100**	**550+ 100**
				Grand Total	**180**	**145 + 10**	**1300 +100**	**2400 +400**	**3700 +500**

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

- o Integrated Course
- # Internship

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 2022-23)

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 print f function – gets and puts function – Interactive programming.
Control Statements: Preliminaries – **Branching:** The If-else Statement - Looping – while statement – do-while statement – for statement – nested control structures – switch statement – break statement – continue statement – coma operator – goto statement - **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 for strings
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
2. https://nptel.ac.in/courses/106/105/106105171/
3. https://onlinecourses.nptel.ac.in/noc21_cs01/preview

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	9	9	3	9	**45**
CO2	9	3	3	3	9	3	9	**39**
CO3	9	3	3	3	9	9	9	**45**
CO4	9	3	3	3	9	9	9	**45**
CO5	9	9	9	3	9	9	9	**45**
Total	**45**	**21**	**21**	**21**	**45**	**27**	**45**	**225**

Low-1 Medium-3 High-9

Core II - R Programming

(For Students Admitted from 2022-23)

Semester : I **Hours/week: 6**
Subject Code: IBDSC12 **Credit: 5**

Course Objectives:

1. To know the fundamentals of statistical analysis in R environment
2. To understand probability and sampling distributions

Unit I **(18 hours)**

Introduction to R Programming

R and R Studio, Logical Arguments, Missing Values- Characters- Factors and Numeric- Help in R- Vector to Matrix- Matrix Access- Data Frames- Data Frame Access- Basic Data Manipulation Techniques- Usage of various apply functions – apply- lapply- sapply and tapply- Outlier's treatment.

Unit II **(18 hours)**

Descriptive Statistics

Types of Data- Nominal, Ordinal, Scale and Ratio- Measures of Central Tendency- Mean, Mode and Median- Bar Chart- Pie Chart and Box Plot- Measures of Variability- Range- Inter-Quartile- Range- Standard Deviation- Skewness and Kurtosis- Histogram- Stem and Leaf Diagram- Standard Error of Mean and Confidence Intervals.

Unit III **(18 hours)**

Probability- Probability& Sampling Distribution

Experiment- Sample Space and Events- Classical Probability- General Rules of Addition- Conditional Probability- General Rules For Multiplication- Independent Events- Bayes' Theorem- Discrete Probability Distributions: Binomial- Poisson- Continuous Probability Distribution- Normal Distribution & t-distribution- Sampling Distribution and Central Limit Theorem.

Unit IV **(18 hours)**

Statistical Inference and Hypothesis Testing

Population and Sample- Null and Alternate Hypothesis- Level of Significance- Type I and Type II Errors- One Sample t Test- Confidence Intervals- One Sample Proportion Test- Paired Sample t Test- Independent Samples t Test- Two Sample Proportion Tests- One Way Analysis of Variance and Chi Square Test.

Unit V **(18 hours)**

Correlation and Regression

Analysis of Relationship- Positive and Negative Correlation- Perfect Correlation- Correlation Matrix- Scatter Plots- Simple Linear Regression- R Square, Adjusted R Square- Testing of Slope- Standard Error of Estimate- Overall Model Fitness- Assumptions of Linear Regression- Multiple Regression- Coefficients of Partial Determination- Durbin Watson Statistics- Variance Inflation Factor.

Course Outcomes:

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

CO 1: Describe key terminologies, concepts and techniques employed in Statistical Analysis
CO 2: Demonstrate fundamentals of statistical analysis in R environment
CO 3: Analyze the purpose of exploration using Descriptive and Inferential Statistics
CO 4: Evaluate the variety of Hypothesis Tests to aid Decision Making.
CO 5: Create application of Linear Regression in multivariate context for predictive purpose.

Text Book:

1. Ken Black, 2013, *Business Statistics*, New Delhi, Wiley.

Reference Books:

1. Lee, Cheng. et al., 2013, *Statistics for Business and Financial Economics*, New York: Heidelberg Dordrecht.
2. Anderson, David R., Thomas A. Williams and Dennis J. Sweeney, 2012, *Statistics for Business and Economics*, New Delhi: Southwestern.
3. Waller, Derek, 2008, *Statistics for Business*, London: BH Publications.
4. Levin, Richard I. and David S. Rubin, 1994, *Statistics for Management*, New Delhi: Prentice Hall.

E Resources:

1. https://onlinecourses.nptel.ac.in/noc19_ma33/preview
2. https://onlinecourses.nptel.ac.in/noc22_ma69/preview

3. https://onlinecourses.nptel.ac.in/noc22_ma34/preview

Course Outcome	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	1	9	9	9	**43**
CO2	9	3	3	1	9	9	9	**43**
CO3	9	3	3	1	9	9	9	**43**
CO4	9	3	3	1	9	9	9	**43**
CO5	9	3	3	1	9	9	9	**43**
Total	45	15	15	5	45	45	45	**215**

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

AECC I –Mathematical Statistics - I

(For Students Admitted from 2022-23)

Semester: I **Hours / Week: 5**
Subject Code: IBDSA13 **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 **(15 hours)**

Theory of Probability: Random Experiment - Event - Probability: Mathematical Notion - Probability function - Laws of Addition of probabilities - Laws of multiplication or Theorem of Compound Probability - Independent Events - Pairwise Independent Events - Mutually Independent Events – Baye's Theorem.

Unit II **(15 hours)**

Random Variables and Distribution Functions: Properties of Distribution Function - Discrete Random variable – Probability mass function - Discrete distribution function - Continuous random variable - Probability density function - Continuous distribution function

Joint p.m.f and marginal and conditional probability function - Joint p.d.f - Joint density function, marginal density function - Independent random variable - The conditional distribution function and conditional p.d.f.

Unit III **(15 hours)**

Mathematical Expectation and Generating Functions: Additional theorem of expectation

Multiplication theorem of expectation - Covariance - Expectation of linear combination of random variables - Variables of a linear combination of random variables - Expectation of continuous random variables - Moment generating function - Theorems on moment generating functions.

Unit IV **(15 hours)**

Theoretical Discrete Distributions: Binomial Distribution: Recurrence relation for the moments of Binomial Distribution - Moments Generating functions of Binomial Distribution - Recurrence relation for the probabilities of Binomial Distribution. **Poisson distribution:** Moments of the Poisson distribution - Mode of the Poisson distribution - Recurrence relation for the moments of the Poisson distribution -

Moment generating function of Poisson distribution - Additive property of independent Poisson variates - Recurrence formula for the probability of Poisson distribution.

Unit V **(15 hours)**

Theoretical Continuous Distributions: Normal Distribution: Chief characteristics of the Normal Distribution and Normal probability curve - M.G.F of Normal Distribution -Moments of Normal Distribution - A linear combination of independent Normal variates is also a Normal variate - Area property - Importance of Normal Distribution - Fitting of Normal Distribution.

Course Outcomes:

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

CO 1: Illustrate and differentiate the basic probability concepts
CO 2: Analyze the Probability density function to solve the problems
CO 3: Evaluate relationship between joint p.m.f and joint p.d.f
CO 4: Make use of poison and binomial distribution to solve real life problems
CO 5: Classify the random variables and determine solution to the given problems by MGF

Text Book:

1. S.C.Gupta, V.K.Kapoor**,** *Elements of Mathematical Statistics***,** Sultan Chand and Sons, Third Editon, Reprint 2015.

UnitI: Chapter 4 (4.5-4.5.2, 4.6-4.6.2, 4.7, 4.7.2-4.7.4, 4.8);
Unit II: Chapter 5 (5.1-5.4.1, 5.4.3, 5.5.1-5.5.5)
Unit III: Chapter 6 (6.1-6.9.1);
Unit IV: Chapter 7 (7.2, 7.2.2, 7.2.6, 7.2.10, 7.3.1-7.3.5, 7.3.8-7.3.9)
Unit V: Chapter 8 (8.1, 8.2.2, 8.2.5, 8.2.7-8.2.8, 8.2.11, 8.2.13-8.2.14)

Reference Books:

1. S. Arumugam and A. Thangapandi Isaac, *Statistics***,** New Gamma Publishing Houses, 2009.
2. S.C.Gupta, V.K.Kapoor, *Fundamental of Mathematical Statistics***,** Sultan Chand and Sons, Eleventh Edition, Reprint 2019.

E - Resources:

1. https://cims.nyu.edu/~cfgranda/pages/stuff/probability stats for DS.pdf
2. https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=+u3y6UdbIvOJ97LFeSCmHQ=
3. https://www.researchgate.net/publication/272237355 Probability and Mathematical Statistics

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

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

SEC I- Programming in C Lab

(For Students Admitted from 2022-23)

Semester: I **Hours/week: 2**
Subject Code: IBDSS14P **Credit: 2**

Course Objectives:

1. To introduce the programming skills using C language
2. To enhance the analysing and problem solving skills and use the same for writing Programs in C

List of Programs

Formula Substitution

1. Check whether the given number is odd or even
2. Find sum of the digits and reverse the digits
3. Generate the Fibonacci series
4. Generate Prime number within range
5. Find whether a given number is Armstrong or not
6. Count the number of positive, negative and zero in the list
7. C Program to solve the Quadratic Equation
8. C Program to find the area of various shapes using switch case

Array

9. Create a C Program to Find Matrix Addition , Subtraction, Multiplication and Transpose of a matrix using switch case
10. Create a C Program to Check whether the element is present in the given list or not
11. Create a C Program to sort numbers in ascending and descending order
12. Create a C Program to sort names in Alphabetical order

Functions & Structures

13. Create a C Program to find the factorial of a given number using function declaration
14. Create a C Program to find the factorial of a given number using recursion function
15. Create a C Program to Prepare student mark list using structure
16. Create a C Program to Prepare electricity bill using structure

String Manipulation

17. Create a C Program to count the vowels in the given string
18. Create a C Program to convert the case of given string from upper case to lower case and vice versa

Pointers

19. Create a C Program to sort numbers in ascending order using pointers
20. Create a C Program to find average of two numbers using pointers

Note:-Questions for Internal and External examination will be based on concept learnt

Course Outcomes:

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

CO1: Remember the control structures and loops
CO2: Apply the concepts of functions and pointers
CO3: Analyze the concepts of structures by creating student mark list and electricity bill
CO4: Evaluate string handling functions

CO5: Create programs with pointers, arrays and structures

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	1	9	9	9	**43**
CO2	9	3	3	1	9	9	9	**43**
CO3	9	3	3	1	9	9	9	**43**
CO4	9	3	3	1	9	9	9	**43**
CO5	9	3	3	1	9	9	9	**43**
Total	45	15	15	5	45	45	45	**215**

Low-1 Medium-3 High-9

Core III- Discrete Mathematics

(For Students Admitted from 2022-23)

Semester: II **Hours / week: 5**
Subject Code: IBDSC21 **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 – Propositional equivalences Predicates and quantifiers – Nested quantifiers – Rules of inference - Introduction to proofs - Proof methods and strategy.

Unit II **(15 hours)**

Basic Structures: Sets, Functions, Sequences and Sums – Set Operations – Functions – Recursive Functions – Sequences and Summations. **Relations:** Relations and their Properties -n-array Relations and their Applications - Representing Relations - Closures of Relations, Equivalence Relations - Partial Orderings.

Unit III **(15 hours)**

The Fundamentals: Algorithms, The integers and Matrices: Algorithms - The Growth of Functions - Complexity of Algorithms. **Induction and Recursion:** Mathematical Induction - Strong Induction and Well-Ordering - Recursive Definitions and Structural Induction – Recursive Algorithms.

Unit IV **(15 hours)**

Counting: The Basics of Counting – The Pigeon hole Principle – Permutations and Combinations – Binomial Coefficients. **Advanced Counting Techniques:** Recurrence Relations - Solving Linear Recurrence Relations - Divide-and-Conquer Algorithms and Recurrence Relations, Generating Functions - Inclusion-Exclusion - Applications of Inclusion - Exclusion.

Unit V **(15 hours)**

Algebraic Structures & Coding Theory: Introduction – The Structure of Algebras – Semi groups, Monoids and Groups – Homomorphism's, Normal Subgroups and Congruence Relations – Rings, Integral Domains and Fields – Quotient and Product Algebras – Coding Theory – Polynomial Rings and Polynomials Codes.

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 algebraic structure and codes in polynomial rings

Text Book:

1. Kennath H Rosen, *Discrete Mathematics and Its Applications*, Seventh Edition, Tata McGraw-Hill Education Private Limited, New Delhi, 2012.

Unit I: Chapter 1 (Section 1.1 – 1.6 and 1.8)
Unit II: Chapter 2 (Section 2.1 – 2.5) and Chapter 7 (Section 7.1 – 7.6)
Unit III: Chapter 3 (Section 3.1 – 3.3) and Chapter 4 (Section 4.1 – 4.4)
Unit IV: Chapter 5 (Section 5.1 – 5.4) and Chapter 6 (Section 6.1 – 6.6)
Unit V: Chapter 11 (Section 11.1 – 11.8)

Reference Books:

1. Grimaldi R.P, *Discrete and Combinatorial Mathematics*: *An Applied Introduction*, 4th Edition, Pearson Education Asia, Delhi, 2007.
2. Lipchitz S and Mark Lipson, *Discrete Mathematics*, Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.
3. Koshy T, *Discrete Mathematics with Applications*, Elsevier Publications, 2006.

E Resources:

1. http://discrete.openmathbooks.org/pdfs/dmoi-tablet.pdf
2. https://www.youtube.com/watch?v=Ungebd-uC-g
3. https://en.wikipedia.org/wiki/Discrete_mathematics

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	9	9	3	3	3	3	**39**
CO2	9	3	3	3	1	3	3	**25**
CO3	3	9	3	3	1	3	3	**25**
CO4	3	3	3	3	1	3	3	**19**
CO5	3	9	9	3	3	3	3	**33**
Total	**27**	**33**	**27**	**15**	**9**	**15**	**15**	**141**

Low-1 Medium-3 High-9

Core IV - Python Programming

(For Students Admitted from 2022-23)

Semester: II **Hours/week: 4**
Subject Code: IBDSC22 **Credit: 4**
Course Objectives:
1. To know lists, tuples and dictionaries in Python programs.
2. To understand exception handling in Python applications for error handling.

Unit I **(12 hours)**
Introduction
History of Python- Need of Python Programming- Applications Basics of Python Programming Using the REPL(Shell)- Running Python Scripts- Variables- Assignment- Keywords- Input- Output- Indentation.

Unit II **(12 hours)**
Types, Operators and Expressions
Types - Integers- Strings- Booleans; Operators- Arithmetic Operators- Comparison (Relational) Operators- Assignment Operators- Logical Operators- Bitwise Operators- Membership Operators- Identity Operators- Expressions.

Unit III **(12 hours)**
Data Structures and Control Flow
Lists- Operations- Slicing- Methods- Tuples- Sets- Dictionaries- Sequences- Comprehensions- Conditional blocks using If- Else and El-if- For Loop- For loop using Ranges- String- list and Dictionaries- While Loop- Loop Manipulation using Pass- Continue- Break and Else- Conditional and Loops Block.

Unit IV **(12 hours)**
Functions Modules and Packages
Defining Functions- Calling Functions- Passing Arguments- Keyword Arguments- Default Arguments- Variable-length arguments- Anonymous Functions- Function Returning Values- Scope of the Variables in a Function - Global and Local Variables. Creating modules- Name Spacing- Introduction to PIP- Installing Packages via PIP- Using Python Packages.

Unit V **(12 hours)**
Object Oriented Programming & Exception Handling
Classes- Self-Variable- Methods- Constructor Method- Inheritance- Overriding Methods- Data Hiding- Difference between an Error and Exception- Handling Exception- Try Except Block- Raising Exceptions- and User Defined Exceptions.

Course Outcomes:
After successful completion of this course, student will be able to
CO1: Outline lists, tuples, and dictionaries in Python programs
CO2: Demonstrate the concepts of loops and decision statements in Python
CO3: Illustrate functions and pass arguments in Python
CO4: Design object- oriented programs with Python classes
CO5: Develop Python applications.

Text Book:

1. R. Nageswara Rao, 2018, *Core Python Programming*, Dreamtech.

Reference Books:

1. John Hearty, 2016, *Advanced Machine Learning with Python*, Packt.
2. Jake VanderPlas, 2016, *Python Data Science Handbook: Essential Tools for Working with Data*, O'Reilly.
3. Mark Lutz, 2010, *Programming Python*, O'Reilly.
4. Tim Hall and J-P Stacey, 2009, *Python 3 for Absolute Beginners*, Apress.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc22_cs32/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs31/preview

Course Outcome	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	1	9	9	9	**49**
CO2	9	3	9	1	9	9	9	**49**
CO3	9	3	9	1	9	9	9	**49**
CO4	9	3	9	1	9	9	9	**49**
CO5	9	3	9	1	9	9	9	**49**
Total	**45**	**15**	**45**	**5**	**45**	**45**	**45**	**245**

Low-1 Medium-3 High-9

AECC II – Mathematical Statistics – II

(For Students Admitted from 2022-23)

Semester: II **Hours / week: 5**
Subject Code: IBDSA23 **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 **(15 hours)**

Correlation and Regression: Bivariate distribution, Correlation - Scatter diagram - Karl Pearson Coefficient of Correlation - Limits for correlation coefficient - Rank Correlation - Repeated Ranks - Regression - Lines of Regression - Regression coefficients - Properties of regression coefficient - Angle between two lines of regression.

Unit II **(15 hours)**

Theory of Attributes: Introduction - Notations - Dichotomy - Classes and Class frequencies Order of classes and class frequencies - Relation between class frequencies - Class symbols as operators - Consistence of data - Conditions for consistency of data - Independence of attributes -Criterion of independence - Symbols and Association of Attributes -Yule's Coefficient of association - Coefficient of Colligation.

Unit III **(15 hours)**

Sampling and Large Sample Test: Types of Sampling - Parameters and statistic - Sampling distribution - Standard Error: Tests of Significance - Null hypothesis - Error in sampling - Critical Region and Level of significance - Tests of significance for large samples - Test for single proportion - Test of significance for difference of proportions - Test of significance for single mean - Test of significance for difference of means.

Unit IV **(15 hours)**

Exact Sampling Distribution: Chi-square variate - M.G.F of distribution - Additive Property of Chi-square variates - Chi- square test of goodness of fit - Independence of attributes.

Unit V **(15 hours)**

Exact sampling distribution: Student's t (Definition) - Derivation of Student's t-distribution - Application of t-distribution - Test for single mean - t-Test for difference of means - t-Test for testing significance of an observed - F-statistic (Definition) - Applications of F - distribution.

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, *Elements of Mathematical Statistics*, Sultan Chand and Sons, Third Edition, Reprint 2015.

Unit I: Chapter 10 (10.1-10.3.1, 10.6-10.7.1, 10.7.3-10.7.5)
Unit II: Chapter 11
Unit III: Chapter 12 (12.2-12.8, 12.9.1, 12.9.2, 12.13, 12.14)
Unit IV: Chapter 13 (13.1, 13.3, 13.3.3, 13.5.2, 13.5.3)
Unit V: Chapter 14(14.2, 14.2.1, 14.2.5-14.3.1)

Reference Books:

1. S. Arumugam and A. Thangapandi Isaac, *Statistics***,** New Gamma Publishing Houses, Edition 2009.
2. S.C.Gupta, V.K.Kapoor, *Fundamental of Mathematical Statistics***,** Sultan Chand and Sons, Eleventh Edition, Reprint 2019.

E-Resources:

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

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

Low-1 Medium-3 High-9

SEC II - Data Analytics Lab- I

(For Students Admitted from 2022-23)

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 Spread sheets
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 Pivot Tables
10. To display Charts and Slicers
11. To perform Lookup Functions

Note:-Questions for Internal and External examination will be based on concept learnt

Course Outcomes:

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

CO1: Outline Excel functions to solve mathematical, text, date and time operations
CO2: Demonstrate the concepts of sorting, filtering using Excel
CO3: Illustrate Data validation feature of spread sheet
CO4: Evaluate Statistical operations using Pivot Table tool
CO5: Develop spread sheet with visualization using charts

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	1	9	9	**43**
CO2	9	1	9	3	1	9	9	**41**
CO3	9	1	9	3	1	9	9	**41**
CO4	9	1	9	3	1	9	9	**41**
CO5	9	3	9	3	1	9	9	**43**
Total	**45**	**9**	**45**	**15**	**5**	**45**	**45**	**209**

Low-1 Medium-3 High-9

Extra Credit- Arithmetic for Competitive Examinations

(For Students Admitted from 2022-23)

Semester: II
Subject Code: IBDSX2 **Credit: 2**

Course Objectives:
1. To introduce the basic concepts of Mathematics
2. To promote the problem solving ability to write the competitive examinations

Unit I
Numbers: Four Fundamental Rules - Solved Problems.

Unit II
Simplification: Solved Problems.

Unit III
Average: Solved Problems**.**

Unit IV
Chain Rules: Solved Problems.

Unit V
Allegation or Mixture: Solved Problems.

Course Outcomes:
After successful completion of this course, student will be able to
CO1: Compute the average of numbers
CO2: Make use of Allegation or Mixture in problems
CO3: Solve and simplify the real life problems
CO4: Apply the chain rule for solving the problems
CO5: Build the analytical and logical skills

Text Book:
1. R.S Aggarwal, *Arithmetic (Subjective & Objective) for Competitive Examinations*, S.Chand and Company Limited, Reprint 2009.

Unit I: Chapter 1(Pg.No: 1 - 29)
Unit II: Chapter 4(Pg.No:73 - 89)
Unit III: Chapter 7(Pg.No: 142 -157)
Unit IV: Chapter 10(Pg.No: 205 -223)
Unit V: Chapter 17(Pg.No: 332 – 347)

Reference Books:

1. S.L Gulati, *A Complete Book on Objective Arithmetic* – Cosmos Bookhive(P) Limited, 32nd Edition.
2. R.S Aggarwal, *Objective Arithmetic (Numerical Ability Test) For Competitive Examinations,* S.Chand and 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://careerdost.in/aptitude-questions/average-problems
3. https://byjus.com/govt-exams/mixture-alligation-questions

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

Low-1 Medium-3 High-9

Core V – Calculus & Differential Equations

(For Students Admitted from 2022-23)

Semester: III **Hours / week: 4 Subject**
Code: IBDSC31 **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 Limits - Calculating Limits Using the Limit Laws - Continuity - The Fundamental Theorem of Calculus.

Unit II **(12 hours)**

Infinite Sequences and Infinite Series - Integral test - ratio and root tests - Taylor series 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 (sec: 2.1, 2.2, 2.6) & (Sec: 5.4)
Unit II: Chapter 11 (Sec: 11.1 – 11.3, 11.5, 11.8)
Unit III: Chapter 14 (Sec: 14.1, 14.3, and 14.7)
Unit IV: Chapter 15 (Sec: 15.3, 15.4, and 15.6)

2. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 2011.

Unit V: Chapter 1 & 3 (Sec: 1.1, 1.4, 1.5(Page No: 27-33) and 3.2)

Reference Books:

1. Lian, Hungerford, and Holcomb "*Mathematics with Applications*", Addison Wesley, 2010.
2. Riley K. F., Hobson M. P. and Bence S. J., "*Mathematical Methods for Physics and Engineering*", Cambridge University Press, 2006.
3. Michael D. Greenberg, *"Advanced Engineering Mathematics",* Pearson Education, 2014.

E-Resources:

1. https://www.youtube.com/watch?v=_5fVpdOPLEw
2. https://www.youtube.com/watch?v=UvotN4v9L4c
3. https://www.youtube.com/watch?v=PGmVvIglZx8
4. https://www.youtube.com/watch?v=sZP048TJTXE
5. https://www.youtube.com/watch?v=EzzXTIIX_CU

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	3	3	1	1	3	3	3	17
CO2	3	1	1	1	3	3	3	15
CO3	3	3	1	1	3	3	3	17
CO4	3	3	1	1	1	3	3	15
CO5	3	1	1	1	1	3	3	13
Total	15	11	5	5	11	15	15	77

Low-1 Medium-3 High-9

Core VI - Structured Query Language

(For Students Admitted from 2022-23)

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, ShamkatB.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

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	1	9	3	3	**31**
CO2	9	3	9	1	9	9	3	**43**
CO3	9	3	9	1	9	9	3	**43**
CO4	9	3	3	1	9	3	3	**31**
CO5	9	3	3	1	9	3	3	**31**
Total	**45**	**15**	**27**	**5**	**45**	**27**	**15**	**179**

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

AECC I -Natural Language Processing

(For Students Admitted from 2022-23)

Semester: III **Hours/week: 4**
Subject Code: IBDSA33 **Credit: 4**

Course Objectives:

1. To know the concepts of Text Analytics, Unstructured Information Analysis for better decision making
2. To understand the roots behind Text Mining which evolved from Machine Learning, Natural Language Processing and Statistics

Unit I **(12 hours)**

Introduction to Text Mining

Basics of Text Mining- Natural Language Content Analysis- Core Text Mining Operations- Associations- Using Background Knowledge for Text Mining- Domain Ontologies- Domain Lexicons. Text Mining Pre-processing Techniques- Task Oriented Approaches- NLP Tasks- Tokenization- Part-of-Speech Tagging- Syntactical Parsing and Shallow Parsing.

Unit II **(12 hours)**

Extracting Features, Relations from Text

Finding Implicit Features- Finding Opinion Phrases and their Polarity- Context-Specific Word Semantic Orientation- Analysis of Word- and Document Frequency- tf-idf - Zipf's Law- bind tf-idf Function- Subsequence Kernels for Relation Extraction- Capturing Relation Patterns with a String Kernel.

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.
2. James Pustejovsky, Amber Stubbs, 2012, *Natural Language Annotation for Machine Learning*, O'Reilly.
3. Steve R. Poteet, 2007, *Natural Language Processing with Text Mining*, Springer.
4. James Sanger, Ronen Feldman, 2002, *The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data*, Cambridge.

E-Resources:

1. https://nptel.ac.in/courses/106105158
2. https://nptel.ac.in/courses/106101007

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

Low-1 Medium-3 High-9

OEC I - Quantitative Aptitude for Competitive Examinations -I

(For Students Admitted from 2022-23)

Semester: III **Hours / week: 2**
Subject Code: IBOE3DS **Credit: 2**

Course Objectives:

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

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 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 Ltd, Reprint, 2009.

UnitI: 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, 1st Edition, 2009.
2. Chand S *Quantitative Aptitude (Mathematics & Statistics)* S.Chand & Company Ltd., First Edition, 2008.
3. .Mark Alan Stewart, *Master the GMAT*, 14th Edition, 2007.

E- Resources:

1. https://www.youtube.com/watch?v=rHzggZDdtc4
2. https://www.youtube.com/watch?v=FdAkE032ODI
3. https://pdfgoal.com/downloads/quantitative_aptitude_made_easy_ugcportal_pdf
4. https://www.youtube.com/watch?v=_cW7_BUDYcw
5. https://iim-cat-questions-answers.2iim.com/quant/geometry/mensuration

Course Outcomes	Program Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	1	9	3	9	9	**43**
CO2	3	9	1	9	9	9	9	**49**
CO3	3	9	3	9	3	9	9	**45**
CO4	3	9	9	9	9	9	9	**57**
CO5	3	9	9	9	9	9	9	**57**
Total	**15**	**45**	**23**	**45**	**33**	**45**	**45**	**251**

Low-1 Medium-3 High-9

SEC III – PHP Lab

(For Students Admitted from 2022-23)

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 chess board

Course Outcomes:

After successful completion of this course, student will be able to
CO1: Describe the fundamentals of PHP Language in trivial problem solving
CO2: Determine solution to a problem and apply control structures
CO3: Simplify the use of Strings and String Handling functions
CO4: Justify real time applications using PHP language features.
CO5: Build skill on problem solving by constructing algorithms

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	1	9	1	1	**25**
CO2	9	3	3	3	9	3	3	**33**
CO3	9	3	1	3	9	9	3	**37**

CO4	9	3	3	3	9	9	3	**39**
CO5	9	3	3	3	9	9	3	**39**
Total	**45**	**15**	**11**	**13**	**45**	**31**	**13**	**173**

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

Extra Credit - Logical Reasoning

(For Students Admitted from 2022-23)

Semester III
Subject Code: IBDSX3 **Credit: 2**

Course Objectives:

1. To correlate an application of acquired knowledge on subjective test questions with Linguistically and structurally appropriate answers
2. To attend for competitive examinations

Unit I

Puzzle Test.

Unit II

Logical Venn diagram.

Unit III

Alphabet Test.

Unit IV

Alpha - Numeric Sequence Puzzle.

Unit V

Inserting the Missing Character.

Course Outcomes:

After successful completion of this course, student will be able to
CO 1: Determine the solutions to a range of elementary problems using puzzle test
CO 2: Demonstrate the ability to perform logical Venn diagrams and solve the problem
CO 3: Use analysis of variance techniques to Alphabet test
CO 4: Inspect the alpha numeric sequence puzzle
CO 5: Explicate graph coloring to solve the problems

Text Book:

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

Unit I: Chapter 6
Unit II: Chapter 9
Unit III: Chapter 10
Unit IV: Chapter 11
Unit V: Chapter16

Reference Books:

1. Dr R S Aggarwal, *A Modern Approach to Verbal and Non-verbal Reasoning*, S.Chand &Company Private Limited, 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							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	9	1	3	1	3	3	**23**
CO2	3	9	1	3	3	3	3	**25**
CO3	3	9	1	3	1	3	3	**23**
CO4	3	9	1	3	1	3	3	**23**
CO5	3	9	1	3	1	3	3	**23**
Total	**15**	**45**	**5**	**15**	**7**	**15**	**15**	**117**

Low-1 Medium-3 High-9

Core VII- Matrix Theory and Linear Algebra

(For Students Admitted from 2022-23)

Semester: IV **Hours / week: 4**
Subject Code: IBDSC41 **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 **(12 hours)**

Linear Equations and Matrices: Systems of linear equations - Gaussian elimination - Sums and scalar multiplications of matrices - Products of matrices Block matrices - Inverse matrices - Elementary matrices and finding A^{-1}.

Unit II **(12 hours)**

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

Unit III **(12 hours)**

Vector spaces: The n-space and vector spaces-Subspaces - Bases - Dimensions - Row and column spaces -

Rank and nullity - Bases for subspaces - Invertibility.

Unit IV **(12 hours)**

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

Unit V **(12 hours)**

Inner Product spaces: Dot products and inner products - The lengths and angles of vectors - Matrix representations of inner products - Gram - Schmidt orthogonalization - Projections - Orthogonal projections - Relations of fundamental subspaces - Orthogonal matrices and isometries.

Course Outcomes:

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

CO 1: Make use of Gaussian elimination method to solve system of linear equations
CO 2: Classify the properties of Determinants and use Cramer's rule to solve the problems
CO 3: Summarize the results obtained about solvability of the system, obtain several characterizations of the invertibility of a square matrix
CO 4: Examine the concept of vector space of linear transformation using algebraic operations
CO 5: Construct orthonormal basis for a matrix

Text Book:

1. Jin Ho Kwak Sungpyo Hong, *Linear Algebra*, Springer International, Second Edition, Third Indian, Reprint, 2010.

Unit I: Chapter 1(Pg.no: 01 - 29)
Unit II: Chapter II (Pg.no: 45 - 63)
Unit III: Chapter III (Pg.no: 75 - 108)
Unit IV: Chapter IV (Pg.no: 117 - 138)
Unit V: Chapter V (Pg.no: 157 - 181)

Reference Books:

1. Gilbert Strang, *Linear Algebra and Learning from Data*, willesley, Cambridge, 2019.
2. Peter Selinger, *Matrix theory and Linear Algebra***,** Lyryx Learning and Ken Kuttler, First Edition, 2022.
3. Friedberg S, Insel A, and Spence L, *Linear Algebra*, Pearson, 2019.

E- Resources:

1. https://www.youtube.com/embed/5ahKAiBc-DI
2. https://www.swayamprabha.gov.in/index.php/program/archive/8
3. https://math.mit.edu/~gs/linearalgebra/
4. http://www.math.nagoya-u.ac.jp/~richard/teaching/f2014/Lin_alg_Lang.pdf
5. https://web.stanford.edu/~boyd/vmls/vmls.pdf

Course Outcomes	Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	3	9	3	3	1	3	3	25
CO2	3	9	3	3	1	3	3	25
CO3	3	9	3	3	1	3	1	23
CO4	3	3	3	3	1	3	3	19
CO5	3	3	3	3	3	3	3	21
Total	15	33	15	15	7	15	13	113

Low-1 Medium-3 High-9

Core VIII - Machine Learning & Artificial Intelligence

(For Students Admitted from 2022-23)

Semester: IV **Hours/week: 5**
Subject Code: IBDSC42 **Credit: 4**

Course Objectives:

1. To gain critical knowledge and understanding about major Data Mining procedures like Decision Tree, Cluster Analysis
2. Able to apply and practice this gained knowledge in variety of Business Scenario

Unit I **(15 hours)**

Classification and Regression Tree

Classification & Regression- working of a Decision Tree- Attribute Selection Measures- Information Gain- Gain Ratio- Gini Index- Building Decision Trees- CART- C5.0 and CHAID Trees- Prediction by Decision Tree- Advantages and Disadvantages of Decision Trees- Model Overfitting- Building Decision Trees in R.

Unit II **(15 hours)**

Clustering

Cluster Analysis versus Factor Analysis- Overview of Basic Clustering Methods- Agglomerative Hierarchical Clustering- Within-Group Linkage- Nearest Neighbor or Single Linkage- Furthest Neighbor or Complete Linkage- Centroid Clustering- Ward's Method- K- Means Algorithm- Dendrogram- Profiling of Cluster- Cluster Evaluation.

Unit III **(15 hours)**

Support Vector Machine

Decision Boundaries for Support Vector Machine- Maximum Margin Hyperplanes- Structural Risk Minimization- Linear SVM-Separable Case- Linear SVM-Non-Separable Case- Kernel Function- Kernel Trick- Kernel Hilbert Space- Model Evaluation.

Unit IV **(15 hours)**

Marret Basket Analysis

Market Basket Analysis and Association Analysis- Market Basket Data- Stores- Customers- Orders- Items- Order Characteristics- Product Popularity- Tracking Marketing Interventions- Association Rules- Support- Confidence- Lift- Chi-Square Value- Sequential Pattern Analysis.

Unit V **(15 hours)**

Introduction to Artificial Intelligence

Current Trends in AI- Intelligent Agents- Environments- Problem Solving Agents- Searching Techniques- Knowledge and Reasoning in AI- Forms of Learning- Structure of a Neural Network- Analogy with Biological Neural Network- Activation Functions- Gradient Descent- Model Accuracy.

Course Outcomes:

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

CO 1: Describe the wide variety of Statistical and Machine Learning Algorithms

CO 2: Demonstrate Machine Learning techniques

CO 3: Analyze the performance of machine learning algorithms

CO 4: Evaluate performance of machine learning algorithms and select the best one based on the solution.

CO 5: Create Programming Framework to obtain acceptable decisions for the Real-World problems.

Text Book:

1. Kevin Knight, Elaine Rich, B.Nair, 2017, *Artificial Intelligence*, McGraw.

Reference Books:

1. Han, Jiawei and Kamber, Micheline, 2012, *Data Mining: Concepts and Techniques*, Morgan Kaufman Publishers.
2. AnandRajaraman, 2011, *Mining of Massive Datasets*, 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
2. https://onlinecourses.nptel.ac.in/noc22_cs24/preview

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	1	9	9	9	**49**
CO2	9	3	9	1	9	9	9	**49**
CO3	9	3	9	1	9	9	9	**49**
CO4	9	3	9	1	9	9	9	**49**
CO5	9	3	9	1	9	9	9	**49**
Total	**45**	**15**	**45**	**5**	**45**	**45**	**45**	**245**

Low-1 Medium-3 High-9

Semester: IV **Hours/week: 5**
Subject Code: IBDSA43 **Credit: 4**
Course Objectives:

1. To understand about Big Data Technology, Hadoop Ecosystem and various tools related to it.
2. To learn about the HDFS File System, Map Reduce Framework, analyzing data using Hbase and Hive along with the Integration of R with Hadoop.

Unit I **(15 hours)**
Introduction to Big Data
What Is Big Data? - History of Data Management- Evolution of Big Data- Structuring of Big Data- Elements of Big Data- Application of Big Data in the Business Context- Careers in Big Data. Business Applications of Big Data: The Significance of Social Network Data- Financial Fraud and Big Data- Fraud Detection in Insurance- Use of Big Data in the Retail Industry.

Unit II **(15 hours)**
Technologies for Handling Big Data
Distributed and Parallel Computing for Big Data- Understanding Hadoop- Cloud Computing- Grid Computing- and In-Memory Technology for Big Data. VMWare Installation of Hadoop- Linux and its Shell Commands- Different Hadoop Distributions and their advantages- Horton works- 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							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	1	9	3	3	**31**
CO2	9	3	9	1	9	9	3	**43**
CO3	9	3	3	1	9	9	9	**43**
CO4	9	3	9	1	9	9	9	**49**
CO5	9	3	3	1	9	9	9	**43**
Total	**45**	**15**	**27**	**5**	**45**	**39**	**33**	**209**

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

OEC II - Quantitative Aptitude for Competitive Examinations-II

(For Students Admitted from 2022-23)

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 **(6 hours)**

Ratio, Proportion, Indices and logarithm: Problems.

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 ableto

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, 2nd Edition 2007.
3. Dr.R.S.Aggarwal, *Quantitative Aptitude*, S.Chand publications, 7th Edition, 2015.

E- Resources:

1. https://www.youtube.com/watch?v=oGT0AOihPr8
2. https://www.youtube.com/watch?v=jxlWNJ1MghA
3. https://www.youtube.com/watch?v=PfHOs4ukM5g
4. https://www.youtube.com/watch?v=Qz-WBXsLkos
5. https://www.youtube.com/watch?v=JBNUfNpm35Y

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

CO1	3	3	3	3	1	3	3	**19**
CO2	3	3	3	3	1	3	3	**19**
CO3	3	3	3	3	1	3	3	**19**
CO4	3	3	3	3	3	3	3	**21**
CO5	3	3	3	3	3	3	9	**27**
Total	**15**	**15**	**15**	**15**	**9**	**15**	**21**	**105**

Low-1 Medium-3 High-9

SEC IV - Data Analytics Lab II

(For Students Admitted from 2022-23)

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 data set

Course Outcomes:

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

CO1: Outline R functions to perform numerical operations
CO2: Demonstrate the concepts of import/export operations
CO3: Illustrate data pre-processing operations
CO4: Evaluate Statistical operations
CO5: Develop an application using K-Means algorithm with visualization

Course Outcomes	Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	3	9	3	1	9	9	**43**
CO2	9	1	9	3	1	9	9	**41**
CO3	9	1	9	3	1	9	9	**41**
CO4	9	1	9	3	1	9	9	**41**
CO5	9	3	9	3	1	9	9	**43**
Total	45	9	45	15	5	45	45	**209**

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

Extra Credit – Applications of Group Theory

(For Students Admitted from 2022-23)

Semester: IV

Subject Code: IBDSX4 **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 Hammings codes - Group codes - A detection scheme for group codes – Slepian's Technique for single-error correcting group codes –Hamming'slemma.

Unit IV

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

Unit V

The application of group theory to parity checks 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.

UnitI: 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, *Modern Algebra*, SciTech publications (India) Private Limited 2007.
3. JK Sharma, *Discrete Mathematics*, Macmillan India Limited, 2nd Edition, 2005.

E-Resources:

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

Course Outcomes	Programme Outcomes							
CO	**PO**	**PO**	**PO**	**PO**	**PO**	**PO**	**PO'**	**Tota**
CO1	3	3	3	3	9	3	9	**33**
CO2	3	3	3	3	9	3	3	**27**
CO3	3	3	3	3	3	3	3	**21**
CO4	3	3	3	3	9	3	9	**33**
CO5	3	3	3	3	9	3	9	**33**
Total	**15**	**15**	**15**	**15**	**39**	**15**	**33**	**147**

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

Core IX - Numerical Methods - I

(For Students Admitted from 2022-23)

Semester: V **Hours/ week: 6**
Subject Code: IBDSC51 **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" method - Quotient - Difference method - Solution to Systems of Nonlinear Equations - Method of Iteration - Newton-Raphson method.

Unit IV **(18 hours)**

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*, 6th Edition, New age International Publisher, India, 2007.
2. E. Balagurusamy, *Numerical Methods*, Tata McGraw Hill Private Limited, 2009.
3. Shankara Rao K, *Numerical Methods for Scientists and Engineers*, Prentice Hall of India, 2001.

E- Resources:

1. https://nptel.ac.in/courses/111/107/111107062/
2. https://nptel.ac.in/courses/111/107/111107105/

3. https://www.math.ust.hk/~machas/numerical-methods.pdf

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Tota
CO1	3	3	1	3	9	9	9	37
CO2	3	3	9	3	9	9	9	45
CO3	3	3	9	3	9	9	9	45
CO4	3	3	3	3	9	3	3	27
CO5	3	3	3	3	9	3	3	27
Total	15	15	25	15	45	33	33	181

Low-1 Medium-3 High-9

Core X - Deep Learning

(For Students Admitted from 2022-23)

Semester: V **Hours/week: 6**
Subject Code: IBDSC52 **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. Ian GoodFellow, Yoshua Bengio and Aaron Courville. (2016). *Deep Learning.* MITPress.

E-Resources:

1.https://onlinecourses.nptel.ac.in/noc20_cs62/preview
2.https://nptel.ac.in/courses/106106184

Course Outcome	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	1	9	9	9	**49**
CO2	9	3	9	1	9	9	9	**49**
CO3	9	3	9	1	9	9	9	**49**
CO4	9	3	9	1	9	9	9	**49**
CO5	9	3	9	1	9	9	9	**49**
Total	**45**	**15**	**45**	**5**	**45**	**45**	**45**	**245**

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

Semester: V **Hours/week: 6**
Subject Code: IBDSC53 **Credit: 5**

Course Objectives:

1. To provide structural characterization of graphs with matching, perfect matching and graph coloring
2. To understand the idea of graphs and their importance in computer science

Unit I **(18 hours)**

Basic Concepts of Graph: Introduction - Basic Concepts - Sub graphs - Degrees of Vertices Paths and Connectedness - Automorphism of a simple Graph - Line Graphs - Operations on Graphs - Graph Products.

Unit II **(18 hours)**

Directed Graph and Trees: Introduction - Basic concepts – Tournaments - K- Partite Tournaments. Trees: Definition, Characterization, and simple Properties - Centers and centroids - Counting the number of spanning trees - Cayley's Formula - Helly Property - Applications.

Unit III **(18 hours)**

Connectivity: Introduction-Vertex cuts and Edge cuts- Connectivity and edge connectivity - Blocks - Cyclical Edge Connectivity of a graph – Menger's Theorem.

Unit IV **(18 hours)**

Planarity: Introduction-Planar and nonplanar Graphs-Euler Formula and its consequences - K_5 and $K_{3,3}$ are Nonplanar Graphs-Dual of a Plane Graph-The Four-color theorem and Heawood Five-Color Theorem - Kuratowski's Theorem.

Unit V **(18 hours)**

Graph Colouring: Introduction-Vertex Colorings - Critical Graphs - Homomorphisms and colorings-Triangle-Free Graphs-Edge Colorings of Graphs - Snarks – Kirkman's Schoolgirl Problem-Chromatic Polynomials.

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. R. Balakrishnan & K. Ranganathan, *A Textbook of Graph Theory*, Springer, 2012.

Unit I: Chapter 1(1.1 – 1.9)
Unit II: Chapter 2(2.1 – 2.4) & Chapter 4 (4.1 - 4.7)
Unit III: Chapter 3(3.1 -3.7)

Unit IV: Chapter 8(8.1 – 8.7)
Unit V: Chapter 7(7.1 –7.9)

Reference Books:

1. Narsingh Deo, *Graph Theory with Applications to Engineering and Computer Science*, Dover Publications, 2016.
2. Reinhard Diestel, *Graph Theory*, 5th Edition, Springer, 2017.
3. Edgar G. Goodaire & Michael M. Parmenter, *Discrete Mathematics with Graph Theory*, 3rd Edition, Pearson, 2018.
4. Douglas West, *Introduction to Graph Theory*, 2nd Edition, Pearson, 2017.

E- Resources:

1. https://www.csa.iisc.ac.in/~arpita/DS14/Turan.pdf
2. https://www.youtube.com/watch?v=TBYNkgvnU2s
3. https://nptel.ac.in/courses/111/106/111106050/

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

Low-1 Medium-3 High-9

DSE I. a) -Time Series Analysis and Forecasting

(For Students Admitted from 2022-23)

Semester: V **Hours/week: 4**
Subject Code: IBDSE5A **Credit: 4**

Course Objectives:

1. To equip students with various time series and forecasting methods and techniques to increase the knowledge on modern statistical methods for analyzing time series data
2. To understand the principles behind time series and forecasting techniques for analyzing various Stationary and Nonstationary time series model

Unit I **(12 hours)**

Introduction to Time Series: Examples of Time Series - Objectives of Time Series Analysis - Some Simple Time Series Models - **Introduction to Forecasting:** The Nature and Uses of Forecasts – Some Example of Time Series – The Forecasting Process – Data for Forecasting – Resources for Forecasting.

Unit II **(12 hours)**

Statistics Background for Forecasting: Introduction – Graphical Displays – Numerical Description of Time Series Data – Use of Data Transformations and Adjustments-General Approach to Time Series Modeling and Forecasting – Evaluating and Monitoring Forecasting Model Performance.

Unit III **(12 hours)**

Stationary Processes: Basic Properties - Linear Processes - Introduction to ARMA Processes - Properties of the Sample Mean and Autocorrelation Function – Forecasting Stationary Time Series - **ARMA Models**: ARMA(p, q) Processes - The ACF and PACF of an ARMA(p, q) Process - Forecasting ARMA Processes.

Unit IV **(12 hours)**

Nonstationary and Seasonal Time Series Models: ARIMA Models for Nonstationary Time Series - Identification Techniques - Forecasting ARIMA Models - Seasonal ARIMA Models - **Forecasting Techniques:** The ARAR Algorithm - The Holt–Winters Algorithm.

Unit V **(12 hours)**

Survey of other Forecasting Methods: Multivariate Time Series Models and Forecasting -State Space Model – Arch and Garch Model – Neural Networks and Forecasting – Spectral Analysis – Bayesian Methods in Forecasting.

Course Outcomes:

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

CO1: Explain the concept of Time Series & Forecasting, Stationary, Nonstationary Process and Forecasting Methods

CO2: Apply the models of ARMA, ARIMA and various methods in forecasting process

CO3: Examine an example of time series models, general approach to time series modeling and forecasting and various methods in forecasting

CO4: Evaluate the performance of forecasting models, ARAR Algorithm and Holt -Winters Algorithm

CO5: Elaborate an objective of time series analysis, uses of forecasts, statistics background of forecasting and using various models in forecasting

Text Books:

1. Peter J. Brockwell, Richard A. Davis, *Introduction to Time Series and Forecasting*, Springer New York, Second Edition, 2002.
2. Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulahci, *Introduction to Time Series Analysis and Forecasting*,John Wiley and Sons Publication, Second Edition, 2016.

Reference Books:

1. Bruce L. Bowerman, Richard O'Connell, Anne Koehler, *Forecasting, Time Series, and Regression***,** Cengage Unlimited Publishers, Fourth Edition, 2005.
2. George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung, *Time Series Analysis Forecasting and Control*, John Wiley and Sons Publication, Fifth Edition, 2016.

E – Resources:

1. https://nptel.ac.in/courses/111/104/111104098/
2. https://www.udacity.com/course/time-series-forecasting--ud980

Course Outcome	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	1	1	1	1	1	9	23
CO2	9	1	3	1	1	3	9	27
CO3	9	1	3	1	1	1	9	25
CO4	9	3	9	3	3	3	9	39
CO5	9	3	9	3	3	9	9	45
Total	45	9	25	9	9	17	45	159

Low-1 Medium-3 High-9

DSE I. b) - Operating Systems

(For Students Admitted from 2022-23)

Semester: V **Hours/week: 4**
Subject Code: IBDSE5B **Credit: 4**

Course Objectives:

1. To understand the services provided by and the design of an operating system
2. To understand what a process is and how processes are synchronized and scheduled

Unit I **(12 hours)**

Introduction: What is an Operating System -Mainframe systems- desktop systems- Multiprocessor Systems- Distributed systems- Clustered Systems- Real time systems- Hand held systems. **Operating System Structure:** System components- Operating System services-System calls-System structure.

Unit II **(12 hours)**

Processes: Process concept- process scheduling- operations on processes- Inter process Communication **CPU Scheduling**: Basic Concepts- Scheduling Criteria- Scheduling algorithms **Process Synchronization**: Background- The critical section problem- Mutex Locks-semaphores-Monitors.

Unit III **(12 hours)**

Deadlock: System Model-Deadlock Characterization- Methods of Handling Deadlock-Deadlock Prevention-Deadlock Avoidance- Deadlock Detection- Recovery from Deadlock
Memory management: Background- Contiguous memory allocation- Swapping.

Unit IV **(12 hours)**

Virtual memory: Background- Demand paging- Copy-on-Write - Page replacement –Thrashing **File system interface**: File concepts- access methods- Directory structure **Mass storage structure**: Overview of mass storage structure - HDD Scheduling-NVM Scheduling.

Unit V **(12 hours)**

Protection: Goals of protection- domain of protection- Access matrix- Implementation of Access

matrix- revocation of access rights

Security: The security problem- User authentication- Program threats- System threats- securing systems and facilities- Intrusion detection- Cryptography.

Course Outcomes:

On the successful completion of the course, student will be able to:

CO1: Remember the structure of operating system and scheduling algorithms

CO2: Apply the concept of process scheduling, deadlocks and its recovery

CO3: Analyze the background of memory with segmentation and paging **CO4**: Evaluate file management with file organization, and disk scheduling

CO5: Create Securing systems and facilities

Text Book:

1. Abraham G Silberschatz, *Operating System*, Wiley Publisher, Tenth Edition, 2017.

Reference Books:

1. Milan Milenkovic, *Operating System Concepts & Design*, Tata, McGraw Hill Publishing Limited, Second Edition, 1997.
2. Peter Baer Galvin, Robert Neilson Boyd, *Applied Operating system concepts*, John Wiley & Sons Publisher, First Edition, 2000.
3. Dhananjay M. Dhamdhere, *Operating System, A Concept-Based Approach*, Tata Mc Graw Hill Publishing Limited, Third Edition, 2012.
4. W. Stallings, *Operating Systems, Internals & Design Principles*, Prentice Hall of India, Fifth Edition, 2008.

E-Resources:

1. https://nptel.ac.in/courses/106/106/106106144/
2. https://www.coursera.org/lecture/nand2tetris2/unit-6-1-operating-system-uxqgJ

Course Outcomes CO	Programme Outcomes							
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	1	1	1	1	1	9	**23**
CO2	9	1	3	1	1	3	9	**27**
CO3	9	1	3	1	1	1	9	**25**
CO4	9	3	9	3	3	3	9	**39**
CO5	9	3	9	3	3	9	9	**45**
Total	**45**	**9**	**25**	**9**	**9**	**17**	**45**	**159**

Low-1 Medium-3 High-9

Semester: V **Hours / week: 4**
Subject Code: IBDSE5C **Credit: 4**

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

Unit I **(12 hours)**
Introduction -Operations Research Models -Solving the OR Model - Queuing and Simulation Models -Art of Modeling -More than Just Mathematics - Phases of an OR Study - **Modeling with Linear Programming**: Two -Variable LP Model - Graphical LP Solution.

Unit II **(12 hours)**
The Simplex Method: Artificial Starting Solution – Special Cases in the Simplex Method - **Duality and Post-Optimal Analysis:** Definition of the Dual Problem - Primal –Dual Relationships.

Unit III **(12 hours)**
Transportation Model and Its Variants: Definition of the Transportation Model - Nontraditional Transportation Models -The Transportation Algorithm - The Assignment Model.

Unit IV **(12 hours)**
Games and Strategies: Introduction - Two-Person Zero-Sum Games - Some Basic terms- The Maximin - Minimax Principle - Games without Saddle Points - Mixed Strategies - Graphic Solution of 2 x n and m x 2 Games - Dominance Property.

Unit V **(12 hours)**
Network Scheduling by PERT/CPM: Introduction - Network: Basic Components - Logical Sequencing - Rules of Network construction - Concurrent activities - Critical Path Analysis - Probability Considerations in PERT - Distinction between PERT and CPM.

Course Outcomes:
After successful completion of this course, student will be able to
CO 1: Demonstrate the fundamental terms, principles and elements of operation research
CO 2: Apply graphical and simplex method to get optimally of linear programming
CO 3: Assess optimal solution for the transportation problem and analyze assignment problem to make effective business decisions
CO 4: Estimate the solutions for games and events using different strategies
CO 5: Apply network model and find the shortest path using CPM/ PERT

Text Books:
1. Hamdy A. Taha, *Operations Research - An Introduction***,** University of Arkansas, 10th Edition,2012.

Unit I: Chapter 1 (1.1 – 1.7), Chapter 2 (2.1 & 2.2)
Unit II: Chapter 3 (3.3 – 3.5), Chapter 4 (4.1 & 4.2)
Unit III: Chapter 5 (5.1 – 5.4)

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

Unit IV: Chapter 17 (17:1 – 17:7)

Unit V: Chapter 25(25:1 – 25:8)

Reference Books:

1. S.D. Sharma, *Operations Research*, Dedar Nath Ram Nath, 2009.
2. Srinivasan, *Operations Research - Principles and Applications*, PHI Learning Private Limited, Second Edition, 2012.

E-Resources:

1. https://www.youtube.com/watch?v=YPn4yHM1YsU
2. http://www.math.wsu.edu/faculty/genz/364/lessons/l3067.pdf
3. https://www.youtube.com/watch?v=fSuqTgnCVRg

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	3	9	3	3	3	3	3	27
CO2	3	9	3	3	9	9	3	39
CO3	3	9	3	3	9	9	9	45
CO4	3	9	3	9	9	9	9	51
CO5	3	3	3	9	9	9	9	45
Total	15	39	15	27	39	39	33	207

Low-1 Medium-3 High-9

DSE II. b) - Distributed Systems

(For Students Admitted from 2022-23)

Semester: V **Hours/Week: 4**
Subject Code: IBDSE5D **Credit: 4**

Course Objectives:

1. To learn the architecture and processes of distributed systems
2. To understand the security of distributed systems

Unit I **(12 hours)**

Introduction: Definition of distributed system-Design goals -Types of distributed systems. **Architectures:** Architectural styles-Middleware organization-System architecture- Example architecture.

Unit II **(12 hours)**

Processes: Threads- Virtualization- Clients - Servers- Code migration. **Communication:** Foundations-Remote Procedure Call-Message–Oriented Communication- Multicast communication.

Unit III **(12 hours)**

Naming: Names, identifiers and address-Flat naming-structure naming-Attribute- based naming. **Coordination:** Clock synchronization-Logic clocks-Mutual exclusion-Election algorithms- Location systems-Distributed event matching-gossip based coordination.

Unit IV **(12 hours)**

Consistency and replication: Introduction-Data centric consistency models-Client- centric consistency models-Replica management-Consistency protocols-Example: Caching and replication in the web**. Fault tolerance**: Introduction to fault tolerance- Process resilience- Reliable client server communication-Reliable group communication.

Unit V **(12 hours)**

Fault tolerance: Distributed commit-Recovery. **Security:** Introduction to security- Security channels-Access Control-Secure naming-Security Management.

Course Outcomes:

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

CO1: Tell about distributed systems
CO2: Illustrate processor, process, naming, communication, synchronization, thread, remote procedure calls in distributed systems
CO3: Analyze the types, architecture, client, server, logical clocks and election algorithms and protocols of distributed programs
CO4: Determine the architecture, thread, reliable client server and group communication
CO5: Build security of distributed systems

Text Book:

1. Maarten Van Steen Andrew S. Tanenbaum *Distributed Systems***,** Pearson Education, Third Edition, 2017.

Reference Books:

1. Andrew S.Tanenbaum, Maarten Van Steen, *Distributed Systems Principles And Paradigms*, Pearson Education, Second Edition, 2007.
2. George Coulouris, Jean Dellimore and Tim KIndberg, *Distributed SystemsConcepts and Design*, Pearson Education, Fourth Edition, 2005.

E-Resource:

1. https://www.confluent.io/learn/distributed-systems/

Course Outcomes	Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	9	3	1	9	9	9	**49**
CO2	9	9	3	1	9	3	9	**43**
CO3	9	3	3	1	9	3	9	**37**
CO4	9	3	3	1	9	9	9	**43**
CO5	9	3	3	1	9	3	9	**37**
Total	**45**	**27**	**15**	**5**	**45**	**27**	**45**	**209**

Low-1 Medium-3 High-9

SEC V– Programming in Java Lab

(For Students Admitted from 2022-23)

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 Armstrong

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 inheritance
11. Develop the program for implementing exception handling
12. Develop the program for implementing multithreading

Note: -Questions for the external examination will be based on the concepts learnt

Course Outcomes:
After successful completion of this course, student will be able to
CO1: Outline Java programs that solve simple mathematical problems, number checking and number generation
CO2: Demonstrate the concepts of String Manipulation, Linear Search and Binary Search
CO3: Illustrate OOP in Java programming like inheritance
CO4: Evaluate the multi-threaded programs
CO5: Develop Exception handling programs

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	3	3	9	3	9	**39**
CO2	9	3	3	3	9	3	9	**39**
CO3	9	9	3	9	9	9	9	**57**
CO4	9	9	9	9	9	9	9	**63**
CO5	9	9	9	9	9	9	9	**63**
Total	**45**	**33**	**27**	**33**	**45**	**33**	**45**	**261**

Low-1 Medium-3 High-9

Core XII - Numerical Methods II

(For Students Admitted from 2022-23)

Semester: VI **Hours / week: 6**
Subject Code: IBDSC61 **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 **(18 hours)**
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)
Unit III: Chapter 7 (7.1 – 7.5)
Unit IV: 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*, 6th 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							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
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
Total	15	15	33	15	33	33	33	177

Low-1 Medium-3 High-9

Core XIII – Project

(For Students Admitted from 2022 -23)

Semester : VI **Hours/Week: 6**
Subject Code: IBDSC62PW **Credit: 5**

Course Objectives:

1. Impart the students to implement project
2. Able to understand the data collection for the project

Project shall be a group project (group consisting of maximum of two members)

Course Outcomes:

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

CO1: Identify goals, constraints, deliverables, performance criteria and resource requirements in consultation with stakeholders
CO2: Apply the plan by executing the code
CO3: Illustrate the various aspects of software development for the total project
CO4: Evaluate the entire software project according to the specific problem
CO5: Develop the software project by executing with the various data

Course Outcomes	Programme Outcomes							
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	Total
CO1	9	9	9	9	9	3	9	57
CO2	9	3	9	3	9	9	9	51
CO3	9	3	9	9	9	9	9	57
CO4	9	3	9	9	9	9	9	57
CO5	9	9	9	9	9	9	9	45
Total	45	27	45	39	45	39	45	285

Low-1 Medium-3 High-9

Core XIV- Computer Vision

(For Students Admitted from 2022-23)

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. (2018). *Computer Vision – A Modern Approach*. Prentice Hall.

Reference Books:

1. E. Trucco. (2017). *Introductory Techniques for 3D Computer Vision.* Prentice Hall.
2. R.C. Gonazlez. (2017). *Digital Image Processing.* Addison Wesley.
3. Mark Nixon (2016). *Feature Extraction and Image Processing for Computer Vision*. Academic Press.
4. Simon J. D. Prince (2015). *Computer Vision – Models, Learning and Inference*. Cambridge.
5. Richard Szeliski (2013). *Computer Vision – Algorithms and Applications*. Springer.

E-Resources:

1. https://nptel.ac.in/courses/108103174
2. https://onlinecourses.nptel.ac.in/noc19_cs58/preview

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	1	9	9	9	**49**
CO2	9	3	3	1	9	9	9	**43**
CO3	9	3	9	1	9	9	9	**49**
CO4	9	3	9	1	9	9	9	**49**
CO5	9	3	3	1	9	9	9	**43**
Total	**45**	**15**	**33**	**5**	**45**	**45**	**45**	**233**

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

Core XV- Regression Analysis

(For Students Admitted from 2022-23)

Semester: VI **Hours/week: 6**

Subject Code: IBDSC64 **Credit: 4**

Course Objectives:

1. The emphasis will be more on the development of tools from the statistical theories and concept along with their utility in real life data applications
2. The course starts with a description of need of regression analysis and lays the foundation of simple linear regression model

Unit I **(18 hours)**

Simple Linear Regression: Simple Linear Regression Model- Least square estimation of the parameters- Hypothesis Testing on the slope and intercept- Interval estimation in Simple linear Regression- Prediction of New Observations- Coefficient of Determination.

Unit II **(18 hours)**

Multiple Linear Regression: Multiple Regression Models- Estimation of the Model Parameters, Hypothesis testing in Multiple Linear Regression- Confidence Intervals in Multiple Regression- Prediction of New observations.

Unit III **(18 hours)**

Generalized Linear Models: Introduction- Logistic Regression Models- Poisson Regression

Model Adequacy Checking: Introduction- Residual Analysis - The PRESS Statistic- Detection and treatment of Outliers- Lack of fit of the Regression Model.

Unit IV **(18 hours)**

Polynomial Regression Models: Introduction- Polynomial Models in One Variable- Nonparametric Regression – Polynomial Models in Two or More Variables – Orthogonal Polynomials.

Unit V **(18 hours)**

Analysis of variance: One-Way and Two-Way Analyses: Introduction - Single - factor (One - Way ANOVA) Experiment and linear statistical model - Fixed a Effects Mode and ANOVA - Random Effects Model and ANOVA - Computations for Sum of Squares - Multiple Comparison Test: Grouping of Means - Single - factor (Two-Way ANOVA) Experiment and linear statistical model (Completely Randomized Block Design) - Fixed Effects Models for Two-way ANOVA - Random Effects Models for Two-way ANOVA - Computations for Sum of Square.

Course Outcomes:

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

CO 1: Demonstrate simple linear regression models and its use for data analysis

CO 2: Apply linear regression models for data analysis

CO 3: Classify the importance of model adequacy checks

CO 4: Distinguish between Polynomial Models in One Variable and Polynomial Models in two or more variables

CO 5: Analyze the concept of One Way and Two Way ANOVA

Text Books:

1. Douglas C. Montgomery and Elizabeth A.Peck and G.Geoffrey Vining, *Introduction to Linear*

Regression Analysis, 3rd Edition, John Wiley & Sons, Inc, 2001.

Unit I: Chapter 2 (Section 2.1- 2.6)
Unit II: Chapter 3 (Section 3.1 -3.5)
Unit III: Chapter 13 (Section 13.1 -13.3) & Chapter 4 (Section 4.1 - 4.5)
Unit IV: Chapter 7 (Section 7.1 – 7.5)

2. Ravichandran J. *Probability and Statistics for Engineers*, First Reprint Edition, Wiley India, 2012.

Unit V: Chapter 13 (Section 13.1-13.10).

References Book:

1. Douglas C. Montgomery, *Design and Analysis of Experiments*, 8th Edition, John Wiley& Sons, Inc, 2012.
2. Montgomery. A, *Introduction to Linear Regression Analysis*, John Wiley & Sons Canada Limited, 6th Edition.
3. Samprit Chatterjee, Jeffrey S. 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_S olutions-_Introduction-to-Linear-Regression-Analysis.pdf
2. http://home.iitk.ac.in/~shalab/regression/Chapter12-Regression- PolynomialRegression.pdf
3. https://www.youtube.com/watch?v=nvAMVY2cmok

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	9	3	1	3	3	**25**
CO2	3	3	3	3	1	3	3	**19**
CO3	3	1	3	3	1	3	3	**17**
CO4	3	1	3	3	1	3	3	**17**
CO5	3	1	3	1	3	3	3	**17**
Total	**15**	**9**	**21**	**13**	**7**	**15**	**15**	**95**

Low-1 Medium-3 High-9

DSE III. a) Data Structures and Algorithms

(For Students Admitted from 2022-23)

Semester: VI **Hours / week: 4**
Subject Code: IBDSE6A **Credit: 4**

Course Objectives:

1. To understand the concepts of abstract data types. linear and nonlinear data structures
2. To be able to implement the ADTs stack, queue, and dequeue and to provide students with solid foundations to deal with variety of computational problems

Unit I **(12 hours)**

Introduction: Mathematical Notations and Functions - Algorithmic Notations - Complexity of Algorithms - Other Asymptotic Notations for Complexity of Algorithms- Sub algorithms. **Linear Data Structures:** List ADT, Singly linked lists - Doubly linked lists and Circular Linked Lists - Stack ADT, Implementation of Stacks and applications. Queue ADT, Implementation of Queue and applications.

Unit II **(12 hours)**

Non-Linear Data Structure: Trees: Introduction – Binary Trees-Representing Binary Trees in memory-Traversing Binary Trees - Traversal algorithms using Stacks- **Graphs:** Graph Notation – Searching a Graph- Kruskal's algorithm-Dijkstra's algorithm-Graph representations.

Unit III **(12 hours)**

Balanced Binary Search Trees: Binary Search Trees-AVL Trees - Splay Trees- Iterative Splaying - Recursive Splaying - Performance Analysis.

Unit IV **(12 hours)**

B-Trees: Relational Databases - B-Tree Organization -The Advantages of B-Trees - B- Tree Implementation -B-Tree Insert - B-Tree Delete. **Sorting:** Preliminaries – Insertion Sort – Shell sort – Heap sort – Merge sort – Quicksort - Bucket Sort.

Unit V **(12 hours)**

Algorithm Design Techniques: Greedy Algorithms – Huffman Codes – Approximate Bin Packing- Divide and Conquer – Running Time of Divide and Conquer Algorithms– Dynamic Programming- Backtracking Algorithms.

Course Outcomes:

After successful completion of the course, the students will be able to

CO 1: Explain the basics concept of data structures and Algorithm stacks, queues and lists
CO 2: Distinguish about knowledge of tree and graphs concepts
CO 3: Analyze the concepts about searching and sorting techniques
CO 4: Demonstrate the types of Trees
CO 5: Evaluate about Algorithm and step by step approach in solving problems with the help of fundamental data structure

Text Books:

1. Seymour Lipchutz, *Data Structures,* Special Indian Edition, Revised First Edition, 2014.
2. Mark Allen Weiss — *Data Structures and Algorithm Analysis in C++*, Pearson Education Limited, 4th 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, 2nd Edition, New Delhi, 1992.
2. Alfred V.Aho Johne, Hopcroft, *Data Structures and Algorithm*, 3rd Edition, Addison- Wesley, 2012.
3. S.Sridhar, *Design and Analysis of Algorithms*, 2014.

E-Resources:

1. http://www.math.tau.ac.il/~matias/ds03.html
2. https://onlinecourses.nptel.ac.in/noc20_cs70/preview
3. https://www.tutorialspoint.com/python_data_structure/python_data_structure_tutorial.pdf

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	1	3	1	1	**19**
CO2	9	3	9	1	9	1	3	**35**
CO3	9	1	9	9	1	1	3	**33**
CO4	9	3	3	3	3	3	3	**27**
CO5	9	1	1	9	9	9	3	**41**
Total	**45**	**11**	**23**	**23**	**25**	**15**	**13**	**155**

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

DSE III. b) - Database Security

(For Students Admitted from 2022-23)

Semester: VI **Hours / week: 4**

Subject Code: IBDSE6B **Credit: 4**

Course Objectives:

1. To understand the fundamentals of security, and how it relates to information Systems
2. To provide an overview of database security concepts and techniques and describe new directions of database security in the context of information technology

Unit I **(12 hours)**

Security and Information Technology: Why Database Security? - A Secure Data Environment - Database Security Objectives - Who Are We Securing Ourselves Against? - Hackers - Network and Database Administrators-E-Mails. Malware: Computer Viruses – Worms-Trojan Viruses-Bots. Security Architecture: Assessment and Analysis-Design and \ Modeling -Deployment-Management and Support.

Unit II **(12 hours)**

Global Policies for the Database Environment: Security Policies- Update and Upgrade Management- Backup Management Plan- The Disaster Plan. Database Review: Database Structure Components - Database Models-Database Types- Database Management Systems.

Unit III **(12 hours)**

Oracle Architecture: The Instance and the Database- The Physical Structure- The Memory Structure- The Processes. Password, Profiles, Privileges, and Roles: Authentication - Authorization. Security Auditing: Security Auditing - Audit Classification - The Goal of an Audit - The Auditing Process.

Unit IV **(12 hours)**

Database Auditing: Preparation and Planning for a Database Security Audit-**The Database**. Audit-Reporting a Database Security Audit-Vendor-Specific Auditing Information.

Unit V **(12 hours)**

Security Testing: Security Testing Classification- The Goal of Security Testing. **Testing Methodology**: Planning and Preparation Phase- Execution Phase- Escalating Privileges- Reporting Phase.

Course Outcomes:

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

CO 1: Describe the concepts of Database security and access control

CO 2: Demonstrate the database systems structure

CO 3: Analyze security auditing and security testing

CO 4: Determine Database issues in Trust Management

CO 5: Build skill for solving complex problems in a team of database workers

Text Book:

1. Alfred Basta and Melissa Zgola, *Database Security*, Course Technology, Cengage Learning, 2012.

Reference Books:

1. Alan Williams , Angeline Janet Dhanarani, Ashok Swaminathan , Bettina Schäumer , Manish Choudhary ,Michael Mesaros, *Securing the OracleDatabase A technical primer***,** Fourth Edition, 2021.
2. Michael Gertz , SushilJajodia George Mason , *Handbook of Database Security Applications and Trends*, Springer Science+Business Media, LLC, 2008.

E- Resources:

1. https://nptel.ac.in/courses/106/104/106104135/
2. https://www.careers360.com/courses-certifications/swayam-database-management- courses-brp-org

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	1	3	9	1	3	**29**
CO2	9	3	1	1	9	1	1	**25**
CO3	9	3	3	3	9	3	3	**33**
CO4	9	3	1	1	9	3	3	**29**
CO5	9	3	9	3	9	9	3	**45**
Total	**45**	**15**	**15**	**11**	**45**	**17**	**13**	**161**

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

SEC VI - Data Mining Lab

(For those who joined since 2022-23)

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 dataset student.arff
2. Demonstration of preprocessing on dataset labor.arff
3. Demonstration of Association rule process on dataset contactlenses.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 dataset empl
9. Demonstration of clustering rule process on dataset iris.arff using simple k-means
10. Demonstration of clustering rule process on dataset student.arff using simple k means

Note: - Questions for the external examination will be based on the concepts learnt

Course Outcomes:

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

CO 1: Apply Data mining concept
CO 2: Extract knowledge using data mining techniques
CO 3: Adapt to new data mining tools
CO 4: Explore recent trends in data mining such as web mining, spatial-temporal mining
CO 5: Explore different types of algorithm

Course Outcomes	Programme Outcomes							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	9	3	9	3	1	9	9	**43**
CO2	9	1	9	3	1	9	9	**41**
CO3	9	1	9	3	1	9	9	**41**
CO4	9	1	9	3	1	9	9	**41**
CO5	9	3	9	3	1	9	9	**43**
Total	**45**	**9**	**45**	**15**	**5**	**45**	**45**	**209**

Low-1 Medium-3 High-9

Extra Credit – Quantitative Techniques

(For Students Admitted from 2022-23)

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: Chapter16

Reference Books:

1. P.K.Gupta and Man Mohan, *Problems in Operations Research*, Sultan Chand & Sons, New Delhi, Fourteenth Edition, 2002.
2. Prem Kumar Gupta and D.S. Hira, *Operations Research*, Sultan Chand & Sons, New Delhi First Edition, 1993.
3. Hamdy A. Taha, *Operations Research - An Introduction*, Prentice Hall, Eighth Edition, 2007.

E Resources:

1. https://www.analyticsvidhya.com/blog/2017/02/lintroductory-guide-on-linear- programming-explained-in-simple-english/
2. https://www.hackerearth.com/practice/algorithms/dynamic-programming/introduction- to-dynamic-programming-1/tutorial/
3. https://www.verywellmind.com/problems-in-decision-making-2795486

Course Outcomes	**Programme Outcomes**							
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**Total**
CO1	3	3	3	3	3	9	3	**27**
CO2	9	3	9	3	3	9	9	**45**
CO3	3	3	3	3	3	9	3	**27**
CO4	3	3	3	3	3	9	3	**27**
CO5	9	3	9	3	3	3	9	**39**
Total	**27**	**15**	**27**	**15**	**15**	**39**	**27**	**165**

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