5 - YEAR INTEGRATED M.SC. IN DATA SCIENCE

UGC Recognised

PDEU PANDIT DEENDAYAL ENERGY UNIVERSITY

FORMERLY PANDIT DEENDAYAL PETROLEUM UNIVERSITY [PDPU]

Detailed Curriculum

Semester - I							
Sr. No.	Course/Lab Code	Course/Lab Name	Teaching Scheme				
			L	T	P	C	Hrs./Wk
1.	24BSD101T	Mathematics for Data Science – I	3	1	0	4	4
2.	24BSD102T	Statistics for Data Science – I	3	1	0	4	4
3.	24BSD103T	Linear Algebra	3	1	0	4	4
4.	24BSD131T	Business Analytics	3	0	0	3	3
5.	24BSD131P	Business Analytics (Lab)	0	0	2	1	2
6.	24HS101T	English Communication	2	0	0	2	2
7.	24ENGS102T	Foreign Language – I	2	0	0	2	2
8.	24GSS101T	Yoga and Meditation	2	0	0	2	2
Total			**18**	**3**	**2**	**22**	**23**

Semester - II							
Sr. No.	Course/Lab Code	Course/Lab Name	Teaching Scheme				
			L	T	P	C	Hrs./Wk
1.	24BSD104T	Mathematics for Data Science – II	3	1	0	4	4
2.	24BSD105T	Statistics for Data Science – II	3	1	0	4	4
3.	24BSD106T	Programming in Python – I	3	0	0	3	3
4.	24BSD106P	Programming in Python – I (Lab)	0	0	2	1	2
5.	24BSD132T	Optimization Techniques	3	1	0	4	4
6.	24GSS102T	Leadership and Management	2	0	0	2	2
7.	24ENGS103T	Foreign Language – II	2	0	0	2	2
8.	24GSS103T	Ethics and Values	2	0	0	2	2
Total			**18**	**3**	**2**	**22**	**23**

Semester – III							
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**				
			L	**T**	**P**	**C**	**Hrs./Wk**
1.	24BSD201T	Mathematics for Data Science – III	3	1	0	4	4
2.	24BSD202T	Programming in Python – II	3	0	0	3	3
3.	24BSD202P	Programming in Python – II (Lab)	0	0	2	1	2
4.	24BSD203T	Database Management System	3	0	0	3	3
5.	24BSD203P	Database Management System (Lab)	0	0	2	1	2
6.	24BSD231T	Modern Application Development – I	3	0	0	3	3
7.	24BSD231P	Modern Application Development – I (Lab)	0	0	2	1	2
8.	24BSD232T	Advanced Excel	2	0	0	2	2
9.	24BSD221P	Data Visualization	0	0	4	2	4
10.	24BSD204T	Environmental Studies	2	0	0	2	2
Total			**16**	**1**	**10**	**22**	**27**

Semester – IV							
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**				
			L	**T**	**P**	**C**	**Hrs./Wk**
1.	24BSD205T	Programming Techniques using JAVA	3	0	0	3	3
2.	24BSD205P	Programming Techniques using JAVA (Lab)	0	0	2	1	2
3.	24BSD206T	Data Structure using Python	3	0	0	3	3
4.	24BSD206P	Data Structure using Python (Lab)	0	0	2	1	2
5.	24BSD207T	Predictive Analytics	3	1	0	4	4
6.	24BSD233T	Modern Application Development – II	3	0	0	3	3
7.	24BSD233P	Modern Application Development – II (Lab)	0	0	2	1	2
8.	24BSD222T	Financial Literacy	2	0	0	2	2
9.	24BSD208P	Natural Language Processing	0	0	4	2	4
10.	24BSD209T	Cybersecurity	2	0	0	2	2
Total			**16**	**1**	**10**	**22**	**27**

Semester - V							
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**				
			L	**T**	**P**	**C**	**Hrs./Wk**
1.	24BSD301T	Machine Learning Techniques – I	3	0	0	3	3
2.	24BSD301P	Machine Learning Techniques – I (Lab)	0	0	2	1	2
3.	24BSD302T	Introduction to Cloud Computing	3	1	0	4	4
4.	24BSD303T	Forecasting and Time Series Analysis (using Python)	3	0	0	3	3
5.	24BSD303P	Forecasting and Time Series Analysis (using Python) (Lab)	0	0	2	1	2
6.	24BSD321T	Business Data Management	3	1	0	4	4
7.	24BACS301T	Organisational Behaviour	2	0	0	2	2
8.	24ECOS301T	Managerial Economics	2	0	0	2	2
9.	24BSD331T	Cryptography	2	0	0	2	2
Total			**18**	**2**	**4**	**22**	**24**

Semester – VI							
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**				
			L	**T**	**P**	**C**	**Hrs./Wk**
1.	24BSD304T	Machine Learning Techniques – II	3	0	0	3	3
2.	24BSD304P	Machine Learning Techniques – II (Lab)	0	0	2	1	2
3.	24BSD305T	Scientific Computing	3	1	0	4	4
4.	24BSD306T	System Commands	3	1	0	4	4
5.	24BSD307T	Industry 4.0	3	1	0	4	4
6.	24BSD322T	Marketing Analytics	2	0	0	2	2
7.	24BSD332T	Prompt Engineering	2	0	0	2	2
8.	24BSD333T	Introduction to GitHub	1	0	2	2	3
Total			**17**	**3**	**4**	**22**	**24**

Semester - VII							
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**				
			L	**T**	**P**	**C**	**Hrs./Wk**
1.	24BSD401T	Deep Learning	3	0	0	3	3
2.	24BSD401P	Deep Learning (Lab)	0	0	2	1	2
3.	24BSD402T	Image Processing Using Python	3	1	0	4	4
4.	24BSD421T	Mathematical Finance	3	1	0	4	4
5.	24INT461	Summer Internship (which will be done during 6th Sem – summer vacation)	0	0	0	4	0
6.	24PROM451	Dissertation-I	0	0	0	6	0
7.	24PROM452	Project-I					
Total			**9**	**2**	**2**	**22**	**13**

Semester – VIII							
Sr. No.	**Course/Lab Code**	**Course/Lab Name**	**Teaching Scheme**				
			L	**T**	**P**	**C**	**Hrs./Wk**
1.	24BSD403T	Big Data Analytics	3	0	0	3	3
2.	24BSD403P	Big Data Analytics (Lab)	0	0	2	1	2
3.	24BSD404T	Sequential Decision-Making	3	1	0	4	4
4.	24BSD405T	Deep Learning with Computer Vision	3	1	0	4	4
5.	24BSD406T	Cloud Computing for Data Science – Azure/AWS	3	1	0	4	4
6.	24PROM453	Dissertation-II	0	0	0	6	0
7.	24PROM454	Project-II					
Total			**12**	**3**	**2**	**22**	**17**

Semester - IX							
Sr. No.	Course/Lab Code	Course/Lab Name	Teaching Scheme				
			L	T	P	C	Hrs./Wk
1.	24BSD501T	Stochastic Processes for Data Science	2	0	0	2	2
2.	24BSD501P	Stochastic Processes for Data Science (Lab)	0	0	4	2	4
3.	24BSD502T	Advanced Algorithm	3	0	0	3	3
4.	24BSD502P	Advanced Algorithm (Lab)	0	0	2	1	2
5.	24BSD503T	Deep Learning and Reinforcement Learning	3	0	0	3	3
6.	24BSD503P	Deep Learning and Reinforcement Learning (Lab)	0	0	2	1	2
7.	24PROM551	Industry Project	0	0	0	10	0
Total			**8**	**0**	**8**	**22**	**16**

Semester - X							
Sr. No.	Course/Lab Code	Course/Lab Name	Teaching Scheme				
			L	T	P	C	Hrs./Wk
1.	24PROM552	Capstone Project	0	0	0	22	0
Total			**0**	**0**	**0**	**22**	**0**

Important Notes:

1. For **3 – Year - B.Sc.**: Candidate will finish up to Sem – VI (without summer internship which will be evaluated in succeeding sem.)
2. For **4 – Year – B.Sc. (Hons.)**: Candidate will finish up to Sem – VIII (As mentioned in above tables)
3. For **4 – Year – B.Sc. (Research):** Candidate will study up to sem – VI (as in above tables) and then he will study first subject in Sem – VII, i.e. Deep Learning and first subject in Sem – VIII, i.e. Big Data Analytics and rest will be his full 1 – Year Research Project carrying 18 credits in each semester; which will eventually be earned as 36 credits for full 1 Year Research Project.
4. For **5 – Year – M.Sc:** Candidate will study all the semesters mentioned in above tables.

24BSD101T					Mathematics for Data Science - I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	-	-	100

COURSE OBJECTIVES

1. To make students familiar with a solid understanding of the fundamental principles of set theory and its applications.
2. To understand and work with equations and polynomials effectively, both in theoretical contexts and practical applications.
3. To perform basic operations on vector functions.
4. To make aware of the use of elementary calculus in curve tracing, finding volume, length of curves, surface area, etc.

UNIT 1 BASIC SET THEORY AND EQUATION OF LINE **10 Hrs.**

Number system, Sets and their operations, Relations and functions - Relations and their types, Functions and their types, Horizontal and vertical line tests, Rectangular coordinate system, Straight Lines - Slope of a line, Parallel and perpendicular lines, Representations of a Line, General equations of a line.

UNIT 2 EQUATIONS AND GRAPHS **08 Hrs.**

Quadratic functions, Minima, maxima, vertex, and slope, Quadratic Equations, addition, subtraction, multiplication, and division, Algorithms, Graphs of Polynomials - X-intercepts, multiplicities, end behavior, and turning points, Graphing & polynomial creation.

UNIT 3 FUNCTION(S), SEQUENCES, AND LIMITS **10 Hrs.**

Exponential function(s), composite function(s), Inverse function(s), Logarithmic Function(s) - Properties, Graphs, Exponential equations, Logarithmic equations, Sequence and Limits, Function of one variable, Graphs and Tangents, Limits for sequences, Limits for function of one variable, Limits and Continuity.

UNIT 4 DIFFERENTIAL AND INTEGRAL CALCULUS **14 Hrs.**

Differentiability and the derivatives, computing derivatives and L'Hospital's rule, tangents and linear approximation, critical points: local maxima and minima, Integral of a function of one variable, computing areas, computing areas under a curve, the integral of a function of one variable, derivatives and integrals for functions of one variable.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Define the basic concepts of set theory and calculus.
CO2 : Understand the physical interpretation of the concepts of calculus.
CO3 : Apply the concepts of calculus to evaluate various mathematical and physical problems.
CO4 : Analyze functions to find derivatives, tangent lines, integrals, arc length.
CO5 : Evaluate the various problems using the concept of differential and integral calculus.
CO6 : Create a wide range of problems of mathematical applications using derivatives or integral.

TEXTS/REFERENCE BOOKS

1. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass, **"Thomas' Calculus"**, Pearson Education
2. J. Stewart, **"Essential Calculus-Early Transcendentals"**,Cengage Learning.
3. H. Anton, I. Bivens and S. Davis, **"Calculus"**, John Wiley and sons (Asia), Pvt. Ltd. Singapore.
4. T. M. Apostol, **"Calculus, volume I"**, John Wiley and Sons.
5. Ignacio Bello, **"Introductory Algebra: A Real World Approach"**,McGraw-Hill Science/Engineering/Math.

24BSD102T					Statistics for Data Science - I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	-	-	100

COURSE OBJECTIVES

1. To be able to evaluate problems related to probability and distribution.
2. To be able to obtain the central measure of various data related to real-world problems.
3. To be able to understand data collection, its distribution and testing.
4. To be able to analyze the data related to various fields of science.

UNIT 1 INTRODUCTION TO PROBABILITY **09 Hrs.**

Sample space and events ,properties of probability ,conditional probability, total probability, Bayes theorem, measure of central tendency

UNIT 2 : RANDOM VARIABLE AND DISTRIBUTION FUNCTIONS **10 Hrs.**

Random variables. Discrete random variable, Continuous random variable, Expectation, Variance, Moment generating function, Discrete probability distribution functions, Binomial distribution, Negative binomial distribution, Poisson distribution, Continuous probability, density function, Normal distribution.

UNIT 3 : PARAMETER ESTIMATION **10 Hrs.**

The central limit theorem. General concepts of estimation, point estimation. Interval estimation, sampling distributions and the concept of standard error, confidence levels, confidence intervals based on a single sample and two samples. Concepts of maximum likelihood estimators.

UNIT 4 : REGRESSION ANALYSIS **13 Hrs.**

Correlation, partial correlation, regression analysis, simple linear regression, estimating model parameters – the method of the least squares; inferences about slope parameters, coefficient of determination, predicting Y values, prediction intervals, Logistic Regression, Nonlinear Regression, Introduction to multiple regression and its assumptions, estimating parameters

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Identify the use of probability in engineering aspects.
CO2 : Understand the concept of probability distribution and hypothesis test.
CO3 : Develop the ability to apply appropriate tools/methods to extract the solutions.
CO4 : Analyze the obtained solution of data analysis in context with theory.
CO5 : Appraise mathematical/statistical problems from real to complex domain.
CO6 : Evaluate problems on analysis of variance.

TEXTS/REFERENCE BOOKS

- S.C. Gupta & V.K. Kapoor, **"Fundamentals of Mathematical Statistics"**, Sultan Chand & Sons.
- Jay L. Devore, **"Probability and Statistics for Engineering and the Sciences"**, Cengage Learning.
- Ronald E. Walpole, Sharon L. Myers and Keying Ye, Probability &amp, **"Statistics for Engineers and Scientists"**, Pearson Education.
- Sheldon M. Ross, **"Introduction to Probability Models"** Academic Press.
- Sheldon M. Ross, **"Introduction to Probability and Statistics for Engineers and Scientists"**, Academic Press.

24BSD103T					Linear Algebra					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	-	-	100

COURSE OBJECTIVES

1. To provide students with a basic understanding of the concepts and methods of linear algebra.
2. To help the students develop the ability to solve problems involving concepts in matrices.
3. To connect linear algebra to other fields, both within and outside mathematics.
4. To develop an understanding of multi-dimension by vector spaces.

UNIT 1 MATRIX THEORY **12 Hrs.**

Matrices, Matrix Operations, Elementary Matrices, the inverse of Matrix, Rank and its properties, Introduction to systems of Linear Equations, elementary operations on matrix, row-reduced echelon matrices, applying row reduction to obtain the inverse of a matrix, Solution of a system of equation by Matrix inversion, Gauss Elimination and Gauss Jordan Elimination Method, applications of the system of linear equations, conditions for consistency of the system.

UNIT 2 VECTOR SPACES AND LINEAR TRANSFORMATION **10 Hrs.**

Euclidean n - space, vector space and Subspaces, Linear dependence and Independence; Basis, Dimension, Linear Transformations, Kernel and Range of a Linear Transformation, rank-nullity theorem and its applications.

UNIT 3 INNER PRODUCT SPACES AND ORTHOGONALITY **10 Hrs.**

Inner product (definition and examples), Orthogonality in Inner Product Spaces, Equivalence and similarity of matrices; Orthogonal transformations and rotations, Orthonormal Bases; Gram-Schmidt orthonormalization process, QR-decomposition.

UNIT 4 EIGENVALUES AND EIGENVECTORS **10 Hrs.**

Concept of solutions of higher degree equations or polynomials, Eigenvalues and eigenvectors, Properties of eigenvalues, Diagonalization, Cayley-Hamilton theorem and its applications.

TOTAL HOURS **42 Hrs.**

COURSE OUTCOMES

Upon completion of the course, a student will be able to:

CO1 : Identify the need of vector spaces and matrices in addressing real-world situations.
CO2 : Understand the vocabulary, notation, and operations for matrices and vectors.
CO3 : Apply different solution techniques to various linear systems.
CO4 : Intercompare various solution methods to conclude the one that works better for a given problem.
CO5 : Use computational techniques and algebraic skills essential for the study of linear algebra.
CO6 : Formulate problems based upon Eigenvalues and Eigenvectors to study their applications in various fields.

TEXTS/REFERENCE BOOKS

1. H. Anton, **"Elementary Linear Algebra with Applications"**, John Wiley.
2. G. Strang, **"Linear Algebra and its applications"**, Cengage Learning.
3. K. Hoffman and R. A. Kunze, **"Linear Algebra"**, Prentice Hall of India.
4. S. Lipschutz, M. Lipson, **"Linear Algebra"**, Schaum's outline series, McGraw-Hill Education India Pvt. Ltd.

24BSD131T					Business Analytics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

1. Acquire knowledge of techniques for collecting, processing, and analyzing data.
2. Develop skills in exploratory data analysis (EDA) to identify patterns and trends in the data.
3. Gain proficiency in statistical analysis and time series analysis for modeling and forecasting data.
4. Learn Power BI algorithms and their application in data analysis and prediction

UNIT 1 INTRODUCTION TO ANALYTICS **9 Hrs.**

Basics of Analytics & Analysis, History of Analytics and Business Analytics, Descriptive or Univariate Statistics,Measures of Central Tendency, Measures of Dispersion, Measures of Location, Measures of Asymmetry, Line Plot

UNIT 2 STATISTICS **10 Hrs.**

Introduction to Statistics, Population and Sample, Descriptive and Inferential Statistics, Central Tendency and Dispersion Measures, Percentile Concepts, Exercises using any programming language, Distributions (Normal, Skewed and Uniform)

UNIT 3 DATA PREPROCESSING TECHNIQUES **10 Hrs.**

Data preprocessing techniques: data cleaning, normalization, and transformation Exploratory data analysis (EDA) for understanding patterns and trends in data, Data visualization techniques to effectively communicate insights from the data Case studies and hands-on exercises on collecting, processing, and analyzing data. Forecasting Techniques - Moving Average & Exponential Smoothing, Autocorrelation and stationarity in time series data Popular time series models: AR, MA, ARMA, ARIMA, and GARCH

UNIT 4 POWER BI **13 Hrs.**

Case studies and practical applications of regression and time series analysis.
Power BI: Power BI foundations, Install Power BI Desktop, Get Data from Excel and Text Files,Changing Query Source, Reference Queries to Create Additional Lookup Tables, Create Relationships Between Tables, Create a Dynamic List of Dates, Create Additional Date Columns for Analysis, Sort the Month and Weekday Names Correctly, Mark the Table as a Date Table, Show Summary Information with Cards, Columns Charts to Compare Values, Map Visual to Plot Geographic Data, Slicers to Filter your Reports, KPI Card to Measure Performance Against a Goal, Line Graphs to Visualise Trend, Show Detail with the Matrix, Top N Lists with the Table Visualisation

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Comprehend the significance of data analytics and its impact on decision-making.
CO2 : Demonstrate proficiency in collecting, processing, and analyzing data using appropriate techniques.
CO3 : Utilize exploratory data analysis (EDA) to identify patterns and trends in the given data effectively.
CO4 : Apply time series analysis techniques to model and forecast data accurately.
CO5 : Employ Power BI to make predictions, and derive actionable.
CO6 : Visualizing the trends

TEXTS/REFERENCE BOOKS

1. U. Dinesh Kumar, **"Business Analytics :The Science of Data-Driven Decision-Making"**, IIMB repository.
2. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, **"Business Analytics Principles, Concepts, and Applications: What, Why"**, Pearson Education.
3. Christian Albright S and Wayne L. Winston, **"Business Analytics - Data Analysis and Decision-Making"**, Fifth edition, Cengage Learning.
4. James R. Evans, **"Business Analytics - Methods, Models and Decisions"**, Pearson Education.

24BSD131P					**Business Analytics (Lab)**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

1. Introduce analytics fundamentals and their application in business decision-making.
2. Teach statistical analysis and its practical use in interpreting data.
3. Develop skills in data preprocessing, EDA, and visualization to uncover data insights.
4. Train in Power BI for creating dynamic business reports and data-driven strategies.

LIST OF EXPERIMENTS

1 Calculating and visualizing measures of central tendency (mean, median, mode) and dispersion (range, variance, standard deviation) in a dataset using Python.

2 Analyzing population versus sample data characteristics and their implications on statistical inference using any statistical software.

3 Exploring various data distributions (normal, skewed, uniform) through graphical representations and statistical tests.

4 Performing data cleaning, normalization, and transformation on a raw dataset to prepare it for analysis.

5 Conducting exploratory data analysis (EDA) to identify patterns, trends, and outliers in a dataset, complemented by comprehensive data visualization.

6 Implementing basic forecasting techniques (moving average, exponential smoothing) on time series data and evaluating model performance.

7 Creating a dynamic report in Power BI that integrates data from Excel and text files, demonstrates data model relationships, and includes a variety of visualizations like column charts and maps.

8 Developing advanced Power BI dashboards that showcase time series analysis, utilize line graphs for trend visualization, and KPI cards for performance metrics.

9 Utilizing Power BI to create complex reports featuring slicers for dynamic data exploration, matrix visuals for detailed data breakdown, and top N lists to highlight key information.

10 Power BI project which includes creating a dynamic list of dates, additional date columns for analysis, and correctly sorting month and weekday names, culminating in an interactive analytical dashboard tailored for a specific business scenario.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Understand and apply basic principles of business analytics and statistical analysis.

CO2 : Utilize statistical methods to analyze and interpret data effectively.

CO3 : Perform data cleaning, normalization, and transformation to prepare data for analysis.

CO4 : Conduct exploratory data analysis to identify patterns and insights within data.

CO5 : Create and interpret a variety of data visualizations to communicate findings.

CO6 : Develop proficiency in using Power BI for advanced data modeling, reporting, and analytics.

TEXTS/REFERENCE BOOKS

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, **"Business Analytics Principles, Concepts, and Applications: What, Why"**, Pearson Education**.**
2. Ferrari, A., & Russo, M., **"Introducing Microsoft Power BI",** Microsoft Press.
3. Krishnan, V. , **"Research data analysis with power bi, INFLIBNET Centre"**.

24HS101T					**English Communication**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
1	**2**	**0**	**2**	**2**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. Understand of the fundamental elements of communication in English language.
2. Correct expression in the English language at a basic level
3. Using appropriate vocabulary, grammar, effective paragraph construction, writing in day-to-day scenarios, including digital platforms
4. To learn and apply communication skills in different public and interpersonal contexts.

UNIT 1 Introduction to Communication **07 Hrs.**

The Fundamentals of Language and Communication, Why English?, Types of Communication, Barriers to effective Communication, Digital Communication

UNIT 2 English Grammar and Vocabulary **07 Hrs.**

Tenses, Articles, prepositions, active voice passive voice and concord , Tools for vocabulary building, Homophones, homonyms, one word substitution, antonyms, synonyms, Root Words, Prefixes and Suffixes, Connotations. Collocations, Idioms. Phrases.

UNIT 3 Receptive Skills **07 Hrs.**

Listening Skills: Difference between listening and hearing, Active listening and passive listening, Types of listening, Traits of good listener, Reading Skills: Why reading is important, Effective reading techniques, Speed Reading, The SQ3R Method

UNIT 4 Compendium Skills **07 Hrs.**

Note Taking and Note Making: physical, digital, collective, Summarizing, Creating e-content

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Demonstrate an understanding of the fundamentals of communication, including the basic components of the communication process and its significance in personal, academic, and professional contexts.

CO2 : Apply grammatical rules accurately in written and spoken communication to enhance clarity, coherence, and precision.

CO3 : Employ effective strategies for vocabulary development, such as word association, context clues, and mnemonic devices.

CO4 : Enhance their ability to identify and interpret implicit meanings, inference, and figurative language in both written and spoken texts, contributing to deeper comprehension and critical analysis.

CO5 : Develop strong written communication skills to effectively convey complex ideas and information in a clear, concise, and coherent manner within the compendium.

CO6 : Apply ethical communication principles and standards of academic integrity when creating and sharing compendiums and avoiding plagiarism.

TEXTS/REFERENCE BOOKS

1. Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing, 2022.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. Sharma, Sangeeta and Binod Mishra. Communication Skills for Engineers and Scientists. New Delhi: PHI Learning Pvt. Ltd., 2009.
4. Kaul, Asha. Business Communication. Delhi: Prentice-Hall of India, 2006.

24ENGS102T					**Foreign Language – I**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
2	**0**	**0**	**2**	**2**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. To introduce French language at the beginner's level.
2. To enable students to form and understand basic sentences.
3. To enable students to read and write simple sentences in French.
4. To develop the ability to communicate the basics in the French language
5. To enable students to listen and comprehend conversations about topics regularly encountered in daily life and classroom situations
6. To enable students to recognise key words in conversation.

UNIT 1 Discovering the French language **07 Hrs.**

To introduce oneself and someone else, To know names of different countries, To count, To ask and to give personal information, To know days, months and seasons along with climate of France

UNIT 2 We learn French…. **07 Hrs.**

To greet and to bid someone goodbye, To learn the difference between formal and informal conversations, To get introduced to question words, To know the different forms of the question word "which" in French

UNIT 3 Basics of vocabulary **07 Hrs.**

To know the subject pronouns along with the verb "to be" (être), Vocabulary – nationalities and professions, To learn basic complex sentences with "because" and "for" along with proper pronunciation, To learn politeness in French culture

UNIT 4 Introduction to conversations **09 Hrs.**

To be able to understand conversations of daily life eg: talking to a classmate, ordering at a restaurant, explaining a route, To recognize and to use different typical French sounds like [y] and [z], To understand the system of "liason" with several subject pronouns and verbs

TOTAL HOURS: 30 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Reading, writing, and speaking on personal information
CO2 : Identify beginner's sentences
CO3 : Get introduced to French culture and manners
CO4 : To understand the usage of basic verbs grammatically in a conversation
CO5 : To gather basic vocabulary needed at a beginner's level
CO6 : To understand and be able to grasp French accent

TEXTS/REFERENCE BOOKS

1. Saison 1 Méthode de Français by Élodie Heu, Catherine Houssa, Emilie Kasazian, Delphine Ripaud
2. Saison 1 Cahier d'activités by Marion Alceraz, Dorothee Escoufier, Camille Gomy, Mathilde Landier, Francine Quemener, Delphine Ripaud

24GSS101T					Yoga and Meditation					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	-	-	100

COURSE OBJECTIVES

1. Provides a comprehensive exploration of yoga, encompassing physical postures, breath control, meditation, and philosophical foundations.
2. Students will learn how to incorporate these practices into their daily lives to enhance physical health, mental clarity, and overall well-being.
3. To introduce Yoga therapy, its principles and practices of Yoga to people with various lifestyle disorders
4. To make people aware of the therapeutic and preventive value of Yoga.

UNIT 1 **07 Hrs.**

Foundations of Yoga Practice. Define yoga and its historical context. Explain the eight limbs of yoga and their significance. Perform basic warm-up exercises and relaxation techniques. Understand the importance of alignment and safety in yoga postures.

UNIT 2 **07 Hrs.**

Asana Practice and Alignment. Demonstrate a variety of foundational yoga asanas with proper alignment. Identify the benefits and contraindications of each asana. Create a sequence of asanas targeting specific areas of the body. Explore modifications and variations to accommodate different skill levels.

UNIT 3 **07 Hrs.**

Pranayama and Breath Control. Describe the connection between breath and prana (life force). Practice different pranayama techniques, such as Ujjayi, Nadi Shodhana, and Kapalabhati. Understand the physiological and psychological effects of pranayama. Incorporate pranayama into asana practice to enhance focus and relaxation.

UNIT 4 **07 Hrs.**

Meditation and Yoga Philosophy Define meditation and its role in stress reduction and mental clarity. Explore various meditation techniques, including mindfulness and loving-kindness meditation. Discuss the concepts of Dhyana (meditation) and Samadhi (blissful absorption) from yoga philosophy. Reflect on the ethical principles of yoga, such as Yamas and Niyamas, and their application in daily life.

TOTAL HOURS: **28 Hrs.**

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Demonstrate proficiency in various yoga asana (postures) to enhance flexibility, strength, and balance.
CO2 : Utilize pranayama techniques to regulate and deepen their breath, promoting relaxation and focus.
CO3 : Apply meditation methods to cultivate mindfulness, reduce stress, and increase emotional resilience.
CO4 : Explain the fundamental principles of yoga philosophy and its relevance to modern living.
CO5 : Develop a personalized yoga practice that suits their individual needs and goals.
CO6 : Understand the theoretical relevance of yogic way of life.

TEXTS/REFERENCE BOOKS

1. Light on Yoga" by B.K.S. Iyengar: A classic guide that covers yoga philosophy, asanas (postures), pranayama (breath control), and meditation. It includes detailed instructions and photographs.
2. "The Key Muscles of Yoga" by Ray Long: This book delves into the anatomy of yoga postures, explaining how different muscles are engaged in each pose. It provides a deeper understanding of alignment and movement.
3. "The Heart of Yoga: Developing a Personal Practice" by T.K.V. Desikachar: T.K.V. Desikachar, son of the renowned yoga teacher Krishnamacharya, offers insights into the philosophy and practical aspects of yoga, emphasizing individualized practices.
4. "The Yoga Bible" by Christina Brown: As mentioned earlier, this comprehensive guide covers a wide range of yoga postures, making it a great resource for both beginners and experienced practitioners.
5. MEDITATION: "The Miracle of Mindfulness: An Introduction to the Practice of Meditation" by Thich Nhat Hanh: Thich Nhat Hanh introduces mindfulness meditation, emphasizing its simplicity and applicability to daily life.
6. "The Power of Now: A Guide to Spiritual Enlightenment" by Eckhart Tolle: While not focused solely on meditation, this book explores the concept of being present and offers insights that align with meditation practices.
7. "Mindfulness in Plain English" by Bhante Henepola Gunaratana: A practical guide to mindfulness meditation, providing clear instructions on techniques and addressing common challenges. "Lovingkindness: The Revolutionary Art of Happiness" by Sharon Salzberg: This book introduces loving-kindness meditation, which cultivates compassion and goodwill. It's a valuable addition to meditation practices.

24BSD104T					**Mathematics for Data Science - II**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**1**	**0**	**4**	**4**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

5. To provide basic understanding of calculus of several variables.
6. To be able to obtain extreme values of a multivariate function.
7. To study the basics of graph theory and use them in real life applications.
8. To use this basic course in upcoming courses in respective specializations in higher classes.

UNIT 1 FUNCTIONS OF SEVERAL VARIABLES **11 Hrs.**

Multivariable functions, Partial derivatives, Limit, continuity and directional derivatives - Multivariable functions: visualization; Partial derivatives, Directional derivatives, Limits for scalar-valued multivariable functions, Continuity for multivariable functions, Directional derivatives in terms of the gradient, Directional ascent and descent, Tangent (hyper) plane, Critical points, The directional of steep ascent/descent.

UNIT 2 HIGHER ORDER DERIVATIVES **11 Hrs.**

Tangents for scalar-valued multivariable functions, Finding the tangent hyper(plane), Critical points for multivariable functions, Higher order partial derivatives, Hessian Matrix and local extrema, The Hessian matrix and local extrema for f(x,y), The Hessian matrix and local extrema for f(x,y,z), Differentiability for Multivariable Functions.

UNIT 3 GRAPH THEORY **13 Hrs.**

Representation of graphs, Breadth-first search, Depth-first search, Applications of BFS and DFS; Directed Acyclic Graphs - Complexity of BFS and DFS, Topological sorting, Longest path, Transitive closure, Matrix multiplication, Single-source the shortest paths, Dijkstra's algorithm, Floyd–Warshall algorithm, Minimum cost spanning trees, Prim's algorithm, Kruskal's algorithm.

UNIT 4 ALGEBRAIC STRUCTURES **07 Hrs.**

Groups, semigroup, subgroup, Lagrange's theorem, Normal subgroups, Rings and Fields.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Define the various concepts of functions of several variables, and derivatives.
CO2 : Understand the basics of calculus for more than one variable.
CO3 : Apply the techniques of higher order derivatives to solve various science problems.
CO4 : Analyze the uses of graph theory in various application problems.
CO5 : Evaluate the different sciences application problems.
CO6 : Design new structures using graph theory and algebraic structure.

TEXTS/REFERENCE BOOKS

8. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass, **"Thomas' Calculus"**, Pearson Education.
9. E. Marsden, A. J. Tromba and A. Weinstein, **"Basic Multivariable Calculus"**, Springer (SIE), Indian Reprint.
10. G. B. Thomas, R. L. Finney, **"Calculus and Analytic Geometry"**, Addison-Wesley Publishing Company.
11. M. J. Strauss, G. L. Bradley and K. J. Smith, **"Calculus"**, Dorling Kindersley Pvt. Ltd., Pearson Education.
12. J. Stewart, **"Essential Calculus-Early Transcendentals"**, Cengage Learning.
13. H. Anton, I. Bivens and S. Davis, **"Calculus"**, John Wiley and Sons (Asia), Pvt. Ltd., Singapore.
14. Kenneth Rosen, **"Discrete Mathematics and Its Applications"**, McGraw Hill Education.

24BSD105T					Statistics for Data Science - II					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**1**	**0**	**4**	**4**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. To provide basic understanding of sampling theory and its applications.
2. To be able to obtain and analyse the data using hypothesis test etc..
3. To study the Monte Carlo method and understanding complex physical or mathematical systems by using randomly generated numbers
4. To use an Analysis of Variance (ANOVA) involves several steps.

UNIT 1 INTRODUCTION TO R **14 Hrs.**

Introduction, Operators: Arithmetic, logical and relational, control structures: loops and if-else statements, Descriptive Statistics, Correlation and Regression.

UNIT 2 LARGE SAMPLE THEORY **10 Hrs.**

Hypothesis testing: Introduction, Type I and Type II errors, tests concerning the mean and variance based on a single sample and two samples. Use of p-values. One way and Two way models. Sampling of attributes, sampling of variables.

UNIT 3 EXACT SAMPLING DISTRIBUTION **10 Hrs.**

Student's t distribution, application of t distribution, F-distribution, Application of F-distribution, Relation between t and F distributions, Chi square distribution, Application of Chi square distribution, Relation between F and chi square distribution.

UNIT 4 NON-PARAMETRIC INFERENCE **08 Hrs.**

Introduction to Non-parametric tests for single and paired measurements, Non-parametric tests for comparing two or more populations, Goodness of fit tests.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Understand the concept of sampling distribution.
CO2 : Understand the basics of Hypothesis testing.
CO3 : Apply the techniques of sampling and use them to applications.
CO4 : Analyze the applications of mean and variance.
CO5 : Evaluate the correlation and regression.
CO6 : Appraise sampling technique, simulation and analysis of variance to various problems of science and engineering.

TEXTS/REFERENCE BOOKS

1. S.C. Gupta & V.K. Kapoor, **"Fundamentals of Mathematical Statistics"**, Sultan Chand & Sons.
2. Jay L. Devore, **"Probability and Statistics for Engineering and the Sciences"**, Cengage Learning.
3. Ronald E. Walpole, Sharon L. Myers and Keying Ye, **"Probability & Statistics for Engineers & Scientists"**, Pearson Education.
4. Sheldon M. Ross, **"Introduction to Probability Models"**, Academic Press.
5. Sheldon M. Ross, **"Introduction to Probability and Statistics for Engineers and Scientists"**, Academic Press.

24BSD106T					**Programming in Python - I**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**0**	**0**	**3**	**3**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. Understand the basic concepts of programming and Python syntax,
2. Gain practical experience in writing and executing Python programs,
3. Demonstrate the use of built-in functions to navigate the file system,
4. Write Python functions to facilitate code reuse and manipulate strings

UNIT 1 INTRODUCTION	**10 Hrs.**
Introduction to Python, Data types in Python, Built in data type, Bool data type , Sequences in Python, Sets, Literals in python, Operator in Python, Arrays in Python, Strings and Characters, Control structure – Condition execution in Python, Using iteration within Python programs, Arrays in Python, Strings and characters in Python	
UNIT 2 FUNCTIONS AND FILES IN PYTHON	**12 Hrs.**
Files, Types of Files in Python, Opening a File, Closing a File, Working with Text Files Containing Strings, Knowing Whether a File Exists or Not, Working with Binary Files, The with Statement, Pickle in Python, The seek() and tell() Methods, Random Accessing of Binary Files, Random Accessing of Binary Files Zipping and Unzipping Files, Working with Directories, Running Other Programs from Python Program, Types of Files in Python, Opening a File, Closing a File, Working with Text Files Containing Strings, Knowing Whether a File Exists or Not, Working with Binary Files, The with Statement, Pickle in Python, The seek() and tell() Methods, Random Accessing of Binary Files, Random Accessing of Binary Files Zipping and Unzipping Files, Working with Directories, Running Other Programs from Python Program	
UNIT 3 MODULES AND PACKAGES	**10 Hrs.**
Introduction, module creation and usage, module search path, Package creation and importing, standard library module.	
UNIT 4 SCIENTIFIC AND NUMERICAL COMPUTING WITH PYTHON	**10 Hrs.**
Introduction to Scientific and Numerical computing, Introduction to various modules used for Scientific and Numerical programming: NumPy; SciPy; Scikit-Learn and Pandas	
TOTAL HOURS:	**42 Hrs.**

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Understanding of python syntax.
CO2 : Application: Different control structure.
CO3 : Analysis: Complex Python programs written by another author.
CO4 : Select: Appropriate library.
CO5 : Synthesis: Building Complex Algorithms using function and file.
CO6 : Creating: Complex programs using python.

TEXTS/REFERENCE BOOKS

1. Al Sweigart, **"Automate the Boring Stuff with Python"**, William Pollock.
2. Rao N.R , **"Core Python Programming"**, Dreamtech Publication India.
3. Halterman R., **"Fundamentals of Python Programming"**, Southern Adventist University.
4. Guttag J.V., **"Introduction to Computation and Programming Using Python"**, Prentice Hall India.
5. Chun W., **"Core Python Programming''**, Prentice Hall India.

24BSD106P					**Programming in Python - I (Lab)**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

1. Understand the basic concepts of programming and Python syntax,
2. Gain practical experience in writing and executing Python programs,
3. Demonstrate the use of built-in functions to navigate the file system,
4. To understand and use the functionality of various Python libraries for various scientific tasks.

LIST OF EXPERIMENTS

1 Basic programs
2 Perform operation on given string, array, character
3 Conditional, looping and control statement
4 Create functions and use functions
5 Recursive function
6 Operation on File format
7 File handling techniques
8 Import module and use it
9 Pandas, NumPy
10 SciPy; Scikit-Learn

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Understanding of python syntax.
CO2 : Application: Different control structure.
CO3 : Analysis: Complex Python programs written by another author.
CO4 : Select: Appropriate library.
CO5 : Synthesis: Building Complex Algorithms using function and file.
CO6 : Creating: Complex programs using python.

TEXTS/REFERENCE BOOKS

1. Al Sweigart, **"Automate the Boring Stuff with Python"**, William Pollock.
2. Rao N.R , **"Core Python Programming"**, Dreamtech Publication India
3. Halterman R., **"Fundamentals of Python Programming"**, Southern Adventist University
4. Guttag J.V., **" Introduction to Computation and Programming Using Python"**, Prentice Hall India
5. Chun W., **"Core Python Programming"**, Prentice Hall India

24BSD132T					Optimization Techniques					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	-	-	100

COURSE OBJECTIVES

1. Develops optimization fundamentals such as objective functions, decision variables, constraints, optimality conditions, and feasible regions.
2. Enables to formulate real-world problems into mathematical optimization models,
3. Enables to understand the wide range of applications of optimization techniques across different fields
4. Enables to analyze the theoretical properties of optimization algorithms such as convergence, complexity, and sensitivity analysis to parameters..

UNIT 1 ANALYTIC OPTIMIZATION **12 Hrs.**

Introduction : Optimization, Mathematical Concepts (Matrix, Eigenvalue, Positive definite matrix, positive semidefinite matrix, Negative definite matrix, Negative semidefinite matrix), Convexity and Convex functions, Univariate optimization, Multivariate optimization, Jacobian and Hessian Matrices, Taylor Approximation and Hessian Matrix, FOSC, SONC and SOSC

UNIT 2 UNIVARIATE NUMERICAL OPTIMIZATION **9 Hrs.**

Golden section search, Fibonacci method, Newton's method, Secant method

UNIT 3 MULTIVARIATE NUMERICAL OPTIMIZATION **11 Hrs.**

Level set, normal vector, tangent vector, Sub gradients-I, Sub gradients-II, Gradient Descent - Line Search, Gradient Descent – Backtracking, Gradient Descent with Momentum-I, GD with Momentum and Nestorev Accelerated Gradient Descent Method, Stochastic Gradient Descent Method, Adagrad, RMSProp and ADAM, Bias Correction in ADAM, Newton's method, Quasi-Newton method

UNIT 4 HEURISTIC OPTIMIZATION **10 Hrs.**

Introduction to Search Methods, Simulated Annealing, Genetic algorithms, Tabu Search.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Recognize different types of optimization problems (linear programming, nonlinear programming, integer programming, etc.).
CO2 : Interpret optimization problem formulations and constraints.
CO3 : Solve optimization problems using appropriate techniques and algorithms.
CO4 : Analyze the performance of optimization algorithms in terms of convergence, efficiency, and robustness.
CO5 : Judge the effectiveness of optimization solutions based on quantitative and qualitative criteria.
CO6 : Construct optimization solutions that integrate multiple objectives or constraints effectively.

TEXTS/REFERENCE BOOKS

1. David Luenberger, **"Linear and Nonlinear Programming"**, Springer.
2. Frederick S. Hillier, Gerald J. Lieberman, **"Introduction to Operations Research"**, McGraw-Hill Education

24GSS102T					**Leadership and Management**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
2	**0**	**0**	**2**	**2**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. To develop Self-awareness, and strong communication skills
2. To help build relationships and avoid conflict
3. To enhance decision-making skills
4. To understand the group process and effectiveness

UNIT 1 **07 Hrs.**

Who is a Leader? Difference between Leadership and Management.

UNIT 2 **07 Hrs.**

Leadership Theories, Trait theory, behavioral theory, Transformational Leaders

UNIT 3 **07 Hrs.**

Change Management and Decision Making, Kurt Lewin's Change model, Ways, and techniques of decision making

UNIT 4 **07 Hrs.**

Managing Groups and Teams, Difference between group and team, Managing diversity, Group size, group formation

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Develop a working definition and a distinction between management and leadership.
CO2 : Apply Kurt Lewin's leadership typology to identify leadership styles of contemporary leaders.
CO3 : Differentiate leadership styles of leaders from their personal traits.
CO4 : Assess the role of environment, such as athletics, business, and politics, in shaping leadership.
CO5 : Analyze the impact of situations on leadership effectiveness.
CO6 : Describe the skills associated with effective leadership.

TEXTS/REFERENCE BOOKS

1. Northouse, P. G. (2018). Leadership: Theory and practice. Sage publications.
2. You Are the Team: 6 Simple Ways Teammates Can Go From Good to Great - Michael Rogers
3. Leaders Eat Last: Why Some Teams Pull Together and Others Don't - Simon Sinek
4. Leadership Theory and Practice: Peter G Northhouse, Sage Publication

24ENGS103T					**Foreign Language – II**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
2	**0**	**0**	**2**	**2**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. To make students capable of giving and taking information on one's accommodation
2. To know cities, public places and to know articles, prepositions with the same
3. To form and understand negation
4. To speak about one's professions, hobbies, and dreams
5. To speak about one's family and to describe a person
6. To explain health problems
7. To indicate time and duration
8. To understand the difference between the sounds [e] and [ə], [e] and [ɛ] & the nasal sounds [ɑ̃] [ə] [ɔ̃]

UNIT 1 Knowing French language **07 Hrs.**

French definite and indefinite articles, demonstrative adjectives, verbs of preferences (to like, to adore, to hate) and sentence formation with the same.

UNIT 2 Convey information on places, time and transport **07 Hrs.**

To use prepositions of places with countries, cities, and public places and the usage of the verb "to come" and "to go" with "the article contractés", To be able to understand time and hence be capable of indicating duration, describing one's routine, also a travel programme.

UNIT 3 To talk about one's family and describe a person **07 Hrs.**

To give information about one's family and describe a person using physical and psychological adjectives and to understand the difference of gender and singular or plural

UNIT 4 To convey details relating to health problems **09 Hrs.**

To understand, pronounce as well as use in sentences the vocabulary relating to body, health problems and different doctors

TOTAL HOURS: 30 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Identify More Complex French structures, different pronunciations, and related reading skills
CO2 : Identify and be able to use complex French grammar
CO3 : Identify & Explore French Hobbies, Sports, Movies, Music, and Culture.
CO4 : Solve the French Grammar Complex form of Verbs, Adverbs, Adjectives, Articles, and connecters.
CO5 : Get used gradually to complex grammar easily in day-to-day life

TEXTS/REFERENCE BOOKS

1. Saison 1 A1 Plus and Saison A2 plus by Marie Noeille Cocton

24GSS103T					**Ethics and Values**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
2	**0**	**0**	**2**	**2**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. Development of a positive character, empathetic human being, responsible citizen, a compassionate and empathetic being.
2. Understanding virtues of volunteerism.
3. Promoting a sustainable lifestyle for the individual, community and mankind
4. Developing a sense of right and wrong leading to practical ethical behavior inculcating a positive work culture respecting professional ethics

UNIT 1 **07 Hrs.**

Introduction: General introduction on Ethics and Values, Gender equality, Desirable gender-related values, violence against children

UNIT 2 **07 Hrs.**

Work Ethics Punctuality, Cleanliness Law abidingness and workplace behavior and professional ethics. Women and work, stereotyping at the workplace, Work Conflict

UNIT 3 **07 Hrs.**

Challenges for Ethical Practices in Institutions of Higher Education: Ragging, Suicide and Need for Educational Counseling, Violence vs. Peaceful Protest, Conflict resolution, Plagiarism and Violation of Intellectual property Rights, Cheating in Examination and other Fraudulent Practices.

UNIT 4 **07 Hrs.**

Human Dignity and Ethical issues: Rights of persons with disabilities, prevention of discrimination Elder abuses, sexual abuses, rights of the elderly, Understanding the third gender

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Changes in perceptions, predicaments, and practices towards women.
CO2 : Develop proper attitude towards work and contribution to organizational principles.
CO3 : Pioneer in creating an equal society.
CO4 : Contribute to better Human Development Index (HDI) and inclusive development.
CO5 : End gender-based hierarchy and hegemony.
CO6 : Examine beliefs and practices in light of ethical principles.

TEXTS/REFERENCE BOOKS

1. The Elements of Moral Philosophy, James Rachels, Stuart Rachel, 8th edition, McGraw Hill.
2. Practical Ethics, Peter Singer, South Indian Edition, Cambridge University Press.
3. LaFollette, Hugh, and Hugh La Follette, eds. The Oxford Handbook of Practical ethics. Oxford University Press, 2003.

24BSD201T					**Mathematics for Data Science - III**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**1**	**0**	**4**	**4**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

5. To provide a comprehensive foundation in fundamental concepts of discrete mathematics, including set theory, relations, functions, and logic.
6. To develop problem-solving skills through the application of mathematical reasoning, combinatorial analysis, and algorithmic thinking.
7. To explore the applications of discrete mathematics in various fields, such as computer science, data analysis, and cryptography.
8. To foster analytical and critical thinking skills essential for success in advanced mathematics and related disciplines.

UNIT 1 RELATION AND LATTICES **12 Hrs.**

Relation, Properties of Relation, n-array relation, Application of n-array relation in database management with operators, Representation of relation using matrix and digraph, Reflexive closure, symmetric closure, transitive closure, Warshall's algorithm. Antisymmetric relation, Partial ordered set, Total order set, irreflexive, asymmetric strict order, Hash Diagram, Lattices, Type of Lattices. Recurrence Relation: Introduction, Recursion, Recurrence Relation, Solving, Recurrence Relation

UNIT 2 MATHEMATICAL LOGIC **09 Hrs.**

Propositional Logic: Definition, Statements & Notation, Truth Values, Connectives, Statement Formulas & Truth Tables, Well-formed Formulas, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Examples, CNF, DNF, PCNF AND PDNF. Predicate Logic: Definition of Predicates; Statement functions, Variables, Quantifiers, Predicate Formulas, Free & Bound Variables; The Universe of Discourse, Examples, Valid Formulas & Equivalences, Examples.

UNIT 3 INTEGERS AND COUNTING **11 Hrs.**

Integers: Properties of Integers; Prime Number; Greatest Common Divisor (GCD); Relative Prime; Least Common Multiple (LCM); Representation of Integers in Computer; Decimal, Binary, Octal, and Hexadecimal Representation. Counting : Permutations, Combinations, Pigeonhole Principle, Elements of Probability, Recurrence Relations.

UNIT 4 NUMBER THEORY **10 Hrs.**

Number Systems and Divisibility, Modular Arithmetic and Congruences, Essential Theorems and Algorithms, The Euclidean Algorithm and Fundamental Theorem of Arithmetic and its applications to solving Diophantine equations, Euler's Totient Function (phi function), Properties and Applications, The infinitude of primes, Prime number theorem, Special types of primes (Mersenne primes, Fermat primes), Pythagorean Triples and Diophantine Equations, Generating Pythagorean triples, Solving Diophantine equations using number theory techniques, Applications of Number Theory: Introduction to cryptography and public-key infrastructure, Applications in coding theory and error correction.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Understand the relations, their properties like symmetric, asymmetric etc.
CO2 : Apply mathematical principles to analyze and construct logical arguments.
CO3 : Apply counting techniques, probability theory, and recurrence relations to analyze and solve combinatorial problems.
CO4 : Analyze the use of number theory in cryptography, error correction codes etc.
CO5 : Evaluate the role of a variety of numbers in problem-solving according to their types.
CO6 : Real world Complex problems can be solved by number theory, fundamental logic, counting etc.

TEXTS/REFERENCE BOOKS

4. Lipschutz, Seymour, and Marc Lars Lipson, **"Discrete Mathematics"** , Schaum's Outlines. McGraw-Hill Education.
5. Chang, Chin-Liang, and Richard Char-Tung Lee, **"Symbolic Logic and Mechanical Theorem Proving"** , Academic Press.
6. Rosen, Kenneth H., **"Discrete Mathematics and Its Applications"** McGraw-Hill Education.

24BSD202T					**Programming in Python - II**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**0**	**0**	**3**	**3**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. To understand and use functionality of various Python libraries for various scientific tasks,
2. Able to work with data analysis libraries such as MatplotLib and TensorFlow.
3. To understand and use functionality of various Python libraries for various scientific tasks,
4. Visualize and present the inference using various tools.

UNIT 1 INTRODUCTION **10 Hrs.**

Review of Important Python Concepts, Overview of Advanced techniques in Python: Lambdas, Filter map and reduce, is and id, Modules

UNIT 2 OBJECT-ORIENTED PROGRAMMING IN PYTHON **12 Hrs.**

Overview of OOP, Creating Classes and Objects, Accessing attributes Built-In Class Attributes, Destroying Objects, Exception, Handling an exception. Argument of an Exception, Python Standard Exceptions, Raising exceptions, User-Defined Exceptions, Decorators, Iterators and Generators, Garbage Collector,

UNIT 3 DATA VISUALIZATION **10 Hrs.**

Data Visualization (using MatplotLib, Pandas and Seaborn, Exploring duplicate data and missing data, Data fitting concepts, Introduction to collection modules, counter, data storage offline

UNIT 4 INTRODUCTION TO FRAMEWORK USED WITH PYTHON-TENSORFLOW **10 Hrs.**

Introduction to Frameworks used with Python – TensorFlow Concept of Computational Graph and Nodes, Virtual Environment and Anaconda, Installing TensorFlow with GPU support on a Linux System, TF Data Types, Placeholders, TF Variables, TF Session

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Understanding of advanced python syntax.
CO2 : Application: Modules and Classes.
CO3 : Analysis: Complex Python programs written by another author.
CO4 : Select: Appropriate library for visualization.
CO5 : Synthesis: Building Complex Algorithms using lambdas, filter, map etc.
CO6 : Creating: Complex programs using python.

TEXTS/REFERENCE BOOKS

1. Rao N.R., **"Core Python Programming"**, Dreamtech Publication India.
2. Sebastian Raschka, **"Python Machine Learning"**, Packt Publishing Ltd.
3. Willi Richert, **"Building Machine Learning Systems with Python"**, Packt publication.
4. Fredrik Lundh, **"Python Standard Library"**, O'Reilly Publications.
5. Richard H., **"Fundamentals of Python Programming"**, Southern Adventist University

24BSD202P					**Programming in Python - II (Lab)**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

1. Understand the basic concepts of programming and Python syntax
2. Gain practical experience in writing and executing Python programs
3. Demonstrate the use of built-in functions to navigate the file system
4. To understand and use the functionality of various Python libraries for various scientific tasks.

LIST OF EXPERIMENTS

1 Lambdas, Filter, map and reduce
2 is and id, Modules
3 Creating Classes, Creating Instance Objects
4 Built-In Class Attributes, Destroying Objects (Garbage Collection)
5 User-defined compound types, Exception Handling
6 Plot data using MatplotLib
7 Plot data using Seaborn
8 Exploring duplicate data and missing data
9 Computational Graph and Nodes in TensorFlow
10 TF Data Types, Placeholders, TF Variables, TF Session

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Understanding of advanced python syntax.
CO2 : Application: Modules and Classes.
CO3 : Analysis: Complex Python programs written by another author.
CO4 : Select: Appropriate library for visualization.
CO5 : Synthesis: Building Complex Algorithms using lambdas, filter, map etc.
CO6 : Creating: Complex programs using python.

TEXTS/REFERENCE BOOKS

1. Rao N.R., **"Core Python Programming"**, Dreamtech Publication India, Third Edition.
2. Sebastian Raschka, **"Python Machine Learning"**, Packt Publication.
3. Willi Richert, **"Building Machine Learning Systems with Python"**, Packt publication.
4. Fredrik Lundh, **"Python Standard Library"**, O'Reilly Publications.
5. Richard H., **"Fundamentals of Python Programming"**, Southern Adventist University.

24BSD203T					**Database Management Systems**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**0**	**0**	**3**	**3**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. To learn data models, conceptualize and depict a database system using ER diagram
2. Gain a good understanding of the architecture and functioning of Database Management Systems
3. Understand the use of Structured Query Language (SQL) and its syntax.
4. To understand the internal storage structures in a physical DB design

UNIT 1 INTRODUCTION TO DBMS **11 Hrs.**

Purpose of Database System -– Views of data – data models, database management system, three-schema architecture of DBMS, components of DBMS. E/R Model - Conceptual data modeling - motivation, entities, entity types, attributes, relationships, relationship types, E/R diagram notation, examples

UNIT 2 RELATIONAL DATABASE MODEL **11 Hrs.**

Structure of relational databases, Domains, Relations, Relational algebra – fundamental operators and syntax, relational algebra queries, tuple relational calculus, Basic concepts, Design process, constraints, Keys, Design issues, E-R diagrams, weak entity sets, extended E-R features – generalization, specialization, aggregation, reduction to E-R database schema, Functional Dependency – definition, trivial and non-trivial FD, closure of FD set, closure of attributes, irreducible set of FD, Normalization – 1Nf, 2NF, 3NF, Decomposition using FD- dependency preservation, BCNF, Multivalued dependency, 4NF, Join dependency and 5NF

UNIT 3 SQL **11 Hrs.**

Commands – Data types – DDL - Selection, Projection, Join and Set Operations – Aggregate Functions – DML – Modification - Truncation - Constraints – Subquery, Analyzing current database (SQL implementation), Table structures-SQL implementation.

UNIT 4 TRANSACTION MANAGEMENT **9 Hrs.**

Transaction concepts, properties of transactions, serializability of transactions, testing for serializability, System recovery, Two- Phase Commit protocol, Recovery and Atomicity, Log-based recovery, concurrent executions of transactions and related problems, Locking mechanism, solution to concurrency related problems, deadlock, , two-phase locking protocol, Isolation, Intent locking

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Understand the basic concepts of database systems.
CO2 : Ability to Install, configure, and interact with a relational database management system.
CO3 : Design the database schema with the use of appropriate data types for storage of data in the database.
CO4 : Ability to master the basics of SQL and construct queries using SQL.
CO5 : Competent in use of SQL.
CO6 : Analyze functional dependencies for designing robust databases.

TEXTS/REFERENCE BOOKS

1. C. J. Date, **"An introduction to Database Systems"**, Addison Wesley Longman.
2. Abraham Silberchatz, Henry F. Korth, S. Sudarshan, **"Database System Concepts"**, McGrawHill.
3. Martin Gruber, **"Understanding SQL"**, BPB Publications.

24BSD203P					**Database Management Systems (Lab)**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

1. To learn data models, conceptualize and depict a database system using ER diagram
2. Gain a good understanding of the architecture and functioning of Database Management Systems
3. Understand the use of Structured Query Language (SQL) and its syntax.
4. To understand the internal storage structures in a physical DB design

LIST OF EXPERIMENTS

1 Design a Database and create required tables. For e.g. Bank, College Database and apply different queries on it.
2 Apply the constraints like Primary Key , Foreign key, NOT NULL to the tables.
3 Write a sql statement for implementing ALTER,UPDATE and DELETE
4 Displaying data from Multiple Tables (join)
5 Write the query for implementing the following functions: MAX(),MIN(),AVG(),COUNT()
6 Write the query to implement the concept of Integrity constraints
7 Write the query to create the views
8 Perform the queries for triggers
9 Perform the following operation for demonstrating the insertion , updation and deletion using the referential integrity constraints
10 Write the query for creating the users and their role.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Understand the basic concepts of database systems.
CO2 : Ability to Install, configure, and interact with a relational database management system.
CO3 : Design the database schema with the use of appropriate data types for storage of data in the database.
CO4 : Ability to master the basics of SQL and construct queries using SQL.
CO5 : Competent in use of SQL.
CO6 : Analyze functional dependencies for designing robust databases.

TEXTS/REFERENCE BOOKS

1. A Silberschatz, H Korth, S Sudarshan, **"Database System and Concepts"**, McGraw-Hill .
2. Rob, Coronel, **"Database Systems"**, Cengage Learning.

24BSD231T					Modern Application Development - I					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

1. Understanding web development fundamentals.
2. Proficiency in frontend development.
3. Introduction to backend development and database integration.
4. Ensuring application security and deployment.

UNIT 1 FUNDAMENTALS OF WEB DEVELOPMENT **10 Hrs.**

Basic terminologies of the Web, Webapages written in HTML and CSS, HTML evolution and beyond HTML, Application frontend

UNIT 2 INTRODUCTION TO WEB ARCHITECTURE **10 Hrs.**

Presentation layer - view, Models- Introduction to databases, controllers - business logic, APIs and REST APIs - classification and characterization, Hands-on on Postman API, usage of APIs to convert speech to text

UNIT 3 BACKEND DEVELOPMENT AND DEPLOYMENT **10 Hrs.**

Backend systems, application deployment, application security

UNIT 4 TESTING OF WEB APPLICATIONS **12 Hrs.**

Testing of all the web applications

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Describe the fundamentals of web development.
CO2 : Understand the backend development.
CO3 : Implement and apply techniques in frontend development.
CO4 : Analyze the architecture of web applications and security.
CO5 : Demonstrate proficiency in deploying web applications.
CO6 : Design and explore frontend and backend components to develop cohesive web applications.

TEXTS/REFERENCE BOOKS

1. Jon Duckett, HTML and CSS: **"Design and Build Websites"**, John Wiley & Sons.
2. Jon Duckett, **"Javascript and Jquery: Interactive front end web development"**, Wiley publishing.
3. L. Richardson and M Amundsen, **"RESTful web APIs"**, O'Reilly Media.
4. M. Kleppmann, **"Designing data-intensive applications"**, O'Reilly Media.
5. Lucas da Costa, **"Testing Javascript Applications"**, Simon and Schuster.

24BSD231P					**Modern Application Development - I (Lab)**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**–**	**–**	**–**	**50**		**50**

COURSE OBJECTIVES

1. Foundational understanding of essential web development technologies, including HTML, CSS, and JavaScript
2. Learn the principles of responsive web design by using techniques such as media queries, flexible grids, and responsive images
3. Introduction to popular front-end frameworks such as Bootstrap or Materialize CSS
4. Explore client-side scripting languages such as JavaScript and libraries like jQuery, and to learn how to use JavaScript to manipulate the DOM, handle user interactions, and dynamically update content on web pages

LIST OF EXPERIMENTS

1 Introduction to Microservices Architecture
2 Building a RESTful API with Node.js and Express
3 Exploring data APIs with Postman
4 Implementing Authentication and Authorization
5 GitHub API
6 Frontend Development with React.js
7 Continuous Integration and Continuous Deployment (CI/CD) Pipeline Setup
8 Scalability and Load Testing
9 Security Best Practices and Vulnerability Assessment
10 Monitoring and Logging Setup with ELK Stack

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Identify common Java data structures and their usage.
CO2 : Understand the fundamentals of JavaScript.
CO3 : Implement advanced Javascript features and develop Vue.js applications with APIs.
CO4 : Analyse performance optimization techniques for Vue.js applications.
CO5 : Evaluate advanced Vue.js features and analyze optimization techniques for Vue.js applications.
CO6 : Design secure and efficient APIs for authentication and state management.

TEXTS/REFERENCE BOOKS

1. Richardson & Amundsen, **"RESTful Web APIs: Services for a Changing World"**, O'Reilly Media.
2. Parecki, **"OAuth 2.0 Simplified"**, Aaron Parecki.
3. Chinnathambi, **"Learning React: A Hands-On Guide to Building Web Applications Using React and Redux"**, Addison-Wesley Professional.
4. Sullivan, **"Web Application Security: A Beginner's Guide"**, McGraw-Hill Education.
5. Gormley & Tong, **"Elasticsearch: The Definitive Guide"**, O'Reilly Media.

24BSD232T					**Advanced Excel**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
2	**0**	**0**	**2**	**2**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. Understand Master advanced functions and formulas for complex calculations
2. Explore data analysis techniques such as pivot tables, data validation, and conditional formatting
3. Learn the optimization of spreadsheet performance and efficiency
4. Utilize external data sources and connections for real-time data analysis

UNIT 1 Fundamental Functions and Data Analysis Techniques **7 Hrs.**

Nested functions, Array formulas, Lookup and reference functions, Text functions for data manipulation, Pivot tables and pivot charts, Data validation and validation rules

UNIT 2 Data Visualization **6 Hrs.**

Creating interactive dashboards, Using sparklines and data bars, Advanced chart types and customization

UNIT 3 Spreadsheet Optimization **7 Hrs.**

Managing large datasets efficiently, Workbook organization and structure, Performance optimization techniques, namely, Caching, Reduce volatile functions, Compression, and data partitioning.

UNIT 4 External Data Sources **8 Hrs.**

Importing data from external sources (e.g., databases, web), Using data connections for real-time analysis, Refreshing data and updating connections, ChatGPT 4.0

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Use nested functions and array formulas for complex calculations.

CO2 : Utilizing lookup and reference functions for data retrieval and manipulation.

CO3 : Implement data validation and conditional formatting techniques to ensure data integrity and enhance visual analysis.

CO4 : Create dynamic and interactive dashboards to present insights effectively.

CO5 : Understand techniques for managing large datasets efficiently and organizing workbooks effectively.

CO6 : Import the data from external sources and establish connections for real-time data analysis.

TEXTS/REFERENCE BOOKS

1. Jordan Goldmeier and John Michaloudis, **"Advanced Excel Essentials"**, Apress Publishing
2. Nathan George, **"Excel Charts and Graphs: Master Data Visualization in Excel"** , Que Publishing

24BSD221P					**Data Visualization**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**4**	**2**	**4**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

1. Gaining a basic understanding of the subject (e.g., factual knowledge, methods, principles, Generalizations, theories)
2. Learning appropriate methods for collecting, analysing and interpreting numerical information
3. Developing specific skills, competencies, and points of view needed by professionals in the Field most closely related to this course

LIST OF EXPERIMENTS

1 Import Dataset into Tableau and create relationships between tables.
2 Creating a basic bar chart to visualize sales data and customizing the bar chart by adding labels and tooltips.
3 Create a Pie Chart for Sales Data and customize it using color scheme, Label, size.
4 Creating a line chart to analyze sales trends over time.
5 Building a scatter plot to explore the relationship between two variables.
6 Creating a stacked area chart to analyze Sales Data.
7 Visualizing categorical data using a bubble chart.
8 Creating a Tree map using Tableau and working with data, filter, sorting.
9 Create a geographic Map using Tableau and highlight all relevant states/Cities with labels.
10 Creating a heat map to identify patterns or correlations in data.
11 Implementing dual-axis charts to compare two metrics with different scales.
12 Applying advanced calculations and functions for customized metrics.
13 Create a minimum six worksheets for data visualization in Tableau using Sales Dataset.
14 Designing a comprehensive dashboard with multiple visualizations for Sale Dataset.
15 Prepare a census dataset (data must be actual as per Gov portal), generate maps geographical, Bar Chart, Pie Chart, Bubble Chart visualization using Tableau and Create a Complete Dashboard.
16 Prepare a City wise Air Quality Index dataset and generate visualization using Tableau. Try to use maximum functions available in Tableau 1. Color 2. Label 3. Filter 4. Sorting 5. Swap Row Column 6. Size of objects. Create a Dashboard for AQI Visualizations.
17 Apply BG Color, Float, Add filter, Add links/Image, Add Download button, Add navigation, on your AQI Dashboard.
18 Creating a data story on census dataset using Tableau's story features.
19 Designing annotations and adding captions to enhance your data story.
20 Create a Data Story for City wise Air Quality Index data, Sale Data, Customer Segmentation Dashboard, Analysing Marketing Campaign Impact on Sales, Social Media Analytics.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Understand data visualization.
CO2 : Application: Apply the various processes and tools used for data visualization.
CO3 : Analysis: Analyse the process involved and security issues present in data visualization.
CO4 : Select: Appropriate tool for visualization.
CO5 : Synthesis: Building interactive data visualization to make inferences.
CO6 : Creating: Dashboard using Tableau.

TEXTS/REFERENCE BOOKS

1. Scott Murray, **"Interactive data visualization for the web"**, O"Reilly Media, Inc.
2. Ben Fry, **"Visualizing Data"**, O"Reilly Media, Inc.
3. Greg Conti, **"Security Data Visualization: Graphical Techniques for Network Analysis"**, NoStarch Press Inc.

24BSD205T					Programming Techniques using JAVA (Theory)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

1. To enable the students to give analytical maturity and to build mathematical thinking skills.
2. To learn the OOP concepts which lead them to better understanding of programming
3. To develop the skill of data Structures and Algorithms in Java.
4. To relate with the advanced topics in JAVA programming for various data science applications

UNIT 1 INTRODUCTION TO JAVA PROGRAMMING **10 Hrs.**

Overview of Java programming language, History and evolution of Java, Key features of Java (platform independence, object-oriented, etc.), Setting up Java Development Environment (JDK, IDEs), Basic syntax and structure of Java programs, Data types, variables, and constants, Operators and expressions, Control flow statements (if-else, switch, loops)

UNIT 2 OBJECT-ORIENTED PROGRAMMING (OOP) CONCEPTS **10 Hrs.**

Understanding Object-Oriented Programming paradigm, Classes and objects, Encapsulation, inheritance, and polymorphism, Abstraction and interfaces, Packages and access modifiers, Exception handling, Constructors and destructors

UNIT 3 DATA STRUCTURES AND ALGORITHMS IN JAVA **11 Hrs.**

Introduction to data structures, Arrays and arraylists, Linked lists (singly, doubly, circular), Stacks and queues, Trees (binary trees, binary search trees), Graphs (representation and traversal), Sorting and searching algorithms (selection sort, bubble sort, insertion sort, merge sort, quick sort, linear search, binary search).

UNIT 4 ADVANCED JAVA CONCEPTS **11 Hrs.**

Generics and collections framework, Multithreading and concurrency, Input/output streams and serialization, Networking with Java (sockets, URL handling), Java Database Connectivity (JDBC), GUI Programming with Swing or JavaFX, Introduction to Java Virtual Machine (JVM) and memory management

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Demonstrate a comprehensive understanding of fundamental Java programming concepts including syntax, data types, control structures, and basic object-oriented principles.

CO2 : Implement object-oriented programming concepts such as classes, objects, inheritance, polymorphism, encapsulation, and abstraction in Java.

CO3 : Analyze and implement various data structures and algorithms using Java, including arrays, linked lists, stacks, queues, trees, graphs, and sorting/searching algorithms.

CO4 : Perform input/output operations and file handling in Java, including reading from and writing to files, handling streams, and serialization.

CO5 : Develop strong problem-solving skills and algorithmic thinking abilities through the application of programming techniques in Java to solve real-world problems and challenges.

CO6 : Design graphical user interfaces using Java Swing or JavaFX, including creating windows, dialogs, buttons, menus, and event handling.

TEXTS/REFERENCE BOOKS

1. Herbert Schildt, "**Java: A Beginner's Guide"**, McGraw Hill.
2. J. Bloch, **"Effective Java"**, Addison-Wesley.
3. R. Lafore, **"Data Structures and Algorithms in Java"**, Sams Publishing.
4. K. Sierra & B. Bates, **"Head First Java"**, O'Reilly Media.
5. Harold, Elliotte Rusty, **"Java Network Programming"**, O'Reilly Medi.

24BSD205P					Programming Techniques using JAVA (Lab)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	-	-	-	50	50	100

COURSE OBJECTIVES

1. Understand the basic concepts of programming and JAVA syntax.
2. Gain practical experience in writing and executing OOP concepts.
3. Demonstrate the use of built-in functions in JAVA.
4. To understand and use the functionality of various JAVA utilities for various data scientific tasks.

LIST OF EXPERIMENTS

1 Basic Java Syntax and Output: Write a Java program to display "Hello, World!" on the console. Introduce students to basic Java syntax, compilation, and execution.

2 Variables and Data Types: Create a program that prompts the user to enter their name and age, then displays a personalized greeting message. Teach students about variables, data types, and input/output operations in Java.

3 Control Structures: Implement a program that determines whether a given number is prime or not. Cover if-else statements, loops (such as for, while, and do-while), and logical operators.

4 Object-Oriented Programming (OOP): Develop a simple class hierarchy representing different shapes (e.g., circle, rectangle, triangle) with methods to calculate area and perimeter. Introduce students to classes, objects, inheritance, and polymorphism

5 Exception Handling: Write a program that demonstrates exception handling by handling arithmetic exceptions (e.g., divide by zero) and input validation (e.g., handling non-numeric input).

6 Data Structures: Implement a simple linked list data structure in Java, including methods for insertion, deletion, and traversal. Allow students to practice implementing basic data structures from scratch

7 Sorting and Searching Algorithms: Write Java programs to implement various sorting algorithms such as bubble sort, insertion sort, selection sort, and quick sort. Also, implement linear and binary search algorithms.

8 File Handling: Create a program that reads data from a text file, performs some processing (e.g., counting occurrences of words), and writes the results to another file. Teach students how to handle file input/output streams in Java.

9 Multithreading: Develop a program that demonstrates multithreading by creating multiple threads to perform different tasks concurrently (e.g., computing Fibonacci series, generating prime numbers).

10 Graphical User Interface (GUI) Programming: Use Swing or JavaFX to build a simple GUI application, such as a calculator, address book, or student management system. Allow students to practice designing and implementing user interfaces.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Demonstrate proficiency in Java programming, including syntax, data types, control structures, and object-oriented programming principles.

CO2 : Understand the fundamental data structures and algorithms implemented in Java, such as linked lists, sorting algorithms, searching algorithms, and recursive algorithms.

CO3 : Analyze problem requirements and devise appropriate solutions using Java programming techniques.

CO4 : Apply object-oriented programming concepts, including classes, objects, inheritance, polymorphism, and encapsulation, to design and implement Java programs that model real-world scenarios.

CO5 : Use software development tools such as Integrated Development Environments (IDEs), version control systems, and debugging tools to write, test, and debug Java programs efficiently.

CO6 : Create complex programs using JAVA which are applied in data science.

TEXTS/REFERENCE BOOKS

1. Herbert Schildt, **"Java: A Beginner's Guide"**, McGraw Hill.
2. J. Bloch, **"Effective Java"**, Addison-Wesley.
3. R. Lafore, **"Data Structures and Algorithms in Java"**, Sams Publishing.
4. K. Sierra & B. Bates, **"Head First Java"**, O'Reilly Media.
5. Harold, Elliotte Rusty, **"Java Network Programming"**, O'Reilly Media.

24BSD206T					Data Structure using Python					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

1. Implement Object-Oriented Programming concepts in Python
2. Analyse step-by-step and develop algorithms to solve real-world problems.
3. Understanding how linear and non-linear data structures work.
4. Understanding of various searching & sorting techniques.

UNIT 1 INTRODUCTION TO DATA STRUCTURE **8 Hrs.**

Introduction towards Abstract Data Types and Object-Oriented Programming. Contributes knowledge on analysis of algorithm, asymptotic notations, divide & conquer and recursion with example Types of Data Structures-Linear & Non-Linear Data Structures.

UNIT 2 LINEAR DATA STRUCTURES **12 Hrs.**

Array: Representation of arrays, Applications of arrays, sparse matrix and its representation Stack: Stack-Definitions & Concepts, Operations On Stacks, Applications of Stacks, Polish Expression, Reverse Polish Expression And Their Compilation; Queue: Representation Of Queue, Operations On Queue, Circular Queue, Priority Queue, Array representation of Priority Queue, Double Ended Queue, Applications of Queue; Linked List: Singly Linked List, Doubly Linked list, Circular linked list ,Linked implementation of Stack, Linked implementation of Queue, Applications of linked list., JSON data structure

UNIT 3 NONLINEAR DATA STRUCTURE **10 Hrs.**

Tree-Definitions and Concepts, Representation of binary tree, Binary tree traversal (In order, post order, pre-order), Threaded binary tree, Binary search trees, Conversion of General Trees To Binary Trees, Applications Of Trees - Some balanced tree mechanisms, e.g. AVL trees, 2-3 trees, Height Balanced, Weight Balance, Graph-Matrix Representation of Graphs, Elementary Graph operations, (Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree)

UNIT 4 HASHING AND FILE STRUCTURES **12 Hrs.**

Hashing: The symbol table, Hashing Functions, Collision Resolution Techniques, File Structure: Concepts of fields, records and files, Sequential, Indexed and Relative/Random File Organization, Indexing structure for index files, hashing for direct files, Multi-Key file organization and access methods. Sorting & Searching: Sorting – Bubble Sort, Selection Sort, Quick Sort, Merge Sort Searching – Sequential Search and Binary Search

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Understanding abstract data types including stacks, queues, lists, tree, hash etc.
CO2 : Application: Different algorithmic techniques such as static algorithms, dynamic programming, and backtracking.
CO3 : Analysis: Complex Python programs written by another author.
CO4 : Evaluation: asymptotic performance of the algorithms
CO5 : Synthesis: Building Complex Algorithms using appropriate data structure.
CO6 : Creating: Complex programs using python

TEXTS/REFERENCE BOOKS

1. Michael T. Goodrich, Roberto Tamassia, **"Michael H. Goldwasser, Data Structures and Algorithms in Python"**, John Wiley & Sons.
2. Basant Agarwal, Benjamin Baka, **"Hands-On Data Structures and Algorithms with Python"**, Write complex and powerful code using the latest features of Python 3.7, Packt Publishing.
3. Bradley N Miller and David L Ranum, **"Problem Solving with Algorithms and Data Structures Using Python"** Franklin Beedle.
4. Kent D. Lee and Steve Hubbard, **"Data Structures and Algorithms with Python"**, Springer.
5. R. Nageswara Rao, **"Core Python Programming"** - Dreamtech Press.

24BSD206P					**Data Structure using Python (Lab)**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

1. Understanding linear data structures like array, linked list, stack .
2. Understand non-linear data structures like trees, graphs etc.
3. Analyse step-by-step and develop algorithms to solve real-world problems.
4. Understanding of various searching & sorting techniques.

LIST OF EXPERIMENTS

1 Operation on linear array
2 Operations on the singly linked list, doubly linked list
3 Stack that using an array.
4 Convert infix notation to postfix notation using stack
5 Queue using arrays
6 Circular Queue using arrays
7 Stack using linked list
8 Queue using linked list
9 Binary Search
10 Quick Sort, Merge Sort, Bubble Sort

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Understanding abstract data types including stacks, queues, lists, tree, hash etc.
CO2 : Application: Different algorithmic techniques such as static algorithms, dynamic programming, and backtracking.
CO3 : Analysis: Complex Python programs written by another author.
CO4 : Evaluation: asymptotic performance of the algorithms
CO5 : Synthesis: Building Complex Algorithms using appropriate data structure.
CO6 : Creating: Complex programs using python

TEXTS/REFERENCE BOOKS

1. Kent D. Lee, Steve Hubbard, **"Data Structures and Algorithms with Python"**, Springer Cham.
2. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, **"Data Structures and Algorithms in Python"** , John Wiley & Sons.
3. Basant Agarwal, Benjamin Baka,**"Hands-On Data Structures and Algorithms with Python"**, Write complex and powerful code using the latest features of Python 3.7, Packt Publishing.
4. Bradley N Miller and David L Ranum, **"Problem Solving with Algorithms and Data Structures Using Python"** Franklin Beedle.
5. Kent D. Lee and Steve Hubbard, **"Data Structures and Algorithms with Python"** , Springer.

24BSD207T					Predictive Analytics					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**1**	**0**	**4**	**4**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. Develop predictive and prescriptive models using numerical data.
2. Learn different Time-series Forecasting techniques.
3. Apply optimization algorithms through Linear Programming.
4. Formulate a framework towards business decisions.

UNIT 1 LINEAR REGRESSION **10 Hrs.**

Regression Fundamentals, The linear regression equation, Linear Regression explained, Linear Regression with independent variable, Interpreting R -Squared, Evaluating Model Performance, Key assumptions of Linear Regression, Residual Analysis, Statistical tests to validate assumptions, Correlation, Heat map and Scatter plots, Multiple Linear Regression use case, Interpreting regression outputs, Regression use cases

UNIT 2 TIME SERIES ANALYSIS **10 Hrs.**

Case studies and practical applications of regression and time series analysis. Time Series Fundamentals, Visualizing time series data using plots.Forecasting fundamentals, Forecasting techniques: Exponential Smoothing, Holt's method, Holt's Winter method, ACF & PACF, ARIMA

UNIT 3 LINEAR PROGRAMMING **12 Hrs.**

Introduction to Prescriptive Analytics, Gradient Descent (& code), Gradient descent fundamentals, Stochastic Gradient descent regression, Linear Programming fundamentals, Components of LPP, Formulating the LPP model, Solving linear models-Graphical method, Solving linear models -Simplex method, Assumptions of LPP, Business applications of LPP

UNIT 4 BUSINESS DECISIONS **10 Hrs.**

Business Decisions: Parametric & Non-Parametric Methods -Model building, Tradeoffs -Accuracy vs Explainability, Framework to choose the right model to address business problems

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Understand the difference between Cross sectional and Longitudinal data.
CO2 : Differentiate between a prediction and forecasting problem scenario and apply these concepts towards data led decision-making.
CO3 : Understand Parametric and Non-Parametric modelling approach towards addressing the key tradeoff between Predictive accuracy and Explainability of models.
CO4 : Use LPP towards building multiple "What if" scenarios, which are widely used in business decision-making.
CO5 : Conceptualize Gradient Descent Algorithm, which is a key foundation for most of the widely used algorithms to be introduced subsequently.
CO6 : Make better decisions through the analysis of raw data.

TEXTS/REFERENCE BOOKS

1. Brownlee, Jason, **"Introduction to time series forecasting with python: how to prepare data and develop models to predict the future"** , Machine Learning Mastery.
2. Dantzig, George B. **"Linear programming",** Operations research 50.1.
3. Hollander, Myles, Douglas A. Wolfe, and Eric Chicken, **"Nonparametric statistical methods"** , John Wiley & Sons.

24BSD233T					**Modern Application Development - II**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**0**	**0**	**3**	**3**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. To understand basic of JavaScript and modern frontend development tools and workflows.
2. To master the fundamentals of Vue.js and its integration with APIs.
3. To explore advanced Vue.js and its implementation in handling authentication and authorization.
4. To understand importance of authentication in securing APIs.

UNIT 1 FOUNDATIONS OF WEB DEVELOPMENT AND JAVASCRIPT BASICS **10 Hrs.**

Basics of JavaScript: Introduction to JavaScript syntax, data types, variables, operators, control flow, and functions, Introduction to Web frontend-Basics, of HTML and CSS, structure of web pages, introduction to DOM manipulation using JavaScript

UNIT 2 INTERMEDIATE WEB DEVELOPMENT AND VUE.JS FUNDAMENTALS **11 Hrs.**

JavaScript - closures, prototypes, ES6 features, asynchronous programming using promises and async/await. Vue.js - understanding Vue.js framework, components, directives, state management with Vuex, and Vue router for navigation

UNIT 3 ADVANCED VUE.JS AND MANAGEMENT **11 Hrs.**

Advanced Vue.js - mixins, custom derivatives, transitions, and animation, advanced techniques for component communication and optimization, Advanced management - Vuex for complex state management scenarios, including module organization, actions, mutations, getters.

UNIT 4 WEB APIs, AUTHENTICATION, ASYNCHRONOUS PROGRAMMING **10 Hrs.**

Vue with APIs - Integrating Vue.js with backened APIs using techniques like Axios for HTTP request, handling responses, amd error handling

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Identify common Java datastructures and their usage.
CO2 : Understand the fundamentals of JavaScript.
CO3 : Implement advanced Javascript features and develop Vue.js applications with APIs.
CO4 : Analyse performance optimization techniques for Vue.js applications.
CO5 : Evaluate advanced Vue.js features and analyze optimization techniques for Vue.js applications.
CO6 : Design secure and efficient APIs for authentication and state management.

TEXTS/REFERENCE BOOKS

1. Douglas Crockford, **"JavaScript: The Good Parts"**, O'Reilly.
2. Jennifer Robbins, **"Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics",** O'Reilly.
3. Erik Hanchett and Benjamin Listwon, **"Vue.js in Action"**, Manning Publications.
4. Damian Dulisz, **"State Management Patterns and Best Practices with Vuex"**, Packt Publishing.
5. Trevor Burnham, **"Async JavaScript: Build More Responsive Apps with Less Code"**, Pragmatic Bookshelf.
6. Nicholas C. Zakas, **"High Performance JavaScript"**, O'Reilly.

24BSD233P					**Modern Application Development - II (LAB)**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**–**	**–**	**–**	**50**	**50**	**100**

COURSE OBJECTIVES

1. To build a Simple Calculator using JavaScript.
2. To build an interactive to-do list application using advanced JavaScript concepts such as event handling, closures, and prototypes.
3. To create a Personal Portfolio Website using HTML, CSS, and JavaScript.
4. To develop a Simple Counter App using Vue.js.

LAB EXPERIMENTS

1 Building a Simple Calculator using JavaScript

2 Build an interactive to-do list application using advanced JavaScript concepts such as event handling, closures, and prototypes

3 Creating a Personal Portfolio Website using HTML, CSS, and JavaScript.

4 Building a Simple Counter App using Vue.js.

5 Develop a weather forecast application using Vue.js and integrate it with a weather API (e.g., OpenWeatherMap).

6 Creating a Real-Time Chat Application – Build a real-time chat application using advanced Vue.js features such as Vuex for state management and Vue Router for routing.

7 Implementing a Shopping Cart – Implement a shopping cart functionality using advanced state management techniques such as Vuex.

8 Building a User Authentication System – develop a user authentication system using Vue.js for the frontend and Node.js with Express for the backend.

9 Creating a Task Scheduler – create a task scheduler application that allows users to schedule and execute asynchronous tasks.

10 Implementing Web hooks for Notification System – develop a notification system using webhooks to send real-time notifications between services.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Identify common Java datastructures and their usage.
CO2 : Understand the fundamentals of JavaScript
CO3 : Implement advanced Javascript features and develop Vue.js applications with APIs
CO4 : Analyse performance optimization techniques for Vue.js applications.
CO5 : Evaluate advanced Vue.js features and analyze optimization techniques for Vue.js applications
CO6 : Design secure and efficient APIs for authentication and state management.

TEXTS/REFERENCE BOOKS

1. Jon Duckett, **"HTML and CSS: Design and Build Websites"**, Wiley.
2. Hassan Djirdeh, Nate Murray, Ari Lerner, **"Fullstack Vue: The Complete Guide to Vue.js"**, Fullstack.io.
3. Olga Filipova, Chris Holland, **"Mastering Vue.js**, Packt Publishing.
4. Aneeta Sharma, **"Hands-On Full-Stack Web Development with Vue.js 2 and Node.js"**, Packt Publishing.
5. Andrea Passaglia, **"Vuex Quick Start Guide: Centralized State Management for Your Vue.js Applications"**, Packt Publishing.
6. James Higginbotham, **"Webhooks: Events for RESTful APIs"**, O'Reilly Media.

24BSD222T					Financial Literacy					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
2	**0**	**0**	**2**	**2**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. To be able to understand the basic concepts of the interest.
2. To learn about different types of deterministic cash flows.
3. To be able to understand about different types of random cash flows.
4. To learn about Options and Black-Scholes Formula.

UNIT 1 BASIC CONCEPTS **6 Hrs.**

Arbitrage, Return and Interest, Time Value of Money, Bonds, Shares and Indices, Models and Assumptions.

UNIT 2 DETERMINISTIC CASH FLOWS **8 Hrs.**

Net Present Value (NPV), Internal Rate of Return (IRR), Comparison of IRR and NPV, Bonds price and yield, Clean and Dirty Price, Price – Yield Curves, Duration, Term structure of Interest rates.

UNIT 3 RANDOM CASH FLOWS **6 Hrs.**

Random Returns, Portfolio Diagrams and Efficiency, Feasible Set, Markowitz Model, Financial Derivatives.

UNIT 4 OPTIONS & BLACK-SCHOLES FORMULA **8 Hrs.**

Call Options, Put Options, Put-Call Parity, Binomial Options Pricing Model, Risk-Neutral Valuation, The Black-Scholes Formula.

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Create an ability to formulate return and interest on different investment like bonds, shares, mutual funds etc
CO2 : Explain various types of annuities and perpetuities in detail and apply them to solve financial transactions problems
CO3 : Distinguish net present value and internal rate of return and understand their individual role.
CO4 : Understand the relationship between risk and profit.
CO5 : Apply the concepts of random cash flows to evaluate returns and interest on various investments
CO6 : Demonstrate understanding and competence with the financial models.

TEXTS/REFERENCE BOOKS

1. Amber Habib, "**The Calculus of Finance",** Universities Press.
2. G. Campolieti and R.N. Makarov, "**Financial Mathematics: A Comprehensive Treatment"**, CRC Press.
3. R.J. Williams, "**Introduction to Mathematics of Finance"**, American Mathematical Society.
4. J. R. Buchanan, "**An Undergraduate Introduction to Financial Mathematics"**, World Scientific.

24BSD208T					Natural Language Processing					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	4	2	4	-	-	-	50	50	100

COURSE OBJECTIVES

1. Text Data Handling and Processing: To equip students with skills to effectively handle and preprocess raw text data for NLP tasks.
2. Text Data Analysis and Feature Extraction: To enable students to perform deep text data analysis and extract crucial features using NLP techniques.
3. Understanding of Text Representation Techniques: To give students an understanding of text representation techniques critical for transforming text data for machine learning algorithms.
4. Application of Techniques to Real-Life Problems: To enable students to apply NLP techniques to solve real-world data science problems effectively.

LAB EXPERIMENTS

1 Tokenization: Segment text into words or sentences.
2 Stop Words Removal: Eliminate common words with little meaning.
3 Stemming and Lemmatization: Reduce words to their base forms
4 Parts of Speech (POS) Tagging: Identify grammatical roles of words.
5 Bag of Words (BoW): Represent text as word frequency counts.
6 N-grams: Analyze sequences of words.
7 Named Entity Recognition (NER): Identify and classify named entities.
8 Sentiment Analysis: Determine the emotional tone of text.
9 Topic Modeling: Discover hidden thematic structures in text.
10 Chatbot Development: Build conversational agents.
11 Text Classification: Categorize documents by topic or other criteria.
12 Machine Translation: Translate text between languages.
13 Text Summarization: Generate concise summaries of documents.
14 Question Answering: Build systems that answer questions based on given text.
15 Word Sense Disambiguation: Identify the correct meaning of words in context.
16 Anaphora Resolution: Resolve pronoun references.
17 Sentiment Analysis (Deep Learning): Analyze text for emotional tone using advanced techniques
18 Natural Language Inference: Determine logical relationships between sentences.
19 Text Style Transfer: Apply the style of one text to another.
20 Language Modeling: Build models that predict the next word in a sequence.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Understanding Tokenization.
CO2 : Application: Implementing Text Preprocessing Techniques.
CO3 : Analysis: Extracting Linguistic Features.
CO4 : Evaluation: Vectorizing Text.
CO5 : Synthesis: Building Sentiment Analysis Models.
CO6 : Creating: Advanced NLP Projects.

TEXTS/REFERENCE BOOKS

1. S. Bird, E. Klein, and E. Loper, **"Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit"**, O'Reilly Media.
2. D. Jurafsky and J. H. Martin, **"Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition"**, Second Edition, Prentice Hall.
3. C. Manning and H. Schutze, **"Foundations of Statistical Natural Language Processing"**, First Edition, MIT Press.
4. P. Goyal, S. Pandey, and K. Jain, **"Deep Learning for Natural Language Processing: Creating Neural Networks with Python"**, Apress.

24BSD209T					Cybersecurity					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	-	-	100

COURSE OBJECTIVES

1. Develop a foundational understanding of cybersecurity concepts.
2. Identify and analyze various forms and types of cybercrime
3. Apply best practices for secure usage of digital technologies:
4. Analyze cybercriminal behavior through interdisciplinary perspectives

UNIT 1 FOUNDATIONS OF CYBERSECURITY **6 Hrs.**

Definition – Crime, Cyber Crime, Information Security, Digital Forensics – Conventional Crime Vs. Cyber Crime - Uniqueness of Cyber Crime – History of Cyber Crimes.

UNIT 2 FORMS AND TYPES OF CYBER CRIMES **8 Hrs.**

Forms of Cyber Crimes – Hacking – types of hacking, hackers, Cracking, Dos, DDos, Cyber Bullying, Cyber Stalking, Pornography, Phishing, Intellectual Property Theft, Data Theft, Dada diddling, malwares, stegnography, salami attacks, ATM and Credit card frauds, Telecom Frauds

UNIT 3 CYBER CRIMINAL BEHAVIOR **8 Hrs.**

Understanding cyber criminal behavior – modus operandi - Criminological , Sociological and Psychological theories relating to cyber crime behavior.

UNIT 4 SOCIAL MEDIA SECURITY AND BEST PRACTICES **6 Hrs.**

Social Media – Definition, Types, advantages and disadvantages – Crimes through social media, victimization through social media – Do's and Don'ts in Social Media – Safe Surfing

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Define key cybersecurity concepts and terminology with accuracy and clarity.
CO2 : Explain various forms and motivations behind cybercriminal behavior comprehensively.
CO3 : Implement effective strategies for safe and responsible social media usage.
CO4 : Analyze cybercrime patterns through diverse disciplinary perspectives critically.
CO5 : Assess cybersecurity measures and propose improvements for enhanced protection.
CO6 : Design innovative solutions to address emerging cyber threats effectively.

TEXTS/REFERENCE BOOKS

1. Charles J. Brooks and Christopher Grow, **"Cybersecurity Essentials"**, Wiley.
2. Dafydd Stuttard and Marcus Pinto, **"The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws"**, Wiley.
3. Michael Cross, **"Social Media Security: Leveraging Social Networking While Mitigating Risk**",Syngress.
4. Susan W. Brenner, **"Cybercrime: Criminal Threats from Cyberspace**", Praeger Publishers Inc.

24BSD301T					Machine Learning Techniques - I (Theory)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

1. Introduce students to the basic concepts and techniques of Machine Learning,
2. Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models,
3. Understand the supervised learning techniques Linear Regression
4. Understand the supervised learning techniques Logistic Regression

UNIT 1 INTRODUCTION TO MACHINE LEARNING **10 Hrs.**

Introduction to Machine learning, Supervised learning, Unsupervised learning, Reinforcement learning. Deep learning. Feature Selection: Filter, Wrapper, Embedded methods. Preprocessing data and feature extraction

UNIT 2 METHODS OF EVALUATION **10 Hrs.**

Cross Validation - Holdout Method, K-Fold, Stratified K-Fold, Leave-One-Out Cross Validation. Bias-Variance tradeoff, Regularization , Overfitting, Underfitting, ROC

UNIT 3 LINEAR REGRESSION **12 Hrs.**

Scatter diagram, Model representation for single variable, Single variable Cost Function, Least Square line fit, Normal Equations, Gradient Descent method for Linear Regression, Assumptions in linear regression, properties of regression line, Model Performance through R^2, Multivariable model representation, Multivariable cost function, multiple linear regression, Normal Equations and non-invariability , Gradient Descent method for multiple linear regression , Overfitting, Under fitting, Bias and variance , Regularization

UNIT 4 LOGISTIC REGRESSION **10 Hrs.**

Issues of using Linear Regression in Classification, Sigmoid function, odds of an event, Logit function, Decision Boundary, Maximum Likelihood function, Linear regression versus Logistic Regression, Cost function, Multi-classification , confusion matrix, statistical measures to measure binary classification : Recall, sensitivity, specificity, precision, accuracy, pros and cons of logistic regression

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Understanding Machine learning.
CO2 : Application: Implementing machine learning Techniques.
CO3 : Applying: Regression models
CO4 : Calculating: Model accuracy.
CO5 : Validating: Machine learning models
CO6 : Creating: Advanced machine learning Projects.

TEXTS/REFERENCE BOOKS

1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, **"Machine Learning"**, Pearson.
2. Richert & Coelho, **"Building Machine Learning Systems with Python"**, Packt Publishing Ltd.
3. Joel Grus, **"Data Science from Scratch",** O'Reilly Publications, Second Edition.
4. Stephen Marsland, **"MACHINE LEARNING: An Algorithmic Perspective"**, CRC Press, Second Edition.
5. Rui Xu & Donald C, **"Clustering, Wunsch II"**, IEEE Press.
6. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Jonathan Taylor: **"An Introduction to Statistical Learning",** Springer.

24BSD301P					**Machine Learning Techniques - I (Lab)**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

1. Understand complexity of Machine Learning algorithms and their limitations
2. Understand modern notions in data analysis-oriented computing;
3. Be able to apply common Machine Learning algorithms in practice and implementing their own;
4. Be able to perform experiments in Machine Learning using real-world data.

LAB EXPERIMENTS

1 Extract the data from database using python
2 Identification of features for a given dataset.
3 Covariance matrix
4 Statistical analysis
5 Data preprocessing
6 Feature Normalization
7 Implement linear regression using python.
8 Applied multiple linear regression Model for a given dataset.
9 Develop Logistic Regression Model for a given dataset.
10 Method evaluation

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Understanding Machine learning.
CO2 : Application: Implementing supervised machine learning Techniques.
CO3 : Analysis: Extracting statistical parameters.
CO4 : Evaluation: Evaluate model through different method
CO5 : Synthesis: Building Regression Models.
CO6 : Creating: Advanced machine learning Projects.

TEXTS/REFERENCE BOOKS

1. Andreas C. Müller and Sarah Guido, **"Introduction to Machine Learning with Python",** O'Reilly Publications.
2. Richert & Coelho, **"Building Machine Learning Systems with Python"**, Packt Publishing Ltd.
3. Ethem Alpaydın, **"Introduction to Machine Learning"**, The MIT Press.
4. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, **"Machine Learning",** Pearson.
5. Tom M. Mitchell, **"Machine Learning"**, McGraw-Hill publications.

24BSD302T					**Introduction to Cloud Computing**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**1**	**0**	**4**	**4**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. To be able to understand cloud computing architecture,
2. To be able to utilize cloud simulator models in various applications,
3. To be able to understand the resource management of clouds,
4. To be able to understand service mechanisms in cloud computing.

UNIT 1 INTRODUCTION TO THE CLOUD **10 Hrs.**

Introduction to Cloud Computing, Cloud Computing Architecture

UNIT 2 SERVICE MANAGEMENT IN CLOUD COMPUTING **10 Hrs.**

Service Management in Cloud Computing, Data Management in Cloud Computing,

UNIT 3 RESOURCE MANAGEMENT **11 Hrs.**

Resource Management in Cloud, Cloud Security

UNIT 4 CLOUD SIMULATOR **11 Hrs.**

Open Source and Commercial Clouds, Cloud Simulator, Research Trends in Cloud Computing, and Fog Computing

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Understand the basics of clouds.
CO2 : Understand the concept of data management in cloud computing**.**
CO3 : Understand the concept of various service management policies in cloud computing
CO4 : Identify the areas of application of cloud deployment models.
CO5 : Demonstrate the research trends in cloud computing.
CO6 : Utilize the cloud simulators for engineering problems.

TEXTS/REFERENCE BOOKS

1. Rajkumar Buyya, James Broberg, and Andrzej M. Goscinski, **"Cloud Computing: Principles and Paradigms"**, Wiley.
2. E. Thomas, R. Puttini, and Z. Mahmood, **"Cloud Computing: Concepts, Technology & Architecture"**, Pearson.

24BSD303T					Forecasting and Time Series Analysis using Python					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

1. Acquire proficiency in statistical and computational methods for analyzing temporal data.
2. Master time series analysis techniques, from foundational concepts to advanced modeling and forecasting.
3. Develop skills in parameter estimation, frequency domain analysis, and multivariate time series processes.
4. Understand and apply stochastic volatility models in real-world data science applications.

UNIT 1 TIME SERIES FOUNDATIONS **11 Hrs.**

Introduction to Time Series: Understanding time series and its applications, course outline. Components of Time Series: Decomposition methods for trend determination including free hand curve fitting, semi averages, mathematical curve fitting, and moving averages. Introduction to Profits Library: Utilizing Python's Profits library to analyze and manipulate time series data for profit estimation and trend analysis. Smoothing and Adaptive Forecasting: Exponential smoothing, forecasting errors.

UNIT 2 TIME SERIES PROCESSES AND MODELING **10 Hrs.**

Introduction to Time Series Processes: Stationarity concepts, ergodicity. Stationary Processes Exploration: Wold Decomposition, Autoregressive (AR), Moving Average (MA), Autoregressive Moving Average (ARMA) processes, their properties, stationarity, and invertibility conditions. Profits Library to simulate and analyze AR, MA, and ARMA processes.

UNIT 3 PARAMETER ESTIMATION AND FREQUENCY DOMAIN ANALYSIS **9 Hrs.**

Parameter Estimation: For autoregressive, moving average, and ARMA processes. Frequency Domain Analysis: Fourier transformation, spectral density functions, spectrum analysis, and periodogram analysis for sinusoidal models. Profits Library for enhanced spectral analysis and periodogram analysis for sinusoidal models.

UNIT 4 STOCHASTIC VOLATILITY MODELS: ARCH, GARCH PROCESSES **12 Hrs.**

Non-Stationary and Long Memory Processes: ARIMA models, unit root tests, Seasonal ARIMA (SARIMA). Multivariate Time Series Processes: Vector Autoregressive Moving Average (VARMA) processes, causality analysis, error correction, cointegration. Stochastic Volatility Models: Introduction to Autoregressive Conditional Heteroskedasticity (ARCH), Generalized ARCH (GARCH) models, forecasting. Advanced use of Profits Library for forecasting and profitability analysis in non-stationary environments, Causality analysis, error correction,and volatility modeling and profit forecasts.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Analyze and interpret time series data, identifying trends, patterns, and seasonal variations effectively.

CO2 : Develop, evaluate, and refine complex time series models, including AR, MA, ARMA, and ARIMA models, for forecasting and decision-making.

CO3 : Hands-on experience with statistical software and programming languages of Python, enabling them to implement and simulate time series analysis procedures

CO4 : Develop the critical thinking skills necessary to assess the applicability of various time series models and techniques to different types of temporal data problems.

CO5 : Adept at managing and manipulating large datasets, applying data cleaning, transformation, and visualization techniques to prepare data for analysis

CO6 : Understand the ethical considerations in data collection, analysis, and modeling, ensuring responsible use of data and adherence to privacy standards

TEXTS/REFERENCE BOOKS

1. Box, George E. P., Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung, **"Time Series Analysis, Forecasting and Control"**, Wiley.
2. Brockwell, P.J. and R.A. Davis, **"Time Series: Theory and Methods"**, Springer-Verlag.
3. Huang, C., & Petukhina, A, **"Applied Time Series Analysis and Forecasting with Python"**, Springer.
4. Jaydip, S., & Sidra, M., **"Machine Learning in the Analysis and Forecasting of Financial Time Series"**, Cambridge Press.

24BSD303P					Forecasting and Time Series Analysis (using Python) (Lab)					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	-	-	-	50	50	100

COURSE OBJECTIVES

1. Introduce the foundational concepts and applications of time series analysis, emphasizing the importance of time series data in various domains.
2. Equip students with the knowledge to identify, analyze, and model the different components of time series data, including trend, seasonality, cyclical, and irregular components.
3. Develop skills in advanced time series analysis techniques, including parameter estimation, frequency domain analysis, and the use of Python for practical applications.
4. Modeling and forecasting of time series data using stochastic volatility models and multivariate time series processes, with a focus on ARIMA, SARIMA, ARCH, and GARCH models.

LIST OF EXPERIMENTS

1 Use pandas for data manipulation, matplotlib for plotting, and statsmodels for decomposing the series.

2 Utilize pandas for moving averages and custom Python functions for semi-averages.

3 Implement curve fitting using numpy or scipy.optimize and plot results with matplotlib

4 Use the statsmodels library's Exponential Smoothing tool and analyze errors with statistical methods.

5 Use the Profits library to analyze changes in trends and assess potential profit trends from the decomposed data.

6 Fit Autoregressive (AR), Moving Average (MA), and Autoregressive Moving Average (ARMA) models to time series data in Python, assessing their stationarity and invertibility conditions.

7 Estimate parameters for AR, MA, and ARMA processes using Python and discuss the implications on model performance.

8 Conduct Fourier transformation and spectrum analysis on a time series dataset in Python, using periodogram analysis to identify sinusoidal models.

9 Fit Autoregressive Conditional Heteroskedasticity (ARCH) and Generalized ARCH (GARCH) models to a dataset in Python, exploring their forecasting capabilities.

10 Apply ARIMA and Seasonal ARIMA (SARIMA) models to datasets in Python, incorporating unit root tests to analyze non-stationary and long-memory processes.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Understand and describe the key concepts of time series analysis, including its components and applications.

CO2 : Analyze and decompose time series data to identify underlying patterns such as trends and seasonal variations.

CO3 : Apply smoothing and adaptive forecasting techniques to make informed predictions based on time series data.

CO4 : Utilize Python to model time series processes, including AR, MA, ARMA, and understand their stationarity and invertibility conditions.

CO5 : Perform parameter estimation, frequency domain analysis on time series data to support modeling and forecasting process.

CO6 : Implement advanced stochastic volatility models like ARCH and GARCH, and understand non-stationary and long memory processes for comprehensive time series analysis and forecasting.

TEXTS/REFERENCE BOOKS

1. Peixeiro, M., **"Time series forecasting in python"**, Simon and Schuster.
2. Pal, A., & Prakash, P. K. S., **"Practical time series analysis: master time series data processing, visualization, and modeling using python"**, Packt Publishing Ltd.
3. Auffarth, **"Machine Learning for Time-Series with Python: Forecast, predict, and detect anomalies with state-of-the-art machine learning methods"**, Packt Publishing Ltd.

24BSD321T					Business Data Management					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	0	4	25	50	25	-	-	100

COURSE OBJECTIVES

1. Understand economic principles, consumer behavior, and business decisions within micro and macroeconomic contexts.
2. Analyze e-commerce and distribution data to derive business insights.
3. Apply data management to manufacturing and HR sectors for strategic planning.
4. Explore financial data analysis techniques and their applications in fintech.

UNIT 1 Economic Foundations and Data in Business **10 Hrs.**

Consumption and Demand: Understanding the role of data in micro and macroeconomics, production, consumption, exchange, and consumption baskets. Micro-Economic Concepts: Exploring utility (cardinal vs. ordinal), indifference curves, demand and supply curves, elasticity, production costs, and cost curves. Firm Level Strategies: Analyzing firm performance through key ratios and pricing strategies. Industry Level Analysis: Defining industries, understanding market structures, and analyzing competitive positioning using Porter's five forces.

UNIT 2 Case Studies in E-Commerce and Distribution **10 Hrs.**

Case Study 1 - Fabmart (E-Commerce): Introduction to e-commerce, revenue analysis, sales and revenue scatter plots, and revenue trends. Fabmart Continued: Sales trend analysis, organization of distribution centers, inventory management, and strategies to avoid stockouts.

UNIT 3 Case Studies in Manufacturing and HR **11 Hrs.**

Case Study 2 - Ace Gears (Manufacturing): Exploring the manufacturing sector within the automotive industry context, analyzing sales, production, inventory, and costing. Ace Gears Continued: Conducting regional sales analysis, planning sales agents, production scheduling, and profitability analysis.
Case Study 3 - Tech Enterprises (IT): Examining HR functions, internal sourcing, candidate ranking, job description analysis, and recruitment process evaluation.

UNIT 4 Financial Industry and Data Analysis Techniques **11 Hrs.**

Case Study 4 - PayBuddy (FinTech): Introduction to the finance industry, payment processing, credit product introduction, and application of nudge economics.
PayBuddy Continued: Utilizing A/B testing, credit risk evaluation, and exploring risk-return tradeoffs in financial products.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Grasp the impact of data on economic models and business strategies.
CO2 : Perform comprehensive data analyses in e-commerce, assessing revenue and sales trends.
CO3 : Implement effective data-driven solutions for inventory and distribution challenges.
CO4 : Conduct strategic analyses in manufacturing and HR, optimizing operations and sourcing.
CO5 : Apply analytical skills to the finance industry, focusing on payment systems and product introductions.
CO6 : Utilize advanced data analysis techniques, including A/B testing and risk evaluation, in real-world scenarios.

TEXTS/REFERENCE BOOKS

1. Pindyck, R. S., **"Microeconomics"**, Pearson Publication.
2. Joseph, P. T. , **"E-commerce: An Indian perspective"**, PHI Learning Pvt. Ltd.
3. Srinivasan, R., **"Case Studies in Marketing: The Indian Context"**, PHI Learning Pvt. Ltd.
4. Davis, T., Cutt, M., Flynn, N., & Mowl, **"Talent assessment: A new strategy for talent management"**, Routledge.
5. Jaydip, S., & Sidra, M., **"Machine Learning in the Analysis and Forecasting of Financial Time Series"**, Cambridge Press.
6. Saunders A, Allen L., **"Credit risk measurement: New approaches to value at risk and other paradigms"**, John Wiley & Sons.

24BACS301T					Organisational Behaviour					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	-	-	100

COURSE OBJECTIVES

1. Students will be able to understand the fundamentals of Organisational Behaviour (OB) and its significance in the workplace.
2. Students will be able to define Organisational Behaviour and elucidate its relevance in the context of management and organizational dynamics.
3. Students will be able to examine various leadership theories, including trait theory, behavioral theory, and contingency theory, to understand leadership dynamics.
4. Students will be able to explore the fundamentals of Human Resource Management (HRM), including selection, orientation, training, development, and performance appraisal.

UNIT 1 ORGANISATIONAL BEHAVIOUR **7 Hrs.**

OB: Learning objectives, Definition & Meaning, Why to study OB, An OB model, New challenges for OB Manager
LEARNING: Nature of learning, How learning occurs, Learning & OB Case Study Analysis

UNIT 2 PERSONALITY, PERCEPTION AND MOTIVATION **7 Hrs.**

Meaning & Definition, Determinants of Personality, Personality Traits, Personality & OB, Meaning & Definition, Perceptual process, Importance of Perception in OB, Nature & Importance, Herzberg's Two Factor theory, Maslow's Need Hierarchy theory, Alderfer's ERG theory Case Study Analysis

UNIT 3 COMMUNICATION, GROUPISM, LEADERSHIP, CONFLICT **7 Hrs.**

Importance, Types, Barriers to communication, Communication as a tool for improving Interpersonal Effectiveness, Nature, Types, Why do people join groups, Group Cohesiveness & Group Decision Making- managerial Implications, Effective Team Building, Leadership & management, Theories of leadership- Trait theory, Behavioural Theory, Contingency Theory, Leadership & Followership, How to be an Effective Leader, Nature of Conflict & Conflict Resolution Case Study Analysis

UNIT 4 CULTURE, HR MANAGEMENT AND ORGANISATIONAL CHANGE **7 Hrs.**

Meaning & Definition, Culture & Organisational Effectiveness HUMAN Introduction to HRM, Selection, Orientation, Training & Development, Performance Appraisal, Incentives, Importance of Change, Planned Change & OB Techniques Case Study Analysis

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Enhanced Understanding of Organizational Behavior (OB).
CO2 : Application: Learning Theories in Organizational Context.
CO3 : Analysis: Proficiency in Analyzing Case Studies.
CO4 : Select: Effective Communication and Interpersonal Skills.
CO5 : Synthesis: Insight into Individual Dynamics.
CO6 : Creating: Leadership and Conflict Resolution Proficiency.

TEXTS/REFERENCE BOOKS

1. Robbins, S. P, Judge, T. A, Sanghi, S., **"Organizational Behavior**", Pearson Publication.
2. Aswathappa, K., **"Organisational Behaviour– Text and Problem"**, Himalaya Publication.
3. Pardeshi, P. C., **"Organizational Behaviour & Principles & Practice Of Management"**, Nirali publication.

24ECOS301T					Managerial Economics					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
2	**0**	**0**	**2**	**2**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. Enable to understand the Role of Managerial Economics in Decision Making.
2. Enable to analyze the concept of price and non-price competition used by the sellers.
3. Enable to understand the concept of Business cycles and its relevance to managers economist
4. Enable to estimate demand and forecasting of the market.

UNIT 1 INTRODUCTION TO MANAGERIAL ECONOMICS **5 Hrs.**

Definition, Nature and Scope of Managerial Economics, Managerial Economics and decision-making.Uses and Significance of Managerial Economics.

UNIT 2 DEMAND AND ITS FORECASTING **7 Hrs.**

Meaning and Determinants of Demand. Demand Function, Law of Demand Market Demand, Elasticity of Demand, Types and Measurement of Elasticity, Demand Forecasting. Meaning, Significance and Methods of Demand Forecasting

UNIT 3 PRODUCTION AND COST FORECASTING **8 Hrs.**

Production Function. Law of Variable Proportions. Law of Supply. Elasticity of Supply. Measurement of Elasticity of Supply. Costs of Production. Short run and long run costs. Economies of Scale. Cost estimation and cost forecasting. Break Even analysis

UNIT 4 PRICING STRATEGIES **8 Hrs.**

Pricing under various market forms: Perfect competition, Monopoly, Monopolistic Competition, Oligopoly, Price Discrimination.
Pricing Strategies and Methods, Cost plus Pricing, Marginal cost Pricing. Price Leadership, Transfer Pricing, Seasonal Pricing, Cyclical Pricing.

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Identify Nature, Scope and Significance of Managerial Economics, its Relationship with other Disciplines.
CO2 : Understand the Role of Managerial Economics in Decision Making.
CO3 : Demonstrate Measure living standards, inflation, and unemployment for use as economic indicators.
CO4 : Analyze economic information and develop the solution of micro and macro-economic problems
CO5 : Estimate demand and forecasting of demand in the markets.
CO6 : Formulate economic problems for theoretical framework and actual empirical conditions.

TEXTS/REFERENCE BOOKS

1. Malden, MA: Blackwell, **"Managerial Economics"**, Png, Ivan
2. H.C. Peterson and W.C. Lewis, **"Managerial Economics"**, Prentice Hall of India Pvt.
3. Truett & Truett, **"Managerial Economics"**, John Wiley & Sons Inc.
4. G.S. Gupta, **"Managerial Economics"**, Tata McGraw Hills.

24BSD331T					Cryptography					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
2	**0**	**0**	**2**	**2**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. Grasp the fundamental concepts of cryptography, including encryption, decryption, and cryptographic protocols.
2. Explore various symmetric cipher models such as substitution and transposition techniques, and their applications in data encryption.
3. Analyze the components and workings of the Data Encryption Standard (DES) algorithm, including its key expansion and permutation operations.
4. Apply cryptographic techniques learned, such as the Feistel cipher and DES, to encrypt and decrypt data effectively, understanding their strengths and limitations.

UNIT 1 CRYPTOGRAPHY AND DATA ENCRYPTION STANDARD **10 Hrs.**

Overview of Cryptography, Computer security concepts, Security attacks, Symmetric cipher model, Cryptanalysis and brute-force attack, Substitution techniques, Caesar cipher, Monoalphabetic ciphers, Playfair cipher, Hill cipher, Polyalphabetic ciphers, One-time pad, Transposition techniques, Binary and ASCII, Pseudo-random bit generation, Stream ciphers and Block ciphers, The Feistal cipher, The data encryption standard (DES), DES example.

UNIT 2 ALGORITHMS AND ADVANCED ENCRYPTION STANDARD (AES) **06 Hrs.**

Discrete logarithm., Finite fields of the form GF(p) and GF(2n). Advanced encryption standard (AES), AES transformation functions, AES key expansion, AES example.

UNIT 3 PUBLIC-KEY CRYPTOGRAPHY **06 Hrs.**

Principles of public-key cryptosystems, The RSA algorithm and security of RSA, Elliptic curve arithmetic, Elliptic curve cryptography, Cryptographic Hash functions

UNIT 4 DIGITAL SIGNATURES **06 Hrs.**

Digital signatures, Elgamal and Schnorr digital signature schemes, Digital signature algorithm.

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Recall cryptographic principles, encryption techniques, and DES algorithm components
CO2 : Explain symmetric encryption concepts, DES operation, and cryptographic protocols.
CO3 : Implement symmetric cipher techniques, including substitution and transposition methods.
CO4 : Assess strengths, weaknesses, and suitability of cryptographic techniques.
CO5 : Judge effectiveness and security implications of cryptographic protocols and algorithms.
CO6 : Design secure cryptographic solutions for diverse data security requirements.

TEXTS/REFERENCE BOOKS

1. Stallings, William, **"Cryptography and Network Security, Principles and Practice"**, Pearson Education Limited. England.
2. Trappe, Wade & Washington, Lawrence C., **"Introduction to Cryptography with Coding Theory"**, Pearson Education International.
3. Stinson, Douglas R., **"Cryptography Theory and Practice"**, CRC Press

24BSD304T					Machine Learning Techniques - II					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

1. Students will be able to understand concepts and techniques of Machine Learning,
2. Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models,
3. Understand the unsupervised learning techniques clustering and dimension reduction
4. Understand classification techniques

UNIT 1 CLUSTERING **10 Hrs.**

Cluster Analysis, Classification and Clustering , Definition of Clusters ,Clustering Applications , Distance measures, Proximity Measures for Discrete Variables, Proximity Measures for Mixed Variables, Partitional Clustering, Clustering Criteria, K-Means Algorithm, Fuzzy Clustering , Hierarchical Clustering, Agglomerative Hierarchical Clustering, Divisive Hierarchical Clustering, Cluster Validity, External Criteria, Internal Criteria

UNIT 2 DIMENSIONALITY REDUCTION **10 Hrs.**

Subset Selection, Principal Component Analysis, Feature Embedding, Factor Analysis , Singular Value Decomposition and Matrix Factorization , Multidimensional Scaling , Discriminant Analysis , Canonical Correlation Analysis, Isomap, Locally Linear Embedding , Laplacian Eigen maps

UNIT 3 CLASSIFIER TECHNIQUES-I **10 Hrs.**

Classification Metrics :Confusion Matrix, Precision, Recall, Accuracy, F-score, ROC Curves, Unbalanced data set using SMOTE, ADASYN, Tomek links algorithm, Decision trees: Train Decision Trees to predict states, Use Entropy to build decision trees recursively, Naive bayes: Learn the Bayes rule, and how to apply it to predicting data using the Naive Bayes algorithm Train models using Bayesian Learning, Use Bayesian Inference to create Bayesian Networks of several variables

UNIT 4 CLASSIFIER TECHNIQUES-II **12 Hrs.**

Support vector machines: Learn to train a Support Vector Machine to separate data linearly Use Kernel Methods to train SVMs on data that is not linearly separable , Ensemble methods - Bagging and Boosting (Adaboost), Random forest.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Understanding Machine learning concept and algorithm.
CO2 : Application: Implementing unsupervised machine learning Techniques.
CO3 : Analysis: Extracting statistical parameters.
CO4 : Evaluation: Evaluate model through different method
CO5 : Synthesis: Building classification models.
CO6 : Creating: Advanced machine learning Projects.

TEXTS/REFERENCE BOOKS

1. Andreas C. Müller and Sarah Guido, **"Introduction to Machine Learning with Python"**, O'Reilly Publications.
2. Richert & Coelho, **"Building Machine Learning Systems with Python"**, Packt Publishing Ltd.
3. Ethem Alpaydın, **"Introduction to Machine Learning"**, The MIT Press.
4. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, **"Machine Learning"**, Pearson.
5. Tom M. Mitchell, **"Machine Learning"**, McGraw-Hill publications.

24BSD304P					**Machine Learning Techniques – II (Lab)**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

1. Understand complexity of Machine Learning algorithms and their limitations
2. Understand modern notions in data analysis-oriented computing;
3. Be able to apply common Machine Learning algorithms in practice and implementing their own;
4. Be able to perform experiments in Machine Learning using real-world data.

LIST OF EXPERIMENTS

1 K-Means Algorithm, Fuzzy Clustering
2 Hierarchical Clustering, Agglomerative Hierarchical Clustering
3 Divisive Hierarchical Clustering, Cluster Validity
4 Principal Component Analysis
5 Discriminant Analysis
6 Canonical Correlation Analysis
7 Implement Random forest using python.
8 Applied Decision tree Model for a given dataset.
9 Develop SVM for a given dataset
10 Classification Matrices

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Understanding Machine learning concept and algorithm.
CO2 : Application: Implementing unsupervised machine learning Techniques.
CO3 : Analysis: Extracting statistical parameters.
CO4 : Evaluation: Evaluate model through different method
CO5 : Synthesis: Building classification models.
CO6 : Creating: Advanced machine learning Projects.

TEXTS/REFERENCE BOOKS

1. Andreas C. Müller and Sarah Guido, **"Introduction to Machine Learning with Python"**, O'Reilly Publications.
2. Richert & Coelho, **"Building Machine Learning Systems with Python"**, Packt Publishing Ltd.
3. Ethem Alpaydın, **"Introduction to Machine Learning"**, The MIT Press.
4. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, "**Machine Learning"**, Pearson.
5. Tom M. Mitchell, **"Machine Learning"**, McGraw-Hill publications.

24BSD305T					Scientific Computing					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**1**	**0**	**4**	**4**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. Understand the numerical methods for solving the system of equations.
2. Apply numerical methods to obtain approximate solutions to mathematical problems.
3. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
4. Analyze and evaluate the accuracy of common numerical methods.

UNIT 1 ERRORS, ALGORITHMS, AND CONVERGENCE, TRANSCENDENTAL AND POLYNOMIAL EQUATIONS **10 Hrs.**

Introduction, Bisection method, Regula-falsi method, Secant method, Fixed Point iteration, Newton-Raphson method, Rate of convergence, Error Analysis for iterative methods

UNIT 2 SYSTEM OF LINEAR ALGEBRAIC EQUATIONS **10 Hrs.**

Pivoting Strategies, Matrix inversion, LU-Decomposition, Gauss Jacobi, Gauss–Seidel Method, Relaxation Techniques

UNIT 3 INTERPOLATION AND APPROXIMATIONS **10 Hrs.**

Introduction, Lagrange Interpolation and Newton Interpolation, Least Square Approximation, Uniform Approximation, Differentiation

UNIT 4 NUMERICAL INTEGRATION AND SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **12 Hrs.**

Newton Cotes Algorithm, Trapezoidal rule, Simpson's rule, Gauss – Legendre Integration Method, Ordinary Differential Equations: Euler's Method, Euler Modified Method, Runge - kutta Method.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
CO2 : Apply numerical methods to obtain approximate solutions to mathematical problems.
CO3 : Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations.
CO4 : Analyse and evaluate the accuracy of common numerical methods for solving ordinary differential equations.
CO5 : Analyze and apply the line of best fit on the given set of data.
CO6 : Apply the concept of interpolation and numerical integration for various real world problems.

TEXTS/REFERENCE BOOKS

1. B.S. Grewal, **"Numerical Methods in Engineering and Science with Programs in C & C++"**, Khanna Publishers.
2. S.S. Sastry, **"Introductory Methods for Numerical Analysis"**, Prentice Hall of India.
3. M.K. Jain, S.R.K. Iyengar and R.K. Jain, **"Numerical Methods for Scientific and Engineering Computation"**, New Age International.
4. C. F. Gerald and P. O. Wheatley, **"Applied Numerical analysis"**, Pearson education.
5. Erwin Kreyszig, "**Advanced Engineering Mathematics"**, Wiley publication.
6. R.K. Jain & S.R.K. Iyengar, **"Advanced Engineering Mathematics"**, Narosa.

24BSD306T					System Commands					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**1**	**0**	**4**	**4**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. To understand the fundamentals of the GNU/Linux operating system and its command-line interface.
2. To develop proficiency in managing hardware, software, and file systems using system commands.
3. To gain practical experience in shell scripting, text processing, and automation.
4. To learn networking concepts and basic version control with Git.

UNIT 1: INTRODUCTION TO GNU/LINUX OS **11 Hrs.**

Introduction to GNU/Linux OS; setting up and running Linux environment; the command line environment; knowing hardware of your machine: Information commands (e.g., hwinfo, lshw, df, free); diagnostics: Commands to fetch hardware information (e.g., battery state, memory modules)

UNIT 2: KNOWING THE OS SOFTWARE **11 Hrs.**

Commands to get details about operating system, versions, packages (installed/available); input/output redirection; introduction to packages and repositories; using 'apt' commands to manage packages; file types and related commands.

UNIT 3: FILE SYSTEM MANAGEMENT **10 Hrs.**

Understanding file permissions and access modes; managing file permissions through symbolic and numeric mode; concept of environment variables; managing shell variables; symbolic links and hard links; brief introduction to inode numbers; exploring the root file system and related commands.

UNIT 4: SHELL SCRIPTING AND TEXT PROCESSING **10 Hrs.**

Shell shortcuts with commands; slicing output; managing programs currently running on the machine; shell access to a local/remote machine; redirection to script, variable, and for logging purpose; using pipes Introduction to regex: using regex patterns and egrep.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : navigate the GNU/Linux environment efficiently, executing various system commands to manage hardware, software, and file systems effectively.
CO2 : diagnose hardware issues and gather system information using appropriate commands.
CO3 : manage software packages and repositories effectively using 'apt' commands.
CO4 : have a foundational understanding of version control using Git, including managing repositories, branches, pull requests, and collaborating on projects within teams.
CO5 : demonstrate proficiency in file management, permissions, and shell scripting techniques
CO6 : collaborate effectively in team-based software development workflows using Git.

TEXTS/REFERENCE BOOKS

1. William E. Shotts Jr., **"The Linux Command Line: A Complete Introduction"**, No Starch Press.
2. Richard Blum, **"Linux Command Line and Shell Scripting Bible"**, Wiley.
3. W. Richard Stevens and Stephen A. Rago, **"Advanced Programming in the UNIX Environment (Addison-Wesley Professional Computing Series)"**, Addison-Wesley.
4. Michael Kerrisk, **"The Linux Programming Interface: A Linux and UNIX System Programming Handbook"**, No Starch Press.

24BSD307T					Industry 4.0					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**1**	**0**	**4**	**4**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. Describe Industry 4.0 and scope for Indian Industry 4.0
2. Demonstrate conceptual framework and road map of Industry 4.0
3. Describe Robotic technology and Augmented reality for Industry 4.0
4. Demonstrate obstacle and framework conditions for Industry 4.0

UNIT 1 INTRODUCTION **10 Hrs.**

Introduction to Industry 4.0: Introduction, core idea of Industry 4.0,origin concept of industry 4.0,Industry 4.0 production system, current state of industry 4.0, Technologies, How is India preparing for Industry 4.0 A Conceptual Framework for Industry 4.0: Introduction, Main Concepts and Components of Industry 4.0, State of Art, Supportive Technologies, Proposed Framework for Industry 4.0.

UNIT 2 ADVANCES IN ROBOTICS IN THE ERA OF INDUSTRY 4.0 **12 Hrs.**

Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, Strategy Phase, New Product and Process Development Phase. Introduction, Recent Technological Components of Robots- Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly

UNIT 3 THE ROLE OF AUGMENTED REALITY IN THE AGE OF INDUSTRY 4.0 **8 Hrs.**

Introduction, AR Hardware and Software Technology, Industrial Applications of AR

UNIT 4 OBSTACLES AND FRAMEWORK CONDITIONS FOR INDUSTRY 4.0 **12 Hrs.**

Lack of A Digital Strategy alongside Resource Scarcity, Lack of standards and poor data security, Financing conditions, availability of skilled workers, comprehensive broadband infrastructure, state support, legal framework, protection of corporate data, liability, handling personal data

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Knowledge and Comprehension: Understanding of Industry 4.0 Concepts
CO2 : Application: Robotics Advancements
CO3 : Analysis: Augmented Reality (AR) Technology
CO4 : Select: Identification of Obstacles and Framework Conditions
CO5 : Synthesis: Acquire proficiency in Conceptual Frameworks for Industry 4.0
CO6 : Creating: Develop Strategies and Solutions

TEXTS/REFERENCE BOOKS

1. Alp Ustundag and Emre Cevikcan, **"Industry 4.0: Managing the Digital Transformation"**, Springer.
2. Bartodziej, Christoph Jan, **"The Concept Industry 4.0"**, Springer.
3. Klaus Schwab, **"The Fourth Industrial Revolution",** World Economic Forum**.**
4. Christian Schröder, **"The Challenges of Industry 4.0 for Small and Medium-sized Enterprises",** Friedrich-Ebert-Stiftung.

24BSD322T					**Marketing Analytics**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
2	**0**	**0**	**2**	**2**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. Equip foundational knowledge in marketing principles, market segmentation, and customer value analysis.
2. Develop proficiency in extracting insights from market data using advanced analytic tools and techniques.
3. Acquire skills in revenue management, dynamic pricing models, and customer analytics for sales optimization.
4. Gain expertise in marketing modeling for strategic decision-making, including customer journey analysis and value optimization.

UNIT 1 BASICS OF MARKETING **07 Hrs.**

Basics of Marketing, Segmentation: Cluster Analysis, RFM Analysis

UNIT 2 MARKETING ANALYTIC METHODS **07 Hrs.**

Perceptual/Preference Mapping, Correspondence Analysis, MDS, Conjoint Analysis

UNIT 3 REVENUE MANAGEMENT **06 Hrs.**

Revenue Management, Pricing Analytics, Westendorp Method, Gabor and Granger Method, Dynamic Price Modelling, Customer Analytics.

UNIT 4 MARKETING MODELLING **08 Hrs.**

Customer Journey Mapping, Satisfaction - NPS, Churn Analysis, CLTV, Market Mix Modelling, Online Attribution Modelling

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to:

CO1 : Analyze market segments and customer behavior using cluster and RFM analysis.
CO2 : Apply perceptual mapping and conjoint analysis to understand customer preferences and product positioning.
CO3 : Implement revenue management and dynamic pricing strategies to optimize profitability.
CO4 : Utilize pricing analytics, including the Westendrop and Gabor-Granger methods, for effective pricing decisions.
CO5 : Conduct customer journey mapping and churn analysis to enhance customer satisfaction and retention.
CO6 : Calculate Customer Lifetime Value (CLTV) and employ market mix and online attribution modelling for improved marketing ROI.

TEXTS/REFERENCE BOOKS

1. Mansurali, A., & Jeyanthi, P. M. (Eds.)., **"Marketing analytics: a machine learning approach"**, CRC Press.
2. Seema Gupta, Avadhoot Jathar, **"Marketing analytics"**, Wiley
3. Blanchard, T., Behera, D., & Bhatnagar, P., **"Data Science for Marketing Analytics: Achieve your marketing goals with the data analytics power of Python"**. Packt Publishing Ltd.

24BSD332T					Prompt Engineering					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	0	2	2	25	50	25	-	-	100

COURSE OBJECTIVES

1. Understanding artificial intelligence and its application in data science through prompt engineering, emphasizing the creation and optimization of prompts for AI models.
2. Analyse advanced techniques for generating sophisticated AI interactions, focusing on data preprocessing, analysis, and machine learning enhancement using prompt engineering.
3. Learn practical experience with AI tools such as ChatGPT, Stable Diffusion, and GitHub Copilot, enabling the application of prompt engineering in real data science projects and tasks.
4. Highlight the importance of ethical AI development, including strategies for bias mitigation, and introduce best practices for deploying scalable prompt-engineered solutions in professional settings.

UNIT 1 INTRODUCTION TO AI AND PROMPT-ENGINEERED SOLUTIONS IN PROFESSIONAL SETTINGS **7 Hrs.**

Introduction to AI's role in data science, basic concepts and historical milestones. Fundamentals of prompt engineering, including definitions, scope, and significance in AI interactions. Overview of AI tools such as ChatGPT, Stable Diffusion, GitHub Copilot focusing on their functionalities, strengths, and limitations, Five Principles of Prompting" for crafting effective prompts.

UNIT 2 ADVANCED PROMPTING STRATEGIES AND TECHNIQUES **7 Hrs.**

Advanced prompting strategies for complex AI interactions, including conditional, recursive, and chained prompts, Techniques for managing AI responses, minimizing errors, and ensuring data accuracy. Analysis of real-world case studies showcasing successful applications of prompt engineering in various industries.

UNIT 3 PROMPT ENGINEERING FOR DATA PROCESSING AND ANALYSIS **6 Hrs.**

Application of prompt engineering in data preprocessing, cleaning, and transformation using AI. Leveraging AI for exploratory data analysis (EDA) and feature extraction through effective prompting.

UNIT 4 SCALABILITY, ETHICS, AND ADVANCED TOOLS IN PROMPT ENGINEERING **8 Hrs.**

Best practices for scaling prompt-engineered solutions, focusing on performance optimization, deployment, and maintenance. Ethical considerations in AI applications, with strategies for identifying and mitigating biases in AI-generated content. Introduction to advanced tools and libraries (e.g., LangChain, AUTOMATIC1111) for professional prompt engineering.

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Understand and articulate the principles of artificial intelligence and prompt engineering, and their significance in enhancing data science projects.

CO2 : Apply advanced prompting strategies to effectively communicate with AI models for tasks such as data preprocessing, exploratory data analysis, and feature extraction.

CO3 : Utilize popular AI tools and platforms, including ChatGPT, Stable Diffusion, and GitHub Copilot, to automate and optimize data science workflows.

CO4 : Design and implement prompt-engineered solutions to real-world data science problems, demonstrating the ability to integrate AI into various stages of project development.

CO5 : Recognize and address ethical considerations in AI applications, implementing strategies to mitigate biases in AI-generated outputs and ensure responsible AI use.

CO6 : Deploy scalable and efficient AI solutions, incorporating best practices for prompt engineering, to address complex data science challenges in professional environments.

TEXTS/REFERENCE BOOKS

1. John, I,. **"The art of asking ChatGPT for high-quality answers: a complete guide to prompt engineering techniques"**, United States of America: Zunda Technologies Limited.
2. Zaralli, M., **"Virtual Reality and Artificial Intelligence: Risks and Opportunities for Your Business"**, CRC Press.

24BSD333T					**Introduction to GitHub**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
1	**0**	**0**	**1**	**1**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. Establish a foundational understanding of version control systems and Git.
2. Develop proficiency in local Git repository management and version control operations
3. Integrate GitHub as a collaborative platform for project development and code sharing.
4. Explore advanced Git techniques and integrations for complex workflows and automation.

UNIT 1 INTRODUCTION TO VERSION CONTROL AND GIT **03 Hrs.**

Introduction to Git, Git installation and setup, Understanding Version Control Systems with types of version control including local version control system, centralized vs. distributed version control

UNIT 2 WORKING WITH GIT REPOSITORIES **04 Hrs.**

Creating a new Git repository, cloning an existing repository, recording changes to the repository (git add, git commit), Viewing commit history, undoing changes (git checkout, git reset), core concepts of version control covering repository, commit, branching, merging, conflicts and conflict resolution.

UNIT 3 COLLABORATION AND GITHUB **04 Hrs.**

Introduction to GitHub, Creating a GitHub account, Creating and managing repositories on GitHub, Pushing local repositories to GitHub, Pull requests and code reviews, Collaboration workflows (fork and pull model), Issues and project management on GitHub

UNIT 4 ADVANCED GIT AND GITHUB TOPICS **03 Hrs.**

Remote repositories and remote branches, Git workflow (feature branching, pull requests), Git rebasing, Git hooks, Continuous Integration (CI) with GitHub Actions, Git Large File Storage (LFS), GitHub Pages (for hosting static websites)

TOTAL HOURS: 14 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Explain the fundamental principles and benefits of version control systems in the context of software development.
CO2 : Execute core Git commands for local repository management, including initialization, staging, committing, branching, merging, and revision history exploration.
CO3 : Differentiate between centralized and distributed version control systems, recognizing the advantages and potential challenges of each approach.
CO4 : Utilize GitHub as a platform for collaborative development, employing features such as pull requests, code reviews, issue tracking, and project management tools.
CO5 : Implement advanced Git techniques, encompassing rebasing, hooks, and integration with Continuous Integration (CI) tools for workflow automation.
CO6 : Evaluate and select appropriate Git workflows and strategies based on project requirements and team dynamics.

TEXTS/REFERENCE BOOKS

1. Chacon, Scott and Straub, Ben.,**"Pro Git**", Apress,
2. Loeliger, Jon and McCullough, Matthew., **"Version Control with Git"**, O'Reilly Media,
3. Umali, Rick , **"Git Version Control Cookbook"**, Packt Publishing.

24BSD333P					**Introduction to GitHub (Lab)**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

1. Comprehend the importance of version control: Understand the vital role and benefits of version control in software development, specifically through GitHub.
2. Master the use of GitHub and its GUI: GitHub Desktop: Acquire proficiency in managing repositories, committing changes, creating branches, and merging them using both the web interface and GitHub Desktop.
3. Understand the GitHub collaboration model: Learn about forking, Pull Requests, Code Reviews which form the backbone of Open-Source contribution to GitHub.
4. Leverage GitHub APIs: Gain knowledge on how to programmatically interface with GitHub repositories and data using its REST/GraphQL APIs.

LIST OF EXPERIMENTS

1 Setting up a GitHub account and familiarising with the GitHub user interface,

2 Creating, cloning, and managing GitHub repositories,
3 Use of branches for developing features, fixing bugs and safely experimenting with new ideas
4 The commit model in Git and creating meaningful commit messages
5 Learning pull requests for code review and collaboration
6 Understanding and resolving merge conflicts
7 Leveraging GitHub Issues and Milestones for project management,
8 Introduction to GitHub Actions for Continuous Integration and Continuous Deployment (CI/CD),
9 Learning how to use GitHub Desktop and command line
10 Using GitHub APIs for creating applications that interact with the GitHub platform.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Understand the fundamentals of version control and the significance of Git and GitHub in software development.
CO2 : Capable of performing basic to advanced GitHub operations including branching, merging, and handling pull requests.
CO3 : Able to handle project management within GitHub using tools like Issues and Milestones.
CO4 : Proficient in using GitHub Desktop and command line for performing Git functions.
CO5 : Familiar with GitHub Actions to automate, customize, and execute software development workflows.
CO6 : Capable of building applications that leverage the GitHub API for interacting with GitHub data.

TEXTS/REFERENCE BOOKS

1. M. Hartl, **"Learn Enough Git to Be Dangerous: An introduction to version control with Git and GitHub"**, Self-published,
2. R. Hyman, B. Wilson, **"Pro Git"**, APress,
3. A. Bell, **"Introducing GitHub: A Non-Technical Guide"**, O'Reilly Media,
4. P. Daigle, **"GitHub Essentials"**, Packt Publishing.

24BSD401T					Deep Learning					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**0**	**0**	**3**	**3**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. Make aware of tools and techniques required in handling large amounts of datasets.
2. Acquire familiarity to the theory and practice of a big family of very effective techniques.
3. Gain adequate knowledge to apply the techniques in solving problems.
4. Understand the principles of deep learning and its capabilities

UNIT I: INTRODUCTION **11 Hrs.**

Introduction to Deep Learning, Bayesian Learning, Decision Surfaces, Linear Classifiers, Linear Machines with Hinge Loss, Optimization Techniques, Gradient Descent, Batch Optimization

UNIT II: NEURAL NETWORKS **10 Hrs.**

Introduction to Neural Network, Multilayer Perceptron, Back Propagation Learning, Unsupervised Learning with Deep Network, Apply neural network for classification

UNIT III: CONVOLUTION NEURAL NETWORKS (CNNs) **11 Hrs.**

Convolutional Neural Network, Building blocks of CNN, Transfer Learning, Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam Effective training in Deep Net-early stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization

UNIT IV: DEEP LEARNING ARCHITECTURES **10 Hrs.**

Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network, Fully Connected CNN etc. Classical Supervised Tasks with Deep Learning, Image Denoising, Semantic Segmentation, Object Detection etc.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Understand the basic concepts of Deep Learning.
CO2 : Remember the key features in neural network architectures.
CO3 : Analyse neural networks and modern deep learning systems.
CO4 : Implement architectures/deep learning algorithms to solve practical problems.
CO5 : Evaluate appropriate classical algorithms and models.
CO6 : Design, implement and train practical deep learning systems.

TEXTS/REFERENCE BOOKS

1. Ian Goodfelllow, Yoshua Benjio, Aaron Courville, **"Deep Learning"**, The MIT Press.
2. Richard O. Duda, Peter E. Hart, David G. Stork, **"Pattern Classification"**, John Wiley & Sons Inc.
3. John D Kelleher, **"Deep Learning"**, The MIT Press.

24BSD401P					Deep Learning (Lab)					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

1. Make aware of tools and techniques required in handling large amount of datasets.
2. Acquire familiarity to the theory and practice of a big family of very effective techniques.
3. Gain adequate knowledge to apply the techniques in solving problems.
4. Understand the principles of deep learning and its capabilities.

LIST OF EXPERIMENTS

1 Build a deep neural network model start with linear regression using a single variable.

2 Build a deep neural network model start with linear regression using multiple variables.

3 Write a program to convert speech into text.

4 Write a program to convert text into speech.

5 Write a program to convert video into frames.

6 Write a program for image classification using CNN Models.

7 Build a feed forward neural network for prediction of logic gates.

8 Write a program to implement deep learning Techniques for image segmentation.

9 Write a program for object detection using image labeling tools.

10 Write a program to predict a caption for a sample image using ANN Model.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Understand the basic concepts of Deep Learning**.**
CO2 : Remember the key features in neural network architectures.
CO3 : Analyse neural networks and modern deep learning systems
CO4 : Implement architectures/deep learning algorithms to solve practical problems.
CO5 : Evaluate appropriate classical algorithms and models.
CO6 : Design, implement and train practical deep learning systems.

TEXTS/REFERENCE BOOKS

1. Ian Goodfelllow, Yoshua Benjio, Aaron Courville, **"Deep Learning",** The MIT Press.
2. Richard O. Duda, Peter E. Hart, David G. Stork, **"Pattern Classification",** John Wiley & Sons Inc.
3. John D Kelleher, **"Deep Learning",** The MIT Press.

24BSD402T					Image Processing using Python					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	-	-	100

COURSE OBJECTIVES

1. Students will be able to acquired, sampled, quantized and the relationship between pixels of digital images,
2. Students will learn enhancement and restoration both spatial and frequency domain techniques are utilized,
3. Students will be able to apply the compression techniques and standards for efficient storage. It also deals with the techniques to extract features for image representation and recognition.

UNIT 1 DIGITAL IMAGE FUNDAMENTALS **08 Hrs.**

Digital Image Representation, Fundamental steps in Image Processing, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Relationships between pixels, colour models...

UNIT 2 IMAGE ENHANCEMENT **10 Hrs.**

Spatial Domain: Gray level transformations, Histogram processing, Basics of Spatial, Filtering, Smoothing and Sharpening Spatial Filtering, Frequency Domain: 2D Fourier Transform, Smoothing and Sharpening frequency domain filters, Extracting text from images.

UNIT 3 IMAGE RESTORATION, SEGMENTATION AND COMPRESSION **12 Hrs.**

Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering. Segmentation: Edge detection Edge Linking and Boundary detection – Region-based segmentation- Morphological processing-erosion and dilation. Compression: Fundamentals – Image Compression models – Error-Free Compression – Lossy compression– Image Compression standards

UNIT 4 IMAGE REPRESENTATION AND RECOGNITION **12 Hrs.**

Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments – Boundary description – Shape number – Fourier Descriptor, moments-Regional Descriptors –Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : understand basic concepts image processing, image storage and types of transformations, applied to images.
CO2 : compare the domains and methods of image processing.
CO3 : check the correctness of algorithms using inductive proofs and loop invariants.
CO4 : Learn Image Restoration & Enhancement techniques, colour image processing.
CO5 : Representation and recognition of images.
CO6 : Familiar with morphological image processing.

TEXTS/REFERENCE BOOKS

1. Rafael C. Gonzales, Richard E. Woods, **"Digital Image Processing"**, Pearson Education.
2. Anil Jain K., **"Fundamentals of Digital Image Processing"**, PHI Learning Pvt. Ltd.
3. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins**, "Digital Image Processing Using MATLAB"**, Tata Mc Graw Hill Pvt. Ltd., Third Edition
4. Willliam K Pratt, **"Digital Image Processing"**, John Willey.
5. Malay K. Pakhira**, "Digital Image Processing and Pattern Recognition",** PHI Learning Pvt. Ltd, First Edition.

24BSD421T					Mathematical Finance					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	4	4	25	50	25	-	-	100

COURSE OBJECTIVES

1. Understand the Fundamentals of Forwards and Futures Markets,
2. Master Options Pricing and Valuation Techniques,
3. Apply the Black-Scholes Model and Understand Its Implications,
4. Evaluate Risk Using Value at Risk (VaR) Methodologies.

UNIT 1 Forwards and Futures **10 Hrs.**

Forwards and Futures, Forwards and Futures Price, Value of Future, Method of Replicating Portfolios, Hedging with Futures, Currency Futures, Stock Index Futures

UNIT 2 Options **11 Hrs.**

Stock Price Models: Lognormal and Geometric Brownian Motion, Binomial Tree ModelCall Options, Put Options, Put-Call Parity, Binomial Options Pricing Model, Pricing American Options, Dynamic Hedging, Risk-Neutral Valuation

UNIT 3 Black-Scholes Model **10 Hrs.**

Risk-Neutral Valuation, The Black Scholes Formula, Options on Futures, Black-Scholes and BOPM, Implied Volatility, Dynamic Hedging, The Greeks, The Black-Scholes PDE, Speculating with Options

UNIT 4 Value at Risk **11 Hrs.**

Definition of VaR, Linear Model, Quadratic Model, Monte Carlo Simulation, The Martingale

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Gain proficiency in the mechanisms and pricing of forwards and futures markets, including understanding how to construct replicating portfolios and utilize futures for hedging purposes across different asset classes such as currencies and stock indexes.

CO2 : Develop a comprehensive understanding of options, mastering the valuation and pricing techniques for call and put options, and learning to apply models such as the Lognormal and Geometric Brownian Motion, and the Binomial Tree Model for pricing and hedging strategies.

CO3 : Apply the Black-Scholes Model effectively to options pricing, gaining insights into risk-neutral valuation, understanding the implications of implied volatility, and using the model in conjunction with the Greeks for managing options portfolios.

CO4 : Understand and implement dynamic hedging strategies to manage financial risks associated with options trading, leveraging the concepts of delta, gamma, and other Greeks to adjust positions in a dynamic market environment.

CO5 : Evaluate financial risk using Value at Risk (VaR) methodologies, learning to assess and manage the risk in portfolios through various VaR models, including linear, quadratic models, and Monte Carlo simulations, and understanding the application of the Martingale approach in risk management.

CO6 : Synthesize knowledge of derivatives markets to formulate and execute advanced trading and hedging strategies, incorporating the use of forwards, futures, options, and the Black-Scholes Model to navigate and capitalize on financial markets effectively.

TEXTS/REFERENCE BOOKS

1. Emanuela Rosazza Gianin, Carlo Sgarra, **"Mathematical Finance. Theory Review and Exercises"**, Springer.
2. Amber Habib, "**The Calculus of Finance"**, Universities Press.

24BSD403T					Big Data Analytics					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

1. Students will demonstrate a comprehensive understanding of various Big Data technologies, including Hadoop ecosystem components, cloud computing services, and NoSQL database
2. Students will develop practical skills in implementing Big Data solutions by working with tools and frameworks such as Hadoop, HBase, MapReduce, and others
3. Students will be proficient in integrating Big Data technologies with traditional data warehousing systems.

UNIT 1 BIG DATA AND TECHNOLOGIES FOR HANDLING BIG DATA **10 Hrs.**

Big Data: Introduction to Big Data, Structuring Big Data, Types of Data, Elements of Big Data, Big Data Analytics, Advantages of Big Data Analytics. Introducing Technologies for Handling Big Data: Distributed and Parallel Computing for Big Data, Cloud Computing and Big Data, Features of Cloud Computing, Cloud Deployment Models, Cloud Services for Big Data, Cloud Providers in Big Data Market.

UNIT 2 HADOOP ECOSYSTEM AND HBASE **12 Hrs.**

Understanding Hadoop Ecosystem: Introducing Hadoop, HDFS and MapReduce, Hadoop functions, Hadoop Ecosystem. Hadoop Distributed File System- HDFS Architecture, Concept of Blocks in HDFS Architecture, Namenodes and Datanodes, Features of HDFS. MapReduce. Introducing HBase- HBase Architecture, Regions, Storing Big Data with HBase, Combining HBase and HDFS, Features of HBase, Hive, Pig and Pig Latin, Sqoop, ZooKeeper, Flume, Oozie

UNIT 3 MAPREDUCE FUNDAMENTALS AND BIG DATA TECHNOLOGY **10 Hrs.**

Understanding MapReduce Fundamentals and HBase: The MapReduce Framework, Exploring the features of MapReduce, Working of MapReduce, Techniques to optimize MapReduce Jobs, Hardware/Network Topology, and Synchronization, File system, Uses of MapReduce, Role of HBase in Big Data Processing- Characteristics of HBase. Understanding Big Data Technology Foundations: Exploring the Big Data Stack, Data Sources Layer, Ingestion Layer, Storage Layer, Physical Infrastructure Layer, Platform Management Layer, Security Layer, Monitoring Layer, Visualization Layer

UNIT 4 SPARK AND NOSQL **10 Hrs.**

SPARK: Introduction to Data Analysis with Spark, In-Memory Computing with Spark, Spark Basics, Interactive Spark with PySpark, Writing Spark Applications. NoSQL Data Management: Introduction to NoSQL, Characteristics of NoSQL, History of NoSQL, Types of NoSQL Data Models- Key Value Data Model, Column Oriented Data Model, Document Data Model, Graph Databases, Schema-Less Databases, Materialized Views, CAP Theorem.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Knowledge and Comprehension: understanding of the fundamental concepts of Big Data, including: structure, types, and elements.
CO2 : Application: Big Data technologies, such as Hadoop, HBase, MapReduce, and related tools
CO3 : Analysis: analyse and optimize MapReduce jobs for efficient data processing.
CO4 : Select: Appropriate cloud computing services
CO5 : Synthesis: acquire proficiency in managing NoSQL databases.
CO6 : Creating: integrate Big Data technologies with traditional data warehousing systems effectively

TEXTS/REFERENCE BOOKS

1. DT Editorial Services, **"Black Book TM BIG DATA"**, DreamTech Press.
2. Seema Acharya, Subhasni Chellappan , **"Big Data and Analytics"**, Wiley publications.
3. Nathan Marz and James Warren, **"BIG DATA- Principles and Best Practices of Scalable Real-Time Systems"**.

24BSD403P					**Big Data Analytics (Lab)**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

1. Installation and understanding of working of HADOOP
2. Understanding of MapReduce program paradigm.
3. Understanding working of Pig, Hive
4. Understanding of working of Apache Spark Cluster

LIST OF EXPERIMENTS

1 Setting up and Installing Hadoop in its two operating modes: Pseudo distributed, Fully distributed.

2 Implementation of the following file management tasks in Hadoop: Adding files and directories ,Retrieving files, Deleting files.

3 Implementation of Word Count Map Reduce program. Find the number of occurrences of each word appearing in the input file(s). Performing a MapReduce Job for word search count (look for specific keywords in a file)

4 Map Reduce Program for Stop word elimination: Map Reduce program to eliminate stop words from a large text file.

5 Map Reduce program that mines weather data. Weather sensors collecting data every hour at many locations across the globe gather large volumes of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record oriented. Data available at: https://github.com/tomwhite/hadoopbook/tree/master/input/ncdc/all.(i)Find average, max and min temperature for each year in the NCDC data set?(ii)Filter the readings of a set based on the value of the measurement, Output the line of input files associated with a temperature value greater than 30.0 and store it in a separate file.

6 Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data

7 Write a Pig Latin script for finding TF-IDF value for book dataset (A corpus of eBooks available at: Project Gutenberg)

8 Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.

9 Install, Deploy & configure Apache Spark Cluster. Run apache spark applications using Scala.

10 Perform Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Knowledge and Comprehension: understanding of the fundamental concepts of Big Data, including: structure, types, and elements.

CO2 : Application: Big Data technologies, such as Hadoop, HBase, MapReduce, and related tools

CO3 : Analysis: analyse and optimize MapReduce jobs for efficient data processing.

CO4 : Select: Appropriate cloud computing services

CO5 : Synthesis: acquire proficiency in managing NoSQL databases.

CO6 : Creating: integrate Big Data technologies with traditional data warehousing systems effectively

TEXTS/REFERENCE BOOKS

1. DT Editorial Services, **"Black Book TM BIG DATA"**, DreamTech Press.
2. Seema Acharya, Subhasni Chellappan , **"BIG DATA and ANALYTICS"**, Wiley publications.
3. Nathan Marz and James Warren, **"BIG DATA- Principles and Best Practices of Scalable Real-Time Systems"**.

24BSD404T					Sequential Decision-Making					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**1**	**0**	**4**	**4**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. To understand the uncertain input and simultaneously optimizing the desired objective.
2. To understand the uncertainty in diverse contexts
3. To apply algorithmic tools for sequential decision making.
4. To be able to conceptualize the practical motivation.

UNIT 1 INTRODUCTION **11 Hrs.**

Sequential Decision Making: The Agent, The Environment, Reward, Policies, Formal Models, Evaluation Criteria: Planning Algorithms.

UNIT 2 ONLINE ALGORITHMS AND BANDIT PROBLEMS **11 Hrs.**

Introduction to Online Learning, Halving algorithm, Online Machine Learning; Perceptron and Winnow, Intro to Regret; Online learning with expert advice - Hedge algorithm , Online linear optimization, Online convex optimization; Online learning summary , Introduction to Multi armed Bandits (MAB)

UNIT 3 : MARKOV DECISION PROCESSES **10 Hrs.**

Introduction, Algorithms for Solving Generalized MDPs: Value Iterations, Computing Near-optimal Policies, Policy Iteration, Algorithmic Analysis.

UNIT 4 BANDIT PROBLEMS AND REINFORCEMENT LEARNING **10 Hrs.**

Stochastic MAB, Linear Bandits – Lin UCB algorithm; MAB summary, Introduction to Reinforcement Learning - Markov Decision Process, Q-learning

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Identify the sequential decision-making scenarios.
CO2 : Understand the uncertainty in data sets and simultaneously optimizing the objective function.
CO3 : Apply prior probabilistic models to handle uncertainty and to solve real world problems.
CO4 : Analyze greedy algorithms and adaptivity gaps.
CO5 : Evaluate the performance of algorithms.
CO6 : Develop online algorithms.

TEXTS/REFERENCE BOOKS

1. Warren B. Powell, **"Sequential Data Analytics and Modeling"**, Foundations and Trends® in Technology, Information and Operations Management.
2. Michael Lederman Littman, **"Algorithms for Sequential Decision Making"**, Ph.D. Dissertation.
3. J. C. Gittins, **"Multi-armed Bandit Allocation Indices"**, Wiley-Interscience series in systems and optimization, Wiley, Chichester, New York.

24BSD405T					Deep Learning with Computer Vision					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**1**	**0**	**4**	**4**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. Be familiar with fundamental concepts and applications in computer vision
2. Understand common deep learning workflows such as Image Classification and Object Detection.
3. Introduce major ideas, methods, and techniques of computer vision and pattern recognition.
4. Understand mathematical and scientific concepts that are applied in computer vision.

UNIT I INTRODUCTION AND VISUAL FEATURES **10 Hrs.**

Introduction, Image representation, linear filtering, correlation, convolution, image in frequency domain, edge detection, scale space, image pyramids and filter bank, SIFT and variants.

UNIT II VISUAL MATCHING AND CONVOLUTION NEURAL NETWORKS **12 Hrs.**

Feature matching, From point to images; Bag of words and VLAD representation; Image descriptor matching; From traditional vision to deep learning, Convolution neural networks, Back propagation in CNNs, Evolution of CNN architectures for image classification.

UNIT III VISUALIZATION AND UNDERSTANDING CNNs **10 Hrs.**

Visualization methods, Early methods(Visualization of kernels, back prop to image/ deconvolution methods), class attribution map methods, CNNs for object detection, CNNs for segmentation.

UNIT IV RECURRENT NEURAL NETWORKS AND ATTENTION MODELS **10 Hrs.**

Introduction, Backpropagation in RNNs, Attention in vision models, Vision and Language Image captioning, self attention and transformers, deep generative models.

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Understand basic concepts, models and methods in the field of computer vision.
CO2 : Remember basic convolution neural networks for object detection.
CO3 : Apply knowledge of computer vision to real life problems.
CO4 : Analyse low-level image processing methods such as filtering and edge detection.
CO5 : Develop practical skills necessary to build highly-accurate, advanced computer vision applications.
CO6 : Implement a computer vision system for specific problems.

TEXTS/REFERENCE BOOKS

1. D. Forsyth and J. Ponce, **"Computer Vision - A modern approach"**, Pearson Education India.
2. Charu C. Aggarwal, **"Neural Networks and Deep Learning"**, Springer.
3. Yoshua Bengio, **"Learning Deep Architectures for AI"**, Now Publishers.
4. Richard Szeliski, **"Computer Vision: Algorithms and Applications"**, Springer.

24BSD406T					Cloud Computing for Data Science - Azure/AWS					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
3	**1**	**0**	**4**	**4**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. To be able to understand cloud and its key characteristics,
2. To be able to utilize cloud deployment models in numerous applications,
3. To be able to understand the benefits, drawbacks of public and private clouds,
4. To be able to employ cloud service models.

UNIT 1 CLOUD AND ITS KEY CHARACTERISTICS **10 Hrs.**

Cloud, Key cloud characteristics, Cloud Deployment Models, Cloud Service Models, and System Drivers

UNIT 2 CLOUD ADOPTION INHIBITORS **10 Hrs.**

Cloud Adoption Inhibitors, Ambiguity, Concerns Over Maturity, Integration, Security, Multitenancy, Technology Challenges, and Corporate Policies

UNIT 3 CLOUD DEPLOYMENT MODELS **11 Hrs.**

Public Clouds: Benefits and Drawbacks, Security Considerations, Private Clouds: Benefits, Drawbacks, Responsibilities, and Security Considerations, Community Clouds, and Hybrid Clouds

UNIT 4 CLOUD SERVICE MODELS **11 Hrs.**

Software as a Service, SaaS Characteristics, and Responsibilities, SaaS Drivers, SaaS Challenges, Platform as a Service, PaaS Characteristics, Responsibilities, and Drivers

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Identify the use of clouds and its variants in engineering aspects.
CO2 : Understand the concepts of cloud deployment, service models, and system drivers**.**
CO3 : Understand the concept of cloud adoption inhibitors.
CO4 : Identify the areas of application of cloud deployment models.
CO5 : Understand the notion of hybrid clouds.
CO6 : Utilize the cloud service models in engineering problems.

TEXTS/REFERENCE BOOKS

1. D. Rountree, and I. Castrillo, **"The Basics of Cloud Computing: Understanding the Fundamentals of Cloud Computing in Theory and Practice"**, Elsevier.
2. E. Thomas, R. Puttini, and Z. Mahmood, **"Cloud Computing: Concepts, Technology & Architecture"**, Pearson.

24BSD501T					**Stochastic Processes for Data Science (Theory)**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
2	**0**	**0**	**2**	**2**	**25**	**50**	**25**	**-**	**-**	**100**

COURSE OBJECTIVES

1. Understand the basics of Python programming.
2. Learn the concepts of random numbers and distribution functions.
3. Learn the stochastic modeling used in real-life applications.
4. Utilize the applications of Brownian motion process.

UNIT 1 Python Programming for Beginners **06 Hrs.**

Using Python, iPython, and Jupyter Notebook, Making graphs with Matplotlib

UNIT 2 Distribution Function and Random Number **06 Hrs.**

Stochastic variables and distribution functions, Generating random numbers with Gaussian/binomial/ Poisson distributions, The central limiting theorem

UNIT 3 Stochastic Modeling **11 Hrs.**

Basic knowledge of stochastic processes, Markov chains (discrete and time), M/M/1 model (finite and infinite capacity), and the M/M/c model (finite and infinite capacity).

UNIT 4 Brownian Motion **05 Hrs.**

Brownian motion, The linear response theory, Distribution and time correlation, Mean square displacement and diffusion constant

TOTAL HOURS: 28 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Define and describe stochastic processes and their characteristics.
CO2 : Model stochastic processes using mathematical formulations and equations.
CO3 : Analyze stochastic processes to understand their behavior and properties.
CO4 : Understand the applications of stochastic processes in various domains of data science, including finance, telecommunications, and machine learning.
CO5 : Apply stochastic process concepts and techniques to analyze and model real-world data sets.
CO6 : Familiarize with advanced topics in stochastic processes, such as Markov decision processes, stochastic differential equations, and queuing theory.

TEXTS/REFERENCE BOOKS

1. Gregory F. Lawler, **"Introduction to Stochastic Processes"**, Chapman and Hall, CRC Press.
2. Sheldon M. Ross, **"Stochastic Processes"**, Wiley.
3. Robert G. Gallager, **"Stochastic Processes: Theory for Applications"**, Cambridge University Press.

24BSD501P					Stochastic Processes for Data Science (Lab)					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**4**	**2**	**2**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

1. Understand the basics of Python programming.
2. Learn the concepts of random numbers and distribution functions.
3. Learn the stochastic modeling used in real-life applications.
4. Utilize the applications of Brownian motion process.

LIST OF EXPERIMENTS

1 Simulate random walks using Python to visualize paths and analyze end-point distributions.
2 Construct Markov chains in Python and analyze their properties using real-world examples.
3 Model a weather pattern using a Markov chain and predict future states based on the given data.
4 Simulate stock market movements with a Markov process and analyze transition behaviors.
5 Calculate steady-state probabilities of Markov chains and interpret long-term behaviors.
6 Use Python to compute transition matrices for Markov chains in different scenarios.
7 Experiment with Markov chains by varying initial states to observe effects on chain dynamics.
8 Simulate Poisson processes to model customer arrivals and analyze the distribution of inter-arrival times.
9 Apply Poisson process simulations to radioactive decay and compare to actual decay rates.
10 Analyze event occurrences in a Poisson process and study the influence of varying the rate parameter.
11 Model customer service queues using queuing theory and simulations to determine average waiting times.
12 Simulate network packet queues to assess the performance impacts of traffic intensity.
13 Investigate the impact of service time distributions on queuing system performance using simulations.
14 Solve SDEs representing financial market models and discuss their implications.
15 Simulate SDEs to model population dynamics in ecosystems and analyze the results.
16 Explore Euler-Maruyama numerical methods for SDEs in engineering applications.
17 Visualize Brownian motion in a simulated physical system and correlate it with theoretical models.
18 Discuss the role of Brownian motion in stock price modeling and option pricing.
19 Implement a Monte Carlo simulation of Brownian motion to estimate the probabilities of certain outcomes.
20 Compare Brownian motion paths with actual data from physics experiments on particle diffusion.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Define and describe stochastic processes and their characteristics.
CO2 : Model stochastic processes using mathematical formulations and equations.
CO3 : Analyze stochastic processes to understand their behavior and properties.
CO4 : Understand the applications of stochastic processes in various domains of data science, including finance, telecommunications, and machine learning.
CO5 : Apply stochastic process concepts and techniques to analyze and model real-world data sets.
CO6 : Familiarize with advanced topics in stochastic processes, such as Markov decision processes, stochastic differential equations, and queuing theory.

TEXTS/REFERENCE BOOKS

1. Gregory F. Lawler, **"Introduction to Stochastic Processes"**, Chapman and Hall, CRC Press.
2. Sheldon M. Ross, **"Stochastic Processes"**, Wiley.
3. Robert G. Gallager, **"Stochastic Processes: Theory for Applications"**, Cambridge University Press.

24BSD502T					Advanced Algorithm					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

1. Describes major algorithmic techniques (divide-and-conquer, greedy, dynamic programming, Brute Force, Transform and Conquer approaches) and mention problems for which each technique is appropriate.,
2. Describes how to evaluate and compare different algorithms using worst-case, average-case and best-case analysis,
3. Introduces string matching algorithms.

UNIT 1 ALGORITHM AND ANALYSIS OF ALGORITHM **10 Hrs.**

Basics of Algorithms and Mathematics: What is an algorithm?, Mathematics for Algorithmic Sets, Functions and Relations, Vectors and Matrices, Linear Inequalities and Linear Equations. Analysis of Algorithm: The efficient algorithm, Average, Best and worst-case analysis, Amortized analysis , Asymptotic Notations, Analyzing control statement, Loop invariant and the correctness of the algorithm, Sorting Algorithms and analysis: Bubble sort, Selection sort, Insertion sort, Shell sort Heap sort, Sorting in linear time : Bucket sort, Radix sort and Counting sort

UNIT 2 DYNAMIC AND GREEDY ALGORITHM **10 Hrs.**

Dynamic Programming: Introduction, The Principle of Optimality, Problem Solving using Dynamic Programming – Calculating the Binomial Coefficient, Making Change Problem, Assembly Line-Scheduling, Knapsack problem, All Points Shortest path, Matrix chain multiplication, Longest Common Subsequence. Greedy Algorithm General Characteristics of greedy algorithms, Problem solving using Greedy Algorithm - Activity selection problem, Elements of Greedy Strategy, Minimum Spanning trees (Kruskal's algorithm, Prim's algorithm), Graphs: Shortest paths, The Knapsack Problem, Job Scheduling Problem, Huffman code.

UNIT 3 DIVIDE AND CONQUER ALGORITHM, STRING MATCHING **10 Hrs.**

Divide and Conquer Algorithm: Introduction, Recurrence and different methods to solve recurrence, Multiplying large Integers Problem, Problem Solving using divide and conquer algorithm - Binary Search, Max-Min problem, Sorting (Merge Sort, Quick Sort), Matrix Multiplication, Exponential, String Matching: Introduction, The naive string matching algorithm, The Rabin-Karp algorithm, String Matching with finite automata, The Knuth-Morris-Pratt algorithm

UNIT 4 INTRODUCTION TO NP-COMPLETENESS **12 Hrs.**

Introduction to NP-Completeness: The class P and NP, Polynomial reduction, NP- Completeness Problem, NP-Hard Problems. Travelling Salesman problem, Hamiltonian problem, Approximation algorithms, Randomized algorithms: Monte Carlo v. Las Vegas, Min-Cut Algorithm, MAX SAT via the Probabilistic Methods, 2SAT via Markov Chains, Primality Testing, Class of problems beyond NP – P SPACE

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Knowledge and Comprehension: Understand how the choice of data structures and the algorithm design methods impact the performance of programs.
CO2 : Application: Pattern matching algorithms to find particular patterns.
CO3 : Analysis: Performance of algorithms.
CO4 : Select: Appropriate data structures and algorithm design methods for a specified application.
CO5 : Evaluate: Performance of divide-and-conquer algorithms.
CO6 : Creating: Optimal solution by applying various methods.

TEXTS/REFERENCE BOOKS

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L., **"Introduction to Algorithms"**, Rivest and Clifford Stein, PHI.
2. E. Horowitz, S.Sahni and Dinesh Mehta, **"Fundamentals of Data structures in C++"**, University Press.
3. Gilles Brassard and Paul Bratley, **"Fundamentals of Algorithms"** , Prentice Hall of India. Pvt.Ltd.
4. Anany Levitin, **"Introduction to Design and Analysis of Algorithms"**, Pearson.
5. Shailesh R Sathe, Penram, **"Foundations of Algorithms"**.
6. Dave and Dave, **"Design and Analysis of Algorithms"**, Pearson.

24BSD502P					**Advanced Algorithm (Lab)**					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

1. Describes major algorithmic techniques (divide-and-conquer, greedy, dynamic programming, Brute Force, Transform and Conquer approaches) and mention problems for which each technique is appropriate.,
2. Describes how to evaluate and compare different algorithms using worst-case, average-case and best-case analysis,
3. Introduces string matching algorithms.

LAB EXPERIMENTS

1 Implementation and Time analysis of sorting algorithms. Bubble sort, Selection sort, Insertion sort, Merge sort and Quicksort

2 Implementation and Time analysis of linear and binary search algorithm.

3 Implementation of max-heap sort algorithm

4 Implementation and Time analysis of factorial program using iterative and recursive method

5 Implementation of a knapsack problem using dynamic programming.

6 Implementation of chain matrix multiplication using dynamic programming.

7 Implementation of making a change problem using dynamic programming

8 Implementation of a knapsack problem using greedy algorithm

9 Implement prim's algorithm and kruskal's algorithm.

10 Implement the LCS problem.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Knowledge and Comprehension: Understand how the choice of data structures and the algorithm design methods impact the performance of programs

CO2 : Application: Pattern matching algorithms to find particular pattern

CO3 : Analysis: Performance of algorithms

CO4 : Select: Appropriate data structures and algorithm design methods for a specified application.

CO5 : Evaluate: Performance of divide-and-conquer algorithms.

CO6 : Creating: Optimal solution by applying various methods

TEXTS/REFERENCE BOOKS

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L., **"Introduction to Algorithms"**, Rivest and Clifford Stein, PHI.
2. E. Horowitz et al., **"Fundamentals of Algorithms".**
3. Gills Brassard, Paul Bratley, **"Fundamental of Algorithms"**, PHI.
4. Anany Levitin, **"Introduction to Design and Analysis of Algorithms"**, Pearson.
5. Shailesh R Sathe, Penram, **"Foundations of Algorithms"** .
6. Dave and Dave, **"Design and Analysis of Algorithms"**, Pearson.

24BSD503T					Deep Learning and Reinforcement Learning					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs. / Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	-	-	100

COURSE OBJECTIVES

1. Equip students with a solid understanding of machine learning fundamentals and the foundational concepts of reinforcement learning.
2. Develop proficiency in identifying and applying appropriate reinforcement learning techniques for decision-making problems.
3. Advance students' knowledge in specialized areas of reinforcement learning, including policy gradient methods, advanced actor-critic methods, and hierarchical reinforcement learning.
4. Foster the ability to design and implement reinforcement learning solutions for complex, real-world problems, integrating theoretical knowledge with practical applications.

UNIT 1 Foundations of Machine Learning and Reinforcement Learning Basics **10 Hrs.**

Review of Machine Learning Fundamentals - Classification, Regression, Probability Theory, and Optimization Concepts. Reinforcement Learning Framework - Supervised Learning vs. RL, Explore-Exploit Dilemma

UNIT 2 Core Concepts of Reinforcement Learning **10 Hrs.**

Multi-Armed Bandits (MAB) - Definition, Uses, Algorithms, Contextual Bandits. Introduction to Markov Decision Processes (MDPs) - Definitions, Returns, Value Function, Q-Function
Dynamic Programming in RL - Bellman Equation, Value Iteration, Policy Iteration

UNIT 3 Advanced Reinforcement Learning Techniques **11 Hrs.**

Evaluation and Control in RL - TD Learning, SARSA, Q-learning, Monte Carlo Methods, TD Lambda, Eligibility Traces. Maximization-Bias & Representations - Double Q Learning, Tabular vs. Parameterized Learning, Q-Learning with Neural Networks
Function Approximation in RL - Semi-gradient Methods, Stochastic Gradient Descent (SGD), Deep Q-Networks (DQNs), Replay Buffer

UNIT 4 Special Topics in Deep Learning and Reinforcement Learning **11 Hrs.**

Policy Gradient Methods - Introduction, Motivation, REINFORCE, Policy Gradient Theorem, Actor-Critic Methods. Advanced Value-Based and Actor-Critic Methods - Double DQN, Prioritized Experience Replay, Dueling Architectures, Expected SARSA, Deterministic Policy Gradient (DPG), Deep Deterministic Policy Gradient (DDPG), Soft Actor-Critic (SAC)
Hierarchical Reinforcement Learning (HRL) - Introduction to Hierarchies, Semi-Markov Decision Processes (SMDPs), Options, HRL Algorithms
Partially Observable Markov Decision Processes (POMDPs) - Introduction, Definitions, Belief States, Solution Methods
Model-Based Reinforcement Learning - Introduction, Types of Model-Based RL, Benefits, RL with a Learned Model, Dyna-style Models, Latent Variable Models
Case Study on Design of RL Solution for Real-World Problems

TOTAL HOURS: 42 Hrs.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Understand and articulate the key concepts of machine learning and reinforcement learning, including the differences between supervised learning and reinforcement learning.
CO2 : Analyze and apply multi-armed bandit algorithms and Markov Decision Processes to solve sequential decision-making problems.
CO3 : Implement dynamic programming, temporal difference learning, and Monte Carlo methods for evaluating and optimizing policies in reinforcement learning environments.
CO4 : Design and execute reinforcement learning models using function approximation, including neural networks and deep Q-networks, for complex problem-solving.
CO5 : Apply advanced reinforcement learning techniques such as policy gradient methods, actor-critic methods, and hierarchical reinforcement learning to enhance decision-making strategies.
CO6 : Demonstrate the ability to develop reinforcement learning solutions for real-world applications, effectively integrating theoretical knowledge with practical skills in model-based and model-free reinforcement learning contexts**.**

TEXTS/REFERENCE BOOKS

1. Matsuo, Y., LeCun, Y., Sahani, M., Precup, D., Silver, D., Sugiyama, M. & Morimoto, J., **"Deep learning, reinforcement learning, and world models. Neural Networks"**.
2. Mahmud, M., Kaiser, M. S., Hussain, A., & Vassanelli, S., **"Applications of deep learning and reinforcement learning to biological data"**, IEEE transactions on neural networks and learning systems.

24BSD503P					Deep Learning and Reinforcement Learning (Lab)					
Teaching Scheme					**Examination Scheme**					
L	**T**	**P**	**C**	**Hrs. / Week**	**Theory**			**Practical**		**Total Marks**
					MS	**ES**	**IA**	**LW**	**LE/Viva**	
0	**0**	**2**	**1**	**2**	**-**	**-**	**-**	**50**	**50**	**100**

COURSE OBJECTIVES

1. Equip students with a solid understanding of machine learning fundamentals and foundational concepts of reinforcement learning.
2. Develop proficiency in identifying and applying appropriate reinforcement learning techniques for decision-making problems.
3. Advance students' knowledge in specialized areas of reinforcement learning, including policy gradient methods, advanced actor-critic methods, and hierarchical reinforcement learning.
4. Foster the ability to design and implement reinforcement learning solutions for complex, real-world problems, integrating theoretical knowledge with practical applications.

LIST OF EXPERIMENTS

1 Implementing Basic Machine Learning Algorithms: Use Python to implement basic classification and regression algorithms to understand underlying ML principles relevant to reinforcement learning.

2 Exploring the Reinforcement Learning Framework: Simulate a simple reinforcement learning environment to demonstrate the explore-exploit dilemma and compare supervised learning with reinforcement learning approaches.

3 Multi-Armed Bandit Problem: Implement and compare different strategies for solving the multi-armed bandit problem.

4 Markov Decision Processes (MDP) Simulation: Create a grid world environment to demonstrate the concepts of MDPs.

5 Dynamic Programming in RL: Implement value iteration and policy iteration algorithms in a discrete environment.

6 Temporal Difference Learning Methods: Apply SARSA and Q-learning algorithms to a reinforcement learning task and analyze the performance differences between on-policy and off-policy learning.

7 Function Approximation with Neural Networks: Use a neural network to approximate the Q-function in a simple environment.

8 Deep Q-Network (DQN) Implementation: Build a DQN to solve a more complex environment and investigate the role of experience replay and target networks in stabilizing learning.

9 Policy Gradient Methods Experiment: Implement the REINFORCE algorithm to solve an RL task.

10 Actor-Critic Method for Continuous Spaces: Apply an actor-critic method in a continuous action space environment to learn the advantages of combining value-based and policy-based approaches.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1 : Understand and describe the key concepts of machine learning algorithms.
CO2 : Analyze and explore the reinforcement learning frameworks.
CO3 : Understand the Markov decision process and its practicability in real-time problems.
CO4 : Apply the temporal difference learning methods and analyse the performance differences between on-policy and off-policy learning.
CO5 : Utilize the neural networks to approximate the Q-function.
CO6 : Employ the policy gradient methods and implement the rainforce algorithm.

TEXTS/REFERENCE BOOKS

1. Dong, H., Ding, Z., Zhang, S., & Chang., **"Deep Reinforcement Learning"**, Springer Singapore.