COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE - 641 014, TAMILNADU, INDIA

DIAMOND JUBILEE

(1956 - 2016)

Department of Computing

M.Sc. DATA SCIENCE

Curriculum and Syllabi

FIRST TO TENTH SEMESTER

Under Choice Based Credit System

(For the students admitted during the academis year 2021 - 2022 and onwards)

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COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

VISION AND MISSION OF THE INSTITUTE

VISION

The Institute strives to inculcate a sound knowledge in Engineering along with realized social responsibilities to enable its students to combat the current and impending challenges faced by our country and to extend their expertise to the global arena.

MISSION

The Mission of CIT is to impart high quality education and training to its students to make them World-Class Engineers with a foresight to the changes and problems, and pioneers to offer innovative solutions to benefit the nation and the world at large.

DEPARTMENT OF COMPUTING

COIMBATORE INSTITUTE OF TECHNOLOGY

VISION AND MISSION

VISION

Department of Computing endeavours to make the students, world class software engineers, data scientists and decision makers with prudence of pioneering the solutions to the challengers of the nation and the world.

MISSION

The mission of Department of Computing is

M1: To impart sound conceptual knowledge along with intensive practical training and real time industry/research project exposure to the students

M2: To provide a learning ambience to enhance innovations, problem solving skills, leadership qualities, team-spirit and ethical responsibilities.

M3: To establish Industry Institute Interaction program to provide exposure of latest tools and technologies used in the IT organizations and enhance the entrepreneurship skills.

DEPARTMENT OF COMPUTING
FIVE YEAR INTEGRATED M.Sc. (DATA SCIENCE)
PROGRAMME OUTCOMES (POS)

Students in the M.Sc.(Data Science) should possess the following abilities:

PO1 : Develop mathematical models and their computational solutions to reason and interpret massive amount of data in wide range of domains.

PO2 : Collect and Analyze large quantities of data to discover new knowledge pattern and facilitate decision making.

PO3 : Apply techniques and tools of data science to design and develop the systems for analyzing the rapidly growing data in the fields of medicine, business, geosciences and scientific research.

PO4 : Develop scalable techniques for data analysis and decision making in many areas, including machine learning, algorithms, statistics, operations research, databases, complexity analysis, visualization, and privacy and security.

PO5 : Communicate effectively with decision makers to derive intelligent analytical systems.

PO6 : Work with professional, and ethical values.

PO7 : Understand and solve legal and security issues of analytical applications.

PO8 : Recognize the importance of research to develop leading innovative analytical products.

PO9 : Self learning and adaptation to the emerging technologies to address the challenging issues.

DEPARTMENT OF COMPUTING
FIVE YEAR INTEGRATED M.Sc. (DATA SCIENCE)
PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Our Graduates will:

PEO 1 : **Expertise in Analytical solution :** Be uniquely positioned to pioneer new
developments in the data science field, and to be leaders in industry, the public sector, and academia

PEO 2 : **Research :** Promote research in the development of leading innovative products

PEO 3 : **Leadership :** Inspire and guide the groups they work with in bringing their ideas to
fruition, with managerial skills, self-assurance and integrity

PEO 4 : **Social Responsibility :** commit to social ethical and professional responsibilities

PEO 5 : **Life-long Learning :** Participate in life-long learning to enhance knowledge and skills
necessary to contribute to the betterment of profession

PEO 6 : **Entrepreneurship :** Become Successful entrepreneurs with the strong business
managerial skills

Coimbatore Institute of Technology, Coimbatore - 14.

(Government Aided Autonomous Institution Affiliated to Anna University)

Department of Computing

M. Sc. DATA SCIENCE

CHOICE BASED CREDIT SYSTEM

Five year Integrated Programme

Curriculum for the Academic Year 2021 – 2026

Semester 1

Subject code	Name of the Subject	L	T	P	C	CAT
	THEORY					
21MDS11	Technical English	2	0	0	2	HS
21MDS12	Algebra and Applications	3	1	0	4	BS
21MDS13	Statistical Methods	3	0	0	3	PC
21MDS14	Problem Solving and Programming in Python	3	0	0	3	PC
21MDS15	Principles of Digital Electronics	3	0	0	3	PC
	PRACTICALS					
21MDS16	Computing Laboratory I	0	0	4	2	PC
21MDS17	Programming Laboratory in Python	0	0	4	2	PC
21MDS18	Digital Electronics Laboratory	0	0	4	2	PC
21MDS19	English for Employability	0	0	2	1	EEC
	Total Credits				**22**	

Semester 2

Subject code	Name of the Subject	L	T	P	C	CAT
	THEORY					
	Language Elective	2	0	0	2	HS

Subject code	Subject Name	L	T	P	C	CAT
21MDS21	Calculus and Applications	3	1	0	4	BS
21MDS22	Probability Distributions and Applications	3	0	0	3	PC
21MDS23	Data Structures and Algorithms I	3	0	0	3	PC
21MDS24	Object Oriented Programming	3	0	0	3	PC
	PRACTICALS					
21MDS25	Computing Laboratory II	0	0	4	2	PC
21MDS26	Data Structures and Algorithms Laboratory I	0	0	4	2	PC
21MDS27	Object Oriented Programming Laboratory	0	0	4	2	PC
21MDS28	Employability Skills	0	0	2	1	EEC
	Total Credits				**22**	

Semester 3

Subject code	Subject Name	L	T	P	C	CAT
	THEORY					
21MDS31	Business Statistics	3	0	0	3	PC
21MDS32	Discrete Structures and Automata Theory	3	0	0	3	PC
21MDS33	Operating Systems	3	0	0	3	PC
21MDS34	Database Systems	3	0	0	3	PC
21MDS35	Data Structures and Algorithms II	3	0	0	3	PC
	PRACTICALS					
21MDS36	Database Systems Laboratory	0	0	4	2	PC
21MDS37	Data Structures and Algorithms Laboratory II	0	0	4	2	PC
21MDS38	Web Technology Framework Laboratory	0	0	4	2	PC
	Total Credits				**21**	

Semester 4

Subject code	Subject Name	L	T	P	C	CAT
	THEORY					

21MDS41	Multivariate Data Analysis	3	0	0	3	PC
21MDS42	Graph Theory	3	0	0	3	PC
21MDS43	Design and Analysis of Algorithms	3	0	0	3	PC
21MDS44	Computer Networks	3	0	0	3	PC
21MDS45	Machine Learning	3	0	0	3	PC
	PRACTICALS					
21MDS46	Predictive Analytics Laboratory	0	0	4	2	PC
21MDS47	Design and Analysis of Algorithms Laboratory	0	0	4	2	PC
21MDS48	Machine Learning Laboratory	0	0	4	2	PC
21MDS49	Personality Development	0	0	2	1	EEC
	Total Credits				**22**	

Semester 5

Subject code	Subject Name	L	T	P	C	CAT
	THEORY					
21MDS51	Operations Research	3	0	0	3	PC
21MDS52	Deep Learning	3	0	0	3	PC
21MDS53	Big Data Computing	3	0	0	3	PC
21MDS54	Artificial Intelligence	3	0	0	3	PC
	Elective - I	3	0	0	3	PE
	PRACTICALS					
21MDS55	Deep Learning Laboratory	0	0	4	2	PC
21MDS56	Big Data Computing Laboratory	0	0	4	2	PC
	Elective Lab - I	0	0	4	2	PE
21MDS57	Communication Skills	0	0	2	1	EEC
	Total Credits				**22**	

Semester 6

Subject code	Subject Name	L	T	P	C	CAT
	THEORY					
21MDS61	Stochastic Models	3	0	0	3	PC
21MDS62	Cloud Computing	3	0	0	3	PC
21MDS63	Data Mining	3	0	0	3	PC
21MDS64	Software Engineering	3	0	0	3	PC
	Elective- II	3	0	0	3	PE
	PRACTICALS					
21MDS65	Cloud Computing Laboratory	0	0	4	2	PC
21MDS66	Data Mining and Visualization Laboratory	0	0	4	2	PC
	Elective Lab - II	0	0	4	2	PE
21MDS67	Hackathon	0	0	2	1	EEC
	Total Credits				**22**	

Semester 7

Subject code	Subject Name	L	T	P	C	CAT
21MDS71	Project Work and Viva Voce-I	0	0	0	18	EEC
	Total Credits				**18**	

Semester 8

Subject code	Subject Name	L	T	P	C	CAT
	THEORY					
21MDS81	Data Privacy and Security Analytics	3	0	0	3	PC
21MDS82	Quantum Machine Learning	3	0	0	3	PC
21MDS83	Ethics in Data Science	3	0	0	3	PC

Subject code	Subject Name	L	T	P	C	CAT
	Elective - III	3	0	0	3	PE
	Elective - IV	3	0	0	3	PE
	PRACTICALS					
21MDS84	Data Privacy and Security Analytics Laboratory	0	0	4	2	PC
21MDS85	Quantum Machine Learning Laboratory	0	0	4	2	PC
	Elective Lab - III	0	0	4	2	PE
	Total Credits				**21**	

Semester 9

Subject code	Subject Name	L	T	P	C	CAT
	THEORY					
21MDS91	Econometric Analysis	3	1	0	4	PC
21MDS92	Web Analytics	3	0	0	3	PC
21MDS93	Healthcare Analytics	3	1	0	4	PC
	Elective - V	3	0	0	3	PE
	Elective - VI	3	0	0	3	PE
	PRACTICALS					
21MDS94	Econometric Analysis Laboratory	0	0	4	2	PE
21MDS95	Web Analytics Laboratory	0	0	4	2	PE
	Elective Lab - IV	0	0	4	2	PE
	Total Credits				**23**	

Semester 10

Subject code	Subject Name	L	T	P	C	CAT
21MDS101	Project Work and Viva Voce- II	0	0	0	18	EEC
	Total Credits				**18**	
Grand Total of Credits					**211**	

Language Elective

Subject code	Subject Name	L	T	P	C	CAT
21MDSLE01	Professional English	2	0	0	2	HS
19FYG21	Basic German	2	0	0	2	HS
19FYF21	Basic French	2	0	0	2	HS

Professional Electives

Subject code	Subject Name	L	T	P	C	CAT
Data Analytics and Intelligent Systems Stream						
21MDSE1	Business Intelligence	3	0	0	3	PE
21MDSE2	Natural Language Processing	3	0	0	3	PE
21MDSE3	Computational Intelligence	3	0	0	3	PE
21MDSE4	Geographical Information Analysis	3	0	0	3	PE
21MDSE5	Robotic Process Automation	3	0	0	3	PE
21MDSE6	Machine Learning in Inudstry 4.0	3	0	0	3	PE
21MDSE7	Cyber Security Analytics	3	0	0	3	PE
21MDSE8	Knowledge Engineering	3	0	0	3	PE
21MDSE9	Recommender System	3	0	0	3	PE
21MDSE10	Social Network Analysis	3	0	0	3	PE
21MDSE11	Human Resource Analytics	3	0	0	3	PE
21MDSE12	Marketing Analytics	3	0	0	3	PE
21MDSE13	Data Analytics Software Development	3	0	0	3	PE
21MDSE14	Financial Analytics	3	0	0	3	PE
Technology Stream						
21MDSE15	GPU Computing	3	0	0	3	PE
21MDSE16	Mobile Application Development	3	0	0	3	PE

21MDSE17	Blockchain Technology	3	0	0	3	PE
21MDSE18	Internet of Things	3	0	0	3	PE
21MDSE19	Fog and Edge Computing	3	0	0	3	PE
21MDSE20	Augmented and Virtual Reality	3	0	0	3	PE
21MDSE21	Design Thinking	3	0	0	3	PE
21MDSE22	Enterprise Computing	3	0	0	3	PE
21MDSE23	Business Process Management	3	0	0	3	PE
21MDSE24	Software Architecture and Design Patterns	3	0	0	3	PE

Professional Electives Labs

Subject code	Subject Name	L	T	P	C	CAT
21MDSEL1	Business Intelligence Laboratory	0	0	4	2	PE
21MDSEL2	Natural Language Processing Laboratory	0	0	4	2	PE
21MDSEL3	Computational Intelligence Laboratory	0	0	4	2	PE
21MDSEL4	Geographical Information Analysis Laboratory	0	0	4	2	PE
21MDSEL5	Internet of Things Laboratory	0	0	4	2	PE
21MDSEL6	Robotic Process Automation Laboratory	0	0	4	2	PE
21MDSEL7	Mobile Application Development Laboratory	0	0	4	2	PE
21MDSEL8	Blockchain Technology Laboratory	0	0	4	2	PE
21MDSEL9	Enterprise Computing Laboratory	0	0	4	2	PE

CAT - Category, BS - Basic Sciences, HS - Humanities and Social Sciences,

ES - Engineering Sciences, PC - Professional Core, PE - Professional Elective,

EEC - Employability Enhancement Course, MC - Mandatory Course

21MDS11 – TECHNICAL ENGLISH

L	T	P	C
2	0	0	2

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Given a social context compose appropriate dialogues using functional words, Construct Descriptive paragraphs using sequencing words and unity of thought*
- *Given a communication context, categorize the barriers to communication and formulate solution Plan and present a 15 minute presentation on technical topic.*
- *Given short conversations and monologues for listening, specify appropriate responses and construct a summary.*
- *Interpret the given technical graphical representation and compose passages. Summarize and paraphrase technical text sin about 250 to 300 words.*
- *Apply the rules of the grammar viz, word formation, nouns, adjectives, adverbs, tenses, concord, phrasal verbs and idioms and use appropriate patterns in the given sentence.*

FOCUS ON LANGUAGE: GRAMMAR & VOCABULARY

Changing Words from one form to another - Word Formation: Prefixes & Suffixes - Synonyms and Antonyms – Idioms - Phrasal Verbs – Nouns-Compound Nouns & Noun Phrases - Gerunds & Infinitives – Subject-verb Agreement- Tenses – Adjectives - Expressions of Quantity - Degrees of Comparison – Relative Clause – Modal Verbs – Wh Questions – Sequence Words.   (6)

TECHNICAL COMMUNICATION

Importance of Technical Communication- General and Technical Communication –Objective & Characteristics of Technical Communication – Process of Communication - Levels of Communication – Flow of Communication –Visual Aids in Technical Communication - Barriers to Communication: Noise – Classification of Barriers –Non-verbal Communication: Kinesics – Proxemics- Chronemics- Correlating Verbal and Non-verbal Communication- Cultural Variations.(4)

READING

Reading & Interpreting Ideas - Interpreting Graphics in Technical Writing – Intensive & Extensive Reading- Reading Comprehension – Techniques for Good Comprehension – Skimming & Scanning – Sequencing of Sentences-   Reading text on different topics.   (4)

WRITING

Techniques for Good Writing - Right Words and Phrases – Sentences: Sentence Patterns- Salient Point of Sentence Construction - Paragraph Construction – Paragraph Patterns – Kinds of Paragraph – Writing a First Draft, Revising & Finalizing - Steps to Effective Précis Writing – Process Description – Dialogue Writing – Essays.

(6)

LISTENING

 Meaning and Art of Listening-Importance of Listening & Empathy in Communication – Reasons for Poor Listening – Traits of a good listener – Listening modes – Short Dialogues and Conversation-Listening to monologues.   (4)

SPEAKING

Introducing oneself – Exchanging personal information – Asking for and giving information – Expressing likes and dislikes – Making requests – Agreeing and Refusing Requests – Complaining, apologizing – Giving excuses, instructions and suggestions- Describing positive and negative features, favourite snacks, vacation plans, technology, holidays, festivals, customs and special events - – Making comparisons – Talking about food – giving step by step instructions, travel advice - - Achieving Confidence, Clarity & Fluency – Vocal Cues - Barriers to Speaking – Types of Speaking – Persuasive Speaking – Public Speaking - Effective Presentation Strategies – Planning - Outlining & Structuring – Nuances of Delivery – Controlling Nervousness & Stage Fright – Visual Aids in Presentation – Applications of MS Power Point.   (6)

TOTAL : 30

TEXT BOOKS

1. Jack C Richerds, "Interchange - 2", CUP, Fourth Edition, Chennai, 2015.
2. Meenakshi Raman, Sangeeta Sharma, "Technical Communication – Principles and Practice", Oxford University Press, New Delhi, 2015.

EXTENSIVE READING

1. Abhijit Acharjee & Rakesh Ramamoorthy, "Frontiers of Communication – An Anthology of Short Stories and Prose", CUP, 2018. (Only Essay Questions)

REFERENCE BOOKS

1. Sudharshana N. P & Savitha C, "English for Technical Communication", CUP, 2016.
2. Sudharshana N. P & Savitha C, "English for Engineers", CUP, 2018.
3. Ronald Carter, Michael Mc Carthy. "Cambridge Grammar of English", CambridgeUniversity Press, 2011.
4. Michael Mc Carthy and Felicity O'Dell, "English Vocabulary in Use", Cambridge University Press, 2012.
5. Mark Ibbotson. "Cambridge English for Engineering" Cambridge University Press, 2012.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1					H	L			
CO2					H	M			
CO3					H				
CO4					H				
CO5					H				

21MDS12 – ALGEBRA AND APPLICATIONS

L	T	P	C
3	1	0	4

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Describe the knowledge gained on sequences and apply them in financial mathematics*
- *Describe the linear algebra concepts and apply them appropriately*
- *Apply the concepts of matrices, eigen values and eigen vectors in economics, population biology and computer graphics*
- *Apply difference equation ideas in data modelling*

SEQUENCES, SERIES AND ALGEBRAIC EQUATIONS
Convergence and divergence of infinite series-series of positive terms-comparison, ratio, root and Raabe's tests-alternating series-Leibnitz test Expansions and summations using Binominal-exponential and logarithmic series. Applications of series in financial mathematics: Simple and Compound Interest-Nominal and Effective Interest Rates-Continuous Compounding –Future Value and Present Value-Annuities- Ordinary Annuity: Future and Present Value, Annuity Payment, Principal Sum, Period and Interest Rate , Annuity Due, Deferred Annuity and Perpetuity. Roots of algebraic and transcendental equations using Graeffe's and Newton-Raphson method. Real World Applications of Newton Raphson Method: Finding the Break Even Point of a Firm and finding the interest rates of Annuities.

(12)

LINEAR ALGEBRA
Definition of vector spaces-linearly dependent and independent-subspaces-basis and dimension-of vector space-rank and nullityof linear transformation. Inner product, properties- Cauchy Schwarz-inequality, norm and its properties, introduction of orthogonalbasis and Gram-Schmidt orthogonalization process.   (6)

MATRICES
Eigenvalues and eigenvectors-properties-Cayley-Hamilton theorem (without proof)-Eigendecomposition and Diagonalization- Cholesky Decomposition-Quadratic form reduction in threevariables-applications.

APPLICATIONS OF MATRICES
Matrix factorization techniques-special matrices-permutation matrix (non negative elements)-Hessenberg matrix-sparse matrixsparsematrix-band width-Linear system of equations-Gauss elimination-Gauss Jordan-Inverse of a matrix-Gauss-seidal-iterationmethod. Application of Linear systems: A homogeneous system in economics- non homogenous system by inversion-Applications of Matrices in Input-Output Analysis in Economics. Leslie's Population Growth Model, Homogeneous Coordinates and their applications to Computer Graphics.   (12)

INTERPOLATION AND DIFFERENCE EQUATIONS

Finite differences-operators and their interrelations-Interpolations-Newton's and Lagrange's method-Solutions of finite differenceequations with constant coefficients-Solution of first order equation (Iterative Method)-General method of solving first orderdifference equation-simple applications in economics.   (9)

THEORY : 45

TUTORIAL : 15

TOTAL : 60

TEXT BOOKS

1. *Srimanta pal and Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press India, 1st Edition, 2015.*
2. *David. C. Lay, "Linear Algebra and its Applications", Addision Wesley, 2003.*
3. *Mehta B.C, and G.M.K. Madani, "Mathematics for Economists", Sultan Chand & Sons, New Delhi, 2006. (Para III)*
4. *M.P.Deisenroth, A.A. Faisal and C.S.Ong. "Mathematics for Machine Learning", Cambridge University Press, 2019.*

REFERENCE BOOKS

1. *Ahmad NazriWahidudin, "Financial Mathematics and Its Applications", Ventus Publishing ApS,ISBN 978-87-7681-928-6, 2011.*
2. *David C Lay "Linear Algebra and its Applications", Fourth edition Pearson 2012.*
3. *R.A.Barnett, M.R.Ziegler and K.E.Bylen, Calculus for Business, Economics, Life Sciences and Social Sciences, 12th Edition, Prentice Hall, 2011.*
4. *L.D.Hoffman and G.L.Bradley, Calculus for Business, Economics and the Social and Life Sciences, 10th Edition, McGraw Hill, Higher Education, 2010.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	M						L	L
CO2	H	M						L	L
CO3	H	M						L	L
CO4	H	M						L	L
CO5	H	M						L	L

21MDS13 - STATISTICAL METHODS

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Achieve good skills in presentation and summarization of data using statistical tool*
- *Apply basic concepts in probability theory to data and derive useful measures for easy interpretation of the probability structure of data*
- *Describe the knowledge gained in sampling and various methods of sampling from population data*
- *Understand the meaning of association between two variables and use regression analysis in prediction.*

DATA TYPES AND SCALES
Structured and Unstructured Data-Cross-Sectional, TimeSeries, and Panel Data-Types of Data Measurement Scales: Nominal, Ordinal, Interval and Ratio Scale-Raw data and grouped data – Primary and secondary data – Methods of collection –Classification of data – Tabulation –frequency distribution- **Data visualization**: **Charts:** Scatter Plot, Bar Chart- Pie Chart, Coxcomb Chart-**Graphs:-**Histogram, Frequency Polygon and Curve, Ogive curves and histograms-Stem and Leaf plot. (7)

SUMMARY STATISTICS
MEASURES OF CENTRAL TENDENCY-Arithmetic Mean (AM) -weighted arithmetic mean, median, mode, Geometric Mean (GM) and Harmonic Mean (HM) - Merits, demerits and uses-Relationship between mean, median and mode-Relationship AM, GM and HM, computation of the measures for grouped and ungrouped data -Percentile, Decile and Quartile.
MEASURES OF DISPERSION-range, mean deviation and standard deviation – coefficient of variation and its use- Inter Quartile Range (IQR)-Outliers-Box Whisker Plot and its uses- Treemap–Measures of shape - Skewness and Kurtosis and their uses.

(8)

PROBABILITY
*[**Review** of basic concepts of probability, addition theorem, conditional probability and multiplication theorem- random variables: discrete and continuous, probability mass function and probability density function and cumulative distribution function]*
Bayes's Theorem and its applications– Moments of a random variable-raw and central moments. Mathematical expectation-mean and variance – Inequalities: Markov, Chebyshev, Chernoff, Jensen and Cauchy-Schwarz -Important discrete distributions-Discrete Uniform Distribution, Binomial, Poisson, -The Poisson approximation to the Binomial- Continuous distributions: Continuous Uniform Distribution and Normal distribution, its properties and applications-The Normal approximation to the Binomial-Normal Probability Plot andQ-Q plot.

(15)

SAMPLING

Population and sample- sampling and its need –sampling vs complete enumeration –parameter and statistics-Probability sampling and –random sampling- simple random sampling, lottery method and random number table method- stratified random sampling-sampling distribution and standard error of a statistic. Bootstrap sampling.

(7)

CORRELATION AND REGRESSION

Standardisation of variables-Methods: Z-score, 0-1 scale(min-max scale), standard deviation method and range method-Definition of correlation - Scatter plot –Karl Pearson's correlation coefficient its properties– Definition of Regression – Simple regression-Regression of x on y and y on x - fitting regression equation by the method of least squares-properties of regression coefficients -Spearman's rank correlation coefficient-Multiple regression with two independent variables-Multiple and Partial correlation coefficients in three variables and their properties.

(8)

TOTAL : 45

TEXT BOOKS

1. *U.Dinesh Kumar. Business Analytics, Wiley India Pvt. Ltd., 4435-36/7, Ansari Road, Daryaganj, New Delhi-110002, 2017.*
2. *Walpole, R. E., Myers, R. H. Myers R. S. L. and Ye. K, "Probability and Statistics for Engineers and Scientists", Ninth Edition, Prentice Hall, Delhi, 2002.*

REFERENCE BOOKS

1. *Michael Baron, "Probability and Statistics for Computer Scientists", 2nd edition, CRC Press.*
2. *Gupta,S.C. – "Fundamentals of Statistics", 7th revised and enlarged edition, - Himalaya Publishing House, New Delhi, 2013.*
3. *Peter Bruce and Andrew Bruce. Practical Statistics for Data Scientists, O'Reilly Media, Inc., 1005 Gravenstein Highway North,Sebastopol, CA 95472, 2017.*
4. *Gun, A.M., Gupta, M.K. and B. Dasgupta, "Fundamentals of Statistics", Vol.1.World Press, Kolkatta, 2013.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H	H	H					
CO2	H	H	H	H					
CO3	H	H	H	H					
CO4	H	H	H	H					
CO5									

21MDS14 -PROBLEM SOLVING AND PROGRAMMING IN PYTHON

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Develop algorithmic solutions to simple computational problems*
- *Write and execute simple python programs*
- *Decompose python program into functions*
- *Represent compound data using Python lists, tuples, dictionaries*
- *Read and write data from/to files in Python programs*
- *Create GUI application*

ALGORITHMIC PROBLEM SOLVING

General problem - solving concepts - Problem solving concepts for computers – Algorithms - Flowchart - Pseudocode. Programming concepts - Structured programming concepts -Programming methodologies viz. top-down and bottom-up programming.

(8)

INTRODUCTION TO PYTHON

Python in real world - Installing Python-Running Python. Numbers-Strings and Variables.Lists – Tuples - Dictionaries, Set.

(10)

CODING STRUCTURE

Comment-Continuation-Comparing if., elif - Repeat with while-Iterating with for-Functions-Handle errors with try and except.

(10)

MODULES, PACKAGES, FILES

Modules - Importing modules - Creating a module-Packages. Working with file-file processing - Controlling I/O - Basic File/Directory management - Access and ownership - Manipulating file paths.

(10)

USER INTERFACE

Date and Time - Regular Expressions - Graphical User Interface. (7)

TOTAL: 45

TEXT BOOKS

1. Maureen Sprankle, "Problem Solving and Programming Concepts", Seventh Edition. [Para 1].
2. Bill Lubanovic, "Introducing Python: Modern Computing in Simple Packages", First Edition, O'Reilly Media, 2014. [Para 2,3].
3. Martin C. Brown, "Python the Complete Reference", Paperback, 2018. [Para 4].
4. R. Nageswara Rao, "Core Python Programming", Paperback, 2018. [Para 5].

REFERENCE BOOKS:

1. John V Guttag, "Introduction to computation and programming using python", MIT Press, 3rd Edition, 2013.
2. Yashavant Kanetkar, "Let Us Python", 2019.
3. Code Quickly, "Learn Python Quickly: A Complete Beginner's Guide to Learning Python, Even If You're New to Programming (Crash Course with Hands-On Project)", Paperback, March 22, 2020.
4. Nichola Lacey, "Python by Example: Learning to Program in 150 Challenges", Cambridge University Press, 1st Edition, 2019.
5. Dr. Charles R. Severance, "Python for Everybody Exploring Data Using Python 3", 2016.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	L	L	H	H	M			
CO2	M	M	H	H	M	M	L	M	
CO3	H	M	M	H	M	M	M	M	
CO4	M	M	M	H	M	M	M	M	
CO5	H	M	M	H	M	M	M	M	

21MDS15 -PRINCIPLES OF DIGITAL ELECTRONICS

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Ability to understand the elements of digital system abstractions such as digital representations of information, digital logic, and Boolean algebra*
- *Identify basic requirements for a design application*
- *Evaluate combinational and sequential logic designs using various metrics: switching speed, throughput/latency, and gate count*
- *Create gate level implementations of sequential/ combinational logic function.*
- *Design and develop digital logic for real time applications.*

NUMBER SYSTEMS AND CODES

Introduction - Decimal, Binary, Octal and Hexadecimal base conversions-BCD (8421) code - Gray code and conversion- ASCII code – Error detecting and correcting codes: parity, CRC and Hamming code.

(9)

BINARY ARITHMETIC

Unsigned and signed numbers - 1's, 2's, 9's, 10's, 15's, 16's Complement representation - 1's and 2's Complement Binary subtraction - BCD addition - 9's and 10's BCD subtraction - Binary Multiplication and Division.

(9)

BOOLEAN ALGEBRA AND LOGIC GATES

Introduction - Basic theorems and postulates - Boolean function - Canonical and Standard forms - Minimization of Boolean expression - Karnaugh Map and Quine Mc-Cluskey Method - Basic logic gates - truth tables - Applications.

(9)

COMBINATIONAL AND SEQUENTIAL LOGICS

Introduction - Combinational logic: Half Adder and Full Adder, Half Subtractor and Full Subtractor - Encoder and Decoder – 4X1 Multiplexer and 1X4 Demultiplexer, Sequential logic: Latches and Flip Flops – Types of flipflops - Clocked RS,JK, T and D Flip-Flops.

(9)

COUNTERS AND REGISTERS

Introduction to Asynchronous and Synchronous counters - 4 bit Up counter – 4 bit Down counter - Mod n counter - Parallel / Serial In / Out Shift Registers - Ring Counter.

(9)

TOTAL : 45

TEXT BOOKS

1. Anil K. Maini, "Digital Electronics Principles, Devices and Applications", John Wiley & Sons Ltd, 2007.
2. A.P.Godse,"Digital Electronics", Technical Publications, Pune, 2009.

REFERENCE BOOKS

1. Morris Mano.M., "Digital Logic and Computer Design", PHI, 2001.
2. Malvino PA and Leach BP, "Digital Principles and Applications", McGraw Hill Book Company, 5th Edition, 1994.
3. Thomas C Bartee, "Digital Computer Fundamentals", McGraw Hill Book Company, 6th Edition, 1997.
4. Thomas L Floyd, "Digital Fundamentals", UBS, 10th Edition, 2008.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	M	M						L
CO2	M	M	H						
CO3	H	M		L					
CO4	H	L		M					
CO5	H	H		M			L		

21MDS16 - COMPUTING LABORATORY I

L	T	P	C
0	0	4	2

PRE-REQUISITES
> 21MDS12, 21MDS13

ASSESSMENT : PRACTICALS

COURSE OUTCOMES

- *Solve problems in linear algebra using Scilab scripts and commands.*
- *Measures of central tendency and dispersion using MS-Excel's in built functions.*
- *Generate graphical and diagrammatic representation of statistical data using MS-Excel's tools.*
- *Bivariate data using MS-Excel's Data Analysis Tools.*
- *Write script files and analyze data using Scilab and MS-Excel's Data AnalysisPack.*
- *Compute annuities and solve input-output models and Leslie's population growth models.*

TOPICS TO BE COVERED
1. Scilab Fundamentals.
2. Algebraic operations on matrices Transpose of a matrix, Determinants, inverse of matrix.
3. Computation of annuities, present and future values using Excel
4. Solving System of linear equations and consistency.
5. Applications to Input-Output models
6. Row reduced echelon form and normal form.
7. Eigen values, Eigen vectors, Rank of a matrix.
8. Applications of Leslie population growth model
9. Solving algebraic and system of equations.
10. Estimating numerical values for given data by means of interpolation.
11. Perform data manipulation using excel.
12. Perform graphical and diagrammatic representation of statistical data, like bar diagram, pie, histogram and line diagram.
13. Construct the pivotal tables and apply statistical functions to calculate the descriptive statistics.
14. Practice the theory behind the descriptive statistics, like measures of central tendency, dispersion, skewness and kurtosis.
15. Apply and Implement the theory of probability in various applications.
16. Simple probability and random sampling.
17. Practicing the simple correlation and regression techniques.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	M	M	M					
CO2	M	M	M	M					
CO3	M	M	M	M					
CO4	M	M	M	M					
CO5	H	M	H	H					

21MDS17 - PROGRAMMING LABORATORY IN PYTHON

L	T	P	C
0	0	4	2

PRE-REQUISITES
21MDS14

ASSESSMENT : PRACTICALS

COURSE OUTCOMES

- *Write, test and debug simple python programs*
- *Implement Python programs with conditionals and loops*
- *Develop Python programs with functions*
- *Use Python lists, tuples, dictionaries for representing compound data.*
- *Read and write data from/to files in Python.*
- *Create GUI based applications*

CONCEPTS TO BE COVERED

1. Steps in problem solving –drawing flowchart using Raptor Tool
2. Introduction to Python, Demo on IDE, Keywords, Identifiers and I/O statements.
3. Simple programs in Python
4. Operations and Expressions in Python
5. Algorithmic approach 1: Sequential
6. Algorithmic approach 2: Selection (if,elif,if…else,nested if else)
7. Algorithmic approach 3: Iteration (while and for)
8. Strings and its Operations
9. List and its operations
10. Dictionaries: operations
11. Tuples and its operations
12. Functions, Recursions
13. Files and its operations with command line arguments.
14. Date and Time manipulation
15. Creating User Interface for applications

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	L	L	H	H	M			
CO2	M	M	H	H	M	M	L	M	
CO3	H	M	M	H	M	M	M	M	
CO4	M	M	M	H	M	M	M	M	
CO5	H	M	M	H	M	M	M	M	

21MDS18 - DIGITAL ELECTRONICS LABORATORY

L	T	P	C
0	0	4	2

PRE-REQUISITES
21MDS15

ASSESSMENT : PRACTICALS

COURSE OUTCOMES

- *To emulate and understand the internal working of arithmetical, relational and logical circuits inside computer systems.*
- *To familiarize digital data processing and storage through combinational and sequential logic.*
- *To Demonstrate serial and parallel data operations using shift registers and counters.*
- *To comply data encryption and decryption methods using encoding and decoding.*
- *To implement low level to high level digital computer systems using combinational and sequential logic.*

CONCEPTS TO BE COVERED

1. Study of logic gates.
2. Study of Flip-Flops.
3. Design of binary counter & decade counter.
4. Construction of Half-adder & Full-adder.
5. Implementation of basic Logic gates using Universal gates.
6. Testing Left shift, Right shift and Parallel-In, Parallel-Out operation of the Shift registers.
7. Multiplexing and Demultiplexing.
8. Encoding and decoding.
9. Conversion of binary into gray and gray into binary.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H		M	M					
CO2	M		M	L					
CO3	M		L	M					
CO4	M	L							L
CO5	H	M		L					

21MDS19 -ENGLISH FOR EMPLOYABILITY

L	T	P	C
0	0	2	1

PRE-REQUISITES
Consent of the Instructor

COURSE OUTCOMES

- *Given strictly timed objective questions on logical sequence of words, sequential order of things, comparison, and sentence correction, solve within the given time.*
- *For a given specific speaking task on topics like JAM, Describing an object, book review and extempore generate ideas and speak confidently.*
- *For a given social situation viz., Travel and Transport, complaining, giving instructions, advising and sympathizing, requesting and warning people, communicate effectively to peer using appropriate functional language.*

UNIT – 1

Ice Breakers - Just a Minute - Book Reviews - Describing an object – Extempore – Paraphrasing.

(6)

UNIT – II

Spoken English - Travel and Transport, Complaining - Giving Instructions, Advising and Sympathizing – Requesting and warning people

(4)

UNIT – III

Logical Sequence of Words- Exercises - Sequential Order of Things - Comparison Type Questions – Introduction and Exercises - Idioms and Phrases - Types and Exercises Vocabulary through Mythology - One word Substitutes, Word Power Exercises - Common Errors in English - Sentence Correction.

(7)

UNIT – IV

Activity based on newspaper articles - Vocabulary – Homophones and Homonyms - Reading Prose – Reading Comprehension Activity

(3)

UNIT – V

Professional Communication - Mock Group Discussion – Mock Interview – Telephoning Skills – Personality Development Activities.

(10)

TOTAL : 30

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1					H				
CO2					H				
CO3					H				
CO4									
CO5									

21MDSLE01 - PROFESSIONAL ENGLISH

PRE-REQUISITES
Consent of the Instructor

L	T	P	C
2	0	0	2

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Apply the rules of grammar namely Active and Passive voice, Direct and Indirect speech, Purpose and Function, Articles and Prepositions, Conjunction, Conditional sentences and use suitable patterns in a given sentence or passage.*

- *Construct appropriate responses to greet, transfer, place the caller on hold, enquires, callbacks, unintentional disconnects, interruptions, using suitable language and telephoning etiquettes. Given a business communication scenario construct a suitable strategy and action plan using specific negotiation tactics consistent with the objectives of the negotiator.*

- *Given a communication context, specify the type and barriers to listening, provide solutions and justify. For a given passage note the important points and summarize it.*

- *Given a business communication scenario, compose a Business Letters, Memo, Emails, Reports, Technical Proposals, Instructions and Recommendation and checklist using appropriate language and format. For a given job requirement, prepare a job application letter with resume.*

- *For a given HR topic, generate valid points for and against the topic and present them with appropriate group behavior. For any job requirement, plan and prepare for a 20min HR mock interview.*

FOCUS ON LANGUAGE: ENGLISH GRAMMAR & VOCABULARY

One Word Substitutes – Homophones – Homonyms – Eponyms – Direct Indirect Speech – Active Passive Voice – Conditional Sentences – Adverbs – Conjunctions – Prepositions – Articles – Relative Clause – Pronouns – Cause and Effect Expressions – Purpose and Function – Modals

(6)

BUSINESS ENGLISH

Telephoning Skills: Understanding Telephone communication – Telephonic Conversations and Etiquettes - Handling Calls – Leaving a Message – Making Requests –Asking for and Giving Information – Giving Instructions - Negotiations: Types of Negotiation –Six Basic Steps of Negotiations – Informal and formal Negotiations

(4)

READING

Summarizing – SQ3R Reading Technique – Note Making: Outline/Linear Method- Sentence Method – Schematic/Mapping Method – Understanding Discourse Coherence – Cloze Comprehension – Critical Reading: Creative and Critical Thinking- Reading proverbs, online advice forum

(4)

WRITING

Letter Writing – Business Letters – Cover Letters – Resumes – Memos – Emails – Reports – Technical Proposals – Instructions & Recommendations – Technical Description – Checklist - Writing a paragraph – Writing a description of a person's past present and future, recent experiences, movie review, list of roles – Writing a job application letter, Advice column list - Writing a guide book introduction – Writing about people response to a survey

(6)

LISTENING

Stress and Intonation -Types of Listening – Barriers of Effective Listening – Listening for Generic Content and Specific Information - Listening & Note Taking – Intensive Listening - Listening to Descriptions - Listening to predicaments, call in radio show and excuses

(4)

SPEAKING

Group Communication: Forms of Group Communication – Using Body Language in Group – Discussions – Group Discussions - Organizational GD – GD as a Part of Selection Process – Meetings – Conferences – Symposia & Seminars – Interviews: Objectives of Interviews – Types of Interviews – Job Interviews – Media Interviews – Press Conference - Describing abilities and Skills, acceptable and prohibited behaviour in different situations, Personality Traits, Countries, a predicament, Recent past events and experiences, movies and books – Giving Advice and suggestions- Making polite requests – Making invitations and excuses- Speculating about past and future events. (6)

TOTAL : 30

TEXT BOOKS

1. Jack C Richerds, "Interchange - 2", CUP, Fourth Edition, Chennai, 2015.
2. Meenakshi Raman, Sangeeta Sharma, "Technical Communication – Principles and Practice", Oxford University Press, New Delhi, 2015, 2015.

REFERENCE BOOKS

1. Sudharshana N. P & Savitha C, "English for Technical Communication", CUP, 2016.
2. Sudharshana N. P & Savitha C, "English for Engineers", CUP, 2018.
3. Ronald Carter, Michael Mc Carthy. "Cambridge Grammar of English" Cambridge University Press, 2011.
4. Michael Mc Carthy and Felicity O'Dell, "English Vocabulary in Use", Cambridge University Press, 2012.
5. Mark Ibbotson. "Cambridge English for Engineering" Cambridge University Press, 2012.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1					H				
CO2					H	L			
CO3					H	M			
CO4					H	M			
CO5					H	H			

19FYG21 - BASIC GERMAN

	L	T	P	C
	2	0	1	2

PRE-REQUISITES
Consent of the Instructor

ASSESMENT: THEORY

COURSE OUTCOMES

At the end of the semester the students will:

- *Understand the basics of the Language*
- *Write simple narration and description and speak to communicate idea.*
- *Demonstrate confidence in Social Interactions.*

EINFUHRUNG

BegrUung - Name - Vorname - Familienname - Anrede   (5)

THEMA

Hallo !Wiegeht's?
Begegnungen
Guten Tag, ichsuche…,
ImSupermarkt
Arbeit und Freizeit
Familie und Haushalt   (7)

GRAMMATIK-I

Position des Verbs : Aussage, W - Frage und
Ja/Nein - Frage; Artikel die der das.
W - Frage; Konjugation in Prasens;
Nominativ : bestimmter, unbestimmter und negative Artikel
Akkusativ : unbestimmterundnegativerArtikel
Adjektive : Akkusativ-Erganzung   (10)

GRAMMATIK-II

ArtikelalsPronomen Dative - Erganzung : Personalpronomen und Ortsangaben;
ImperativModalverben; Ortsangaben; Richtungsangaben; Zeitangaben; OrdinalzahlenPossessiv -
Artikel; trennbare und nicht trennbareVerben; Wechselprapositionen

                                                                      (8)

                                                        TOTAL : 30

TEXT BOOK

1. *Studio d A1: Kurs - und Ubungsbuch (Deutsch alsFremdsprache) CornelsenVerlag.*

REFERENCE BOOK

1. *Tangarmaktuell1 :Kursbuch + Arbeitsbuch (Deutsch alsFremdsprache) Max HueberVerlag.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1					H	M			
CO2					H	M			L
CO3					H	M			L

19FYF21 - BASIC FRENCH

	L	T	P	C
	2	0	1	2

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES

At the end of the semester the students will:

- *Understand the basics of the Language*
- *Write simple narration and description and speak to communicate idea.*
- *Demonstrate confidence in Social Interactions.*

INTRODUCTION (2)

UNITÉ-1
Faire connaissance - inviter etrépondre à une invitation - décrire les personnes- articles définis et indéfinis - genre etnombre des noms et des adjectifs- interrogation et négation - conjugaison du présent. Paris monuments et lieux publics - la vie de quatreparisiens de professions différentes.
(7)

UNITÉ-2

Exprimer l' ordreetl'obligation demander et commander - evaluer et apprécier- féliciter et remercier - articles partitifs -adjectifsdémonstratifs et possessifsprépositions et adverbes de quantité et de l'imperatifverbespronominaux - unerégiondeFrance la Bourgogne - vie quotidienne à la compagne.
(6)

UNITÉ-3

Raconteretrapporter - donner son avis - se plaindre et réprimander - expliquer et justifier - pronomscompléments -futurproche - passé composé et imparfait. Plusieursrégions de France – différentsuniverssociaux. (7)

UNITÉ-4

Demander l'autorisation - interdire - formuler des projects - discuteretdébattre. Pronoms< en >et< y > - pronomsrelatifs et superlatifs - conjugaison du futur - présentcontinu et passé récent.La vie administrativeetrégionale - problems economiques et écologiques - traditions et modernité.
(8)

TOTAL : 30

TEXT BOOK

1. *Le Nouveau Sans Frontières - Philippe Dominique, Jacky GirardetMichèleVerdelhan, Michel Verdelhan*

REFERENCE BOOKS

1. *Dondo Modern French Course ---MathurinDondo*
2. *Modern French Grammar---Margaret Lang and Isabelle Perez.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1					H	M			
CO2					H	M			L
CO3					H	M			L

21MDS21 – CALCULUS AND APPLICATIONS

L	T	P	C
3	1	0	4

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

- *To incorporate the essentials of differential calculus and its applications.*
- *To provide various applications of integral calculus in business and economics.*
- *To describe the concepts of ordinary and partial differential equations, Fourier Series and methods of solving them.*
- *To provide good knowledge in experimental data analysis.*

DIFFERENTIAL CALCULUS

Definition of limit and derivative of a function. Applications to marginal analysis in Business and Economics-Approximations by increments- Relative Rate of Change and Elasticity of Demand-Maxima and Minima of function of single variables –Applications to Optimization of area and perimeter, Relation between Average Cost and Marginal Cost, Maximizing Revenue and Profit and Inventory Control. Functions of Several Variables-Partial Derivatives- Homogeneous functions and Euler's Theorem-Optimization of functions of two variables-Constrained Optimization using Lagrange Multipliers- Significance of Lagrange Multiplier--Optimisation of functions of several variables using Hessian matrix. (12)

INTEGRAL CALCULUS

 Integration as a process of Summation and geometrical meaning-Applications-Beta and Gamma Functions- Application of single integrals- Area between two curves and finding the Net Excess Profit-Application to study Lorenz Curves in Economics –Computing Gini Index-Average Value of a function using integration and its interpretations-Useful life of a machine-Future and Present Value of an Income Flow- -Consumer Willingness to Spend-Consumers' and Producer's Surplus –- Double and triple integrals- Changing the order of integration -Applications of Double and triple integrals – Area and Volume. (10)

ORDINARY DIFFERENTIAL EQUATIONS

 Formation of differential equations-geometrical interpretation of ODE- Higher order differential equations with constant coefficients- Euler Cauchy type-Applications in micro economics. (5)

PARTIAL DIFFERENTIAL EQUATIONS:

Basic Concepts and Solutions of first order Equations-Linear Partial Differential Equations of Second Order with constant coefficients- Classifications-Hyperbolic, Parabolic and Elliptic – Solutions-**Fourier Series:** Dirichlet's conditions-Full range series-Half range series-Complex form of series-Parseval's identity -Harmonic analysis. (9)

EXPERIMENTAL DATA ANALYSIS

Curve fitting: Least Square Method. **Interpolation:** Newton's method - Lagrange's method. **Numerical Differentiation:** Application to Maxima and Minima of functions. **Numerical Integration:** Trapezoidal rule- Simpson's 1/3rd rule. Applications to area, volume and linear motion. **Numerical Solutions of Ordinary Differential Equations**: Taylor's Series – RungeKutta Fourth order methods – Milne's Predictor – Corrector Method. (9)

THEORY : 45
TUTORIAL : 15
TOTAL : 60

TEXT BOOKS

1. *L.D.Hoffman and G.L.Bradley, Calculus for Business, Economics and the Social and   Life Sciences, 10th Edition, McGraw Hill, Higher Education, 2010.*
2. *Mehta B.C, and G.M.K. Madani, Mathematics for Economists, Sultan Chand & Sons,   New Delhi, 2006.*
3. *Shepley L.Ross. Differential Equations. John Wiley and Sons, Third Edition, 2004.*
4. *Sankara Rao.K. Numerical Methods for Scientists and Engineers, Prentice Hal of India, New Delhi, 2001.*

REFERENCE BOOKS

1. *Thomas & Finney, " Calculus", Pearson education, 9th Edition, 2006.*
2. *Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons Asia Private Limited., 2008.*
3. *Grewal, B.S., "Higher Engineering Mathematics", 4th Edition, Khanna Publishers, 2007.*
4. *Wylie C. R, Barret L. C, "Advanced Engineering Mathematics", 6th Edition, McGraw Hill, New York, 1995.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	L		M				L	L
CO2	H	L		M				L	L
CO3	H	L		M				L	L
CO4	H	L		M				L	L

21MDS22 - PROBABILITY DISTRIBUTIONS AND APPLICATIONS

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES
Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Apply various discrete and continuous probability distributions to data and also situations where they can be applied*
- *Apply moment generating functions in understanding various properties of random variables*
- *Become familiar with various methods in statistical inference and he can independently apply many statistical tests to make inferences on the properties of both discrete and continuous types of data.*
- *Describe the concepts of Bayesian inference.*

PROBABILITY DISTRIBUTIONS-DISCRETE

Geometric distribution-its memory less property, negative binomial distribution, Hyper-geometric distributions-The Binomial Approximation to the Hyper-geometric distribution, multinomial distribution. **Continuous**: exponential distribution and its memory-less property, gamma, Beta, Chi-square log normal distributions and Weibull distributions –applications and their properties.

(9)

FUNCTIONS OF RANDOM VARIABLES

Moments and Moment Generating functions –properties-MGF of important distributions-Transformations of Variables (using Jacobians) and finding their distributions -method of direct transformation and method of moment generating functions- Joint and Marginal Probability mass functions(for discrete) and density functions(for continuous) for two and more than two random variables. Conditional probability distributions-conditional mean and variance-Covariance of random variables-Statistically independent random variables-mean and variance of linear combination of random variables. (9)

ESTIMATION

Estimation of parameters using method of moments-Maximum Likelihood Point Estimation(MLE) – Properties of estimators-Unbiasedness, minimum variance, efficiency and sufficiency -Mean Square Error-Asymptotic properties-consistency-Fisher Information and Cramer-Rao's Inequality – Interval Estimation –Interpretation-Confidence interval for mean when variance is i) known and ii) unknown and determination of sample size-Concept of a Large-Sample Confidence Interval-Prediction Intervals. (9)

SAMPLING AND TESTS OF HYPOTHESIS

Population and sample –Sampling distribution of a statistic-Derivation of sampling distribution of mean and S^2- t-distribution and F-distribution-Central limit theorems- Test of significance – Basic

concepts – null hypothesis – alternative hypothesis – level of significance – Standard error and its importance – steps in testing-One and two tailed tests-The use of p-values for Decision making – Large sample tests and Small sample tests for : Single sample: Testing on a single mean with variance known and variance unknown-Two samples-tests on means –One sample test on a single proportion-two sample tests of two proportions-Goodness of Fit tests, One and two sample tests concerning variances-Tests of independence for categorical data, tests for homogeneity-testing of correlation coefficient and regression coefficients. (9)

BAYESIAN ESTIMATION

Bayesian Inferences-Prior and posterior distributions-Point Estimation Using the Posterior Distribution- Bayesian Interval Estimation-Bayes Estimates using Decision Theory framework: Bayes estimate under squared error loss function and absolute error loss function.

(9)

TOTAL : 45

TEXT BOOKS

1. Ronald E.Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability & Statistics for Engineers & Scientists, Ninth Edition, Prentice Hall, Delhi, 2002.
2. Michael Baron, "Probability and Statistics for Computer Scientists", 2nd edition, CRC Press, 2014.

REFERENCE BOOKS

1. U.Dinesh Kumar. Business Analytics. Wiley India Pvt. Ltd., 4435-36/7, Ansari Road, Daryaganj, New Delhi-110002, 2017.
2. Sheldon Ross. Probability and Statistics for Engineers and Scientists, Elsevier Academic Press, 2009.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	L	L	L					
CO2	H	L	L	L					
CO3	H	H	H	H			M	M	M
CO4	H	H	H	H			M	M	M
CO5	H	M	M	M			L	L	L

21MDS23 - DATA STRUCTURES AND ALGORITHMS I

PRE-REQUISITES

21MDS14

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Emphasize the importance of data structures in developing and implementing efficient algorithms.*
- *Describe how the basic data structures are represented in memory and used by algorithm.*
- *Understand the linear data structures such as stacks, queues and their applications.*
- *Assess how the choice of data structures and algorithm design methods impacts the performance of programs.*
- *Design and implement sorting and searching algorithms.*

BASIC CONCEPTS

Definition of an Algorithm -Basic Steps in Development of an Algorithm - Algorithm analysis – Functions used- Asymptotic Analysis **-** Analyzing Recursive Algorithms - Designing Recursive Algorithms. (9)

ARRAYS

Low-Level Arrays - Dynamic Arrays and Amortization - Efficiency of Python's Sequence Types - Using Array-Based Sequences - Multidimensional Data Sets. (9)

STACKS AND QUEUES

Stacks - The Stack Abstract Data Type - Simple Array-Based Stack Implementation - Reversing Data Using a Stack - Matching Parentheses and HTML Tags.
Queues - The Queue Abstract Data Type - Array-Based Queue Implementation - Using an Array

Circularly **-** Double-Ended Queues. (9)

LINKEDLISTS

Singly Linked Lists - Circularly Linked Lists - Doubly Linked Lists - The Positional List ADT -

Sorting a Positional List - Link-Based vs. Array-Based Sequences. (9)

SORTING

Introduction -Insertion Sort, Quick Sort, Merge Sort, Heap Sort, Radix Sort.

SEARCH STRATEGIES

Linear Search-Binary Search. (9)

TOTAL : 45

TEXT BOOK

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser , *"Data Structures and Algorithms in Python", Wiley publications, 2013.*

REFERENCE BOOKS

1. *Rance D. Necaise, "Data Structures and Algorithms using Python ",Wiley publications, 2013.*
2. *Ellis Horowitz & SartajSahani, "Fundamentals of Data Structures", Galgotia Publications, 1994.*
3. *Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivert, Clifford Stein "Introduction to Algorithms", Second Edition, Prentice Hall of India, Publications, New Delhi, 2007.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		M		L	M				
CO2		H	M	L					
CO3	M		M	L					
CO4				H					L
CO5	M	M	M	L					

21MDS24 – OBJECT ORIENTED PROGRAMMING

L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT :THEORY

COURSE OUTCOMES

- *To describe Object Oriented Programming concepts and basic characteristics of Java*
- *To depict the principles of packages, exception handling and String handling*
- *To design and develop applications using inheritance and interfaces*
- *To develop data structure concepts using collections*
- *To develop a java application with threads and build simple Graphical User Interfaces*

INTRODUCTION

Introduction to object oriented programming Paradigm- Introduction – Evolution of Higher Level Languages – Complexity of softwares and their Attributes - object oriented programming Paradigm - Introduction to Java Language – Evolution – Salient Features – Java, Internet and World Wide Web – The Java Environment The Java Language Preliminaries   (7)

FUNDAMENTALS, OBJECTS AND CLASSES

Fundamental Programming Structures in Java – Objects and Classes – Object Construction – Packages - String Handling – String Constructors, String Length, Character Extractions, String Comparison, Searching, Modifying and Joining Strings, String Buffer   (7)

EXCEPTIONS, ASSERTIONS AND LOGGING

Exceptions : Dealing with errors, Catching Exceptions , Using Assertions, try, catch, throw, throws and finally   (7)

INHERITANCE

Classes, superclasses and subclasses – Object : The cosmic superclass – Generic Array List – Object Wrappers and Autoboxing – Method with a variable number of parameters – Enumeration Classes – Constructors – Method Overloading – Method overriding – Constructor overloading – Constructor overriding
Interfaces - Lambda Expressions and Inner Classes – Abstract class – final class, method and variable.   (10)

COLLECTIONS

The Java Collections Framework, Interfaces in the Collections Framework, Concrete Collections, Maps, Views and Wrappers, Converting between collections and Arrays   (7)

CONCURRENCY and EVENT DRIVEN PROGRAMMING

Concurrency: Threads – Thread States – Thread Properties – Synchronization Database Connectivity: JDBC, Introduction to Servlet and Java Server Page.   (7)

TOTAL : 45

TEXT BOOKS

1. *Object Oriented Programming with Java, By M. T. Somashekara, D. S. Guru, K. S. Manjunatha , Prentice Hall India Pvt., Limited , June 2017 (Para – I).*
2. *Core Java Volume I—Fundamentals, Cay.S.Horstmann, 11th Edition, Pearson Education , 2018.*
3. *Herbert Schildt - Java: The Complete Reference, Eleventh Edition McGraw Hill Education, 2018.*

(Para IV).

REFERENCE BOOKS

1. *Effective Java, Joshua Bloch, Third Edition, Addison-Wesley Publications, 2018.*
2. *Herbert Schildt - Java: A Beginner's Guide, 8th Edition, McGraw Hill Education, 2018.*
3. *Core and Advanced Java, Black Book. Dreamtech Press, 2018.*
4. *Paul Deitel, Harvey Deitel, ―Java SE 8 for programmers‖, 3rd Edition, Pearson, 2015.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1				M					
CO2				M		L			
CO3	M			M		L			
CO4	M			M		L			
CO5	M			M		L			

21MDS25 - COMPUTING LABORATORY II

Contact Hours

PRE-REQUISITES

21MDS21, 21MDS22

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICALS

COURSE OUTCOMES

- *Solve problems using R*
- *Understand properties of probability distributions and to perform statistical tests using MS-Excel, R*
- *Perform numerical methods using command in R*
- *Perform Hypothesis testing using MS-Excel and commands in R*

1. Basic commands in R for matrix operations, plotting of functions data storage and retrieval
2. Developing script files in R
3. Probability Distributions using MS-Excel and R
    Using functions in MS-Excel and R to calculate the probabilities and inverse probabilities and cumulative distribution functions for
    i)   Binomial, Poisson, Normal,
    ii)   Geometric, Negative Binomial and Hypergeometric distributions
    iii)   exponential, gamma, beta and
    iv)   normal and lognormal distributions
    v)   t, F, Chi-square distributions
4. **Hypothesis testing Using MS-Excel's Data Analysis Pack and R**
    i) Testing Single mean, difference between two means large samples- Z test
    ii) Testing Single mean, difference between two means small samples- t- test
    iii) Single proportion, Difference between two proportions
    iv) Chi-square for i) goodness of fit and ii) independence of attributes
    v) Equality of Variances
5. **Numerical methods using R**
    i)   Numerical differentiation:
    ii)   Numerical Integration: Trapezoidal rule and Simpson's 1/3 rule
    iii)   Curve fitting: Linear, quadratic, polynomial and exponential
    iv)   Numerical solution of ordinary differential equations using Runge-Kutta 4th order method

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	M	M	M					
CO2	M	H	H	M					
CO3	H	M	L	L					

21MDS26 - DATA STRUCTURES AND ALGORITHMS LABORATORY I

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITES

21MDS17, 21MDS23

ASSESSMENT: PRACTICALS

COURSE OUTCOMES

- *Selection and application of suitable data structures in implementing practical problems.*
- *Demonstrate the abstract properties of various data structures such as stacks, queues and linked list.*
- *Trace and code recursive methods and compare with iterative methods*
- *Apply sorting algorithms that suit the given problem statement.*
- *Demonstrate understanding of linear and binary search algorithms*

APPLICATIONS OF THE FOLLOWING DATA STRUCTURE CONSTRUCTS

1. Sparse and dense Matrix operations using arrays.
2. Stacks using array representation.
3. Evaluate a given postfix expression using stacks.
4. Conversion of infix expression to postfix expression and evaluation.
5. Queues, circular queue and double ended queue using array representation.
6. Linked Lists: Singly linked, doubly linked and Circular lists and applications.
7. Linked Stacks.
8. Linked Queues.
9. Expression Processing.
10. Sorting algorithms-Insertion sort, Merge sort, Quick sort, Heap sort, Radixsort.
11. Searching algorithms-Linear search, Binary search.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	M	H	H					
CO2	M	H	M	M					
CO3		H	M						
CO4			M	M					
CO5	L	M							

21MDS27 – OBJECT ORIENTED PROGRAMMING LABORATORY

Contact Hours

PRE-REQUISITES

21MDS24

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICALS

COURSE OUTCOMES

- *Given software requirements, design an object oriented software solution by discovering appropriate classes and objects and identifying attributes, behaviour and hierarchy among the classes.*
- *Write java programs by employing the object oriented constructs of inheritance and polymorphism for a given software requirement*
- *For a given software solution, organize the application programs into packages and prepare a deployable application*
- *Generate robust java applications for a given user requirements by employing applicable object oriented concepts and handling all possible exceptions*
- *Design and develop interactive three tier applications using Servlets, JSP and JDBC for the given user specifications*

CONCEPTS TO BE COVERED

1. Design use case models and class models using UML notations
2. Creating Classes and Objects using different types of functions
3. Programs using Constructor and Destructor
4. Count the number of objects created for a class using static member function
5. Write programs using Inheritance
6. Write programs to implement Polymorphism
7. Create programs to implement Runtime Polymorphism using Abstract Class and Interface
8. Develop programs for the given scenario using Packages and implement suitable Exception handling mechanisms.
9. Devise problems to implement Multithreading concepts
10. Write programs to choose and implement appropriate Collections for the given scenario
11. Develop a web application using JSP as front end, servlets as controllers and connect it with a database using JDBC connectivity.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M					L			
CO2	M					L			
CO3	M					L			
CO4	M,					L			
CO5	M					L			

21MDS28 – EMPLOYABILITY SKILLS

L	T	P	C
0	0	2	1

PRE-REQUISITES
Consent of the Instructor

COURSE OUTCOMES

- *Solve timed objective question on logical reasoning and verbal ability.*
- *Generate ideas and speak confidently, for a given specific speaking task on topics like describing a picture, movie reviews, storytelling, and extempore.*
- *Use appropriate functional expressions, for a given social situation viz., greeting, thanking, congratulating, apologizing and giving directions.*
- *Produce language structures accurately and fluently, for a given 2 to 5 minutes speaking activity like extempore and Debate. Prepare a power point presentation for 15 minutes, for a given technical topic.*
- *Specify appropriate responses and construct a summary for given short conversations and monologues for listening. Construct dialogues for a given social scenario, interpret the given graphic information and write creative paragraphs.*

UNIT – 1

Self Introduction - Barriers to Speaking and Listening - Introduction to Spoken English, Greetings, Thanking - Apologizing, Congratulating - Giving Directions, Shopping – Role Play.   (6)

UNIT – II

Activity based on newspaper articles - Word Building - A picture and a few words activity - Current Events.   (4)

UNIT – III

Alphabet test – Alphabet Order, Alphabet Series - Letter Word Problem, Word Formation and Scramble - Series Completion –Para Jumbles- Synonyms and Antonyms- Types and Exercises- Sentence Completion –Types and Exercises.   (8)

UNIT – IV

Reading Comprehension- Skimming and Scanning - Reading Prose – Bacon's Essays (Speaking Activity based on the essays) - Story Building- Extempore - Movie Reviews.   (4)

UNIT – V

Speech Sounds - Word Vocabulary - Reading Comprehension - Listening Practice- I -Dialogue

Writing - Conversational Exercise – I - Focus on Language - Creative Writing - Conversational Exercise – II - Listening Practice – II. (8)

TOTAL : 30

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1					H				
CO2					H	L			
CO3					H	M			
CO4					H	M			
CO5					H				L

21MDS31 – BUSINESS STATISTICS

PRE- REQUISITES

21MDS13, 21MDS22

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOMES

- *Compute Various Index Numbers used in Economics and Business*
- *Apply Statistical methods and Decision Analysis tools to analyze data from time series and Business*
- *Prepare Control Charts for variables and attributes using data from economics*
- *Analyze Data from Statistical Experiments using appropriate Statistical Design of Experiment like CRD, RBD, LSDetc*
- *Analyze Data using Non-parametric methods*

INDEX NUMBERS

Definition, characteristics and uses of Index Numbers-Types of Index Numbers-Price, quantity and value indices- Simple and weighted aggregate index numbers – Laspeyre, Paasche, Marshell – Edgeworth, Fisher's Ideal Index Numbers-Tests of adequacy of Index Numbers-Problems in the construction   of   Index   Numbers   and   Consumer   Price Index.   **(9)**

TIME SERIES AND FORECASTING

Definition- Time Series. Components- -Time series decomposition models: multiplicative and additive models –Forecasting error-measurement using Mean Absolute Deviation(MAD), Mean Absolute Percentage Error (MAPE),   Mean Squared Error(MSE) and Root Mean Square Error (RMSE)- Smoothing Techniques: Naïve forecasting , moving averages and weighted moving averages-Exponential smoothing –Simple and double Exponential Smoothing- Trend analysis- linear, quadratic and exponential trend-Seasonal Effects-Decomposition methods: method of simple averages, ratio to trend method and ratio to moving average method-Measurement of cyclic and irregular variations. Auto Regressive Models-Fitting and identifying suitable order-Auto correlations and partial auto correlations.   **(10)**

STATISTICAL QUALITY CONTROL AND DECISION ANALYSIS

Nature of Control Limits-Purpose of Control Charts-Control Charts for Variables-Control Charts for Attributes-Cusum Control Charts.

Decision making under certainty: Analytic Hierarchy Process   - Decision making under risk: Expected value criteria, Expected value of perfect information   - Decision making under uncertainty-Criteria of Optimism, Pessimism, Regret, Laplace and Hurwicz-Decision Tree.   **(10)**

DESIGNS OF EXPERIMENTS

Analysis of Variance (ANOVA) technique-Design of experiments – basic concepts – treatment – experimental unit –experimental error - basic principle – replication, randomization and local control- One way Analysis of Variance: Completely Randomized Design- Randomized blocks design – description – layout – analysis-Latin Square Design-description-layout-analysis.

(9)

NON PARAMETRIC STATISTICS

Introduction to Nonparametric tests –Sign test – Signed Rank test-Rank-Sum test- Wilcoxon-Mann-Whitmey test (U test), Kruskal Wallis test-Runs test-Spearman's Rank correlation coefficient. **(7)**

TOTAL: 45

TEXT BOOKS

1. *Ken Black, Business Statistics for Contemporary Decision Making, 6th Edition, John Wiley &Sons.Inc, 2010 [Para 1,2,3 and 4]*
2. *R.P.Hooda, Statistics for Business and Economics, 5th Edition, Vikas Publishing House Pvt. Ltd., Noida, 2013 [Para 1]*
3. *Richard I. Levin, David S. Rubin, Statistics for Management, 7th Edition Pearson Education, 2011.[Para 2 and Para 3]*
4. *Ronald E.Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability and Statistics for Engineers and Scientists, 9th Edition, Prentice Hall,2012 [Para 3, 4 and 5]*

REFERENCE BOOKS

1. *D M Levine, M L Berensen, T C Krehbiel and P.K.Viswanathan- Business Statistics: A First Course, 5th Edition, Pearson Education, Delhi, India, 2011*
2. *Dinesh Kumar U. Business Analytics, Wiley, First Edition, 2017*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H								
CO2	H	M		L					
CO3	H								
CO4	H		M						
CO5	H		L						

21MDS32-DISCRETE STRUCTURES AND AUTOMATA THEORY

Contact Hours

PRE- REQUISITES

Consent of the Instructor

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Apply logical reasoning in verifying the correctness and validity of simple instances of valid logical arguments*
- *Identify to devise encoding and decoding procedures for error detection and correction in data transmission problems*
- *Classify in constructing system models which are the natural extension of automata that are used to devise decision procedures*
- *Analyze specification of languages using grammars*
- *Develop problems in automata types and turing machines*

MATHEMATICAL LOGIC

Connectives - Conditional and Biconditional statements - Statement formulae and Truth tables- Tautologies and tautological Implications - Normal forms - Disjunctive and Conjunctive Normal forms - The Predicate Calculus.   (7)

ALGEBRAIC STRUCTURES I

Introduction – Semigroups and Monoids – Grammars and language – Rings, Integral domains and fields - Properties Rings - Construction of finite fields-Irreducible Polynomials-Primitive element of a finite field- Primitive Irreducible Polynomials.   (8)

ALGEBRAIC STRUCTURES II

Residue arithmetic for Computers- Coding theory - Error Detection - Correction - Distance between Code words - Minimum distance and weight - Group Code , Linear Code and Cyclic code -Problems under Encoding and Decoding Techniques.   (8)

FINITE AUTOMATA AND GRAMMARS

Basic Machines : - Moore & Mealy Machine-Finite State Systems - Basic definitions - Transition diagrams- Deterministic & Nondeterministic Finite Automata -Regular Expressions- Equivalence of Finite Automata and Regular Expressions Grammars: Definition - Types - Leftmost , Rightmost Derivations-Syntax trees-Ambiguity.   (10)

PUSH DOWN AUTOMATA

Definitions - Deterministic & Non deterministic - Acceptance by empty stack and final state.

TURING MACHINES

Introduction - Turing machine - Types - Universal TM-Multiple TM - Multilevel TM -Offline TM-Halting problem - - Rice theorem - Linear bounded TM

(12)

TOTAL :45

TEXT BOOKS

1. *J.P.Tremblay, R. Manohar, "Discrete Mathematical structures with Applications to computer science", Tata McGraw - Hill, Edition, 1997 , Thirty Eighth reprint , 2010*
2. *Hopcroft J.E., Motwani R., Ullman J.D, " Introduction to Automata Theory, Languages and Computations" , Second Edition , Pearson Education , 2009.*
3. *Ralph P.Grimaidi, "Discrete and Combinatorial Mathematics: An Applied Introduction", Addison Wesley Publishing Company, Fifth Edition, Pearson Education, Second Impression , 2008.*

REFERENCE BOOKS

1. *Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw -Hill , Seventh Edition, 2012.*
2. *John C Martin , "Introduction to Languages and the Theory of Computation" , Third Edition , Tata McGraw Hill Publishing Company , New Delhi, Seventh reprint ,2010.*
3. *Mishra K.L.P, Chandrasekaran . N. "Theory of Computer Science: Automata, Languages and Computation", Prentice Hall of India , Third edition , 2008.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H								M
CO2	H					L			M
CO3	H					L			M
CO4	H								M
CO5	H					L			M

21MDS33 - OPERATING SYSTEMS

Contact Hours

PRE- REQUISITES

21MDS23

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Describe the basics of computer systems and Operating systems.*
- *Reveal Kernel Management for Inter Process Communication systems.*
- *Evaluate the system performance through scheduling algorithms - FIFO, round robin, priority, shortest job first.*
- *Recognize the memory allocation and deallocation for both static and dynamic storage.*
- *Describe the simple File System using Disk and File System Management of Windows Operating System.*

COMPUTER SYSTEMS OVERVIEW

Basic elements, Instruction Execution, Interrupts, The Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization.

INTRODUCTION TO OPERATING SYSTEM

Operating System Objectives and Functions, Evolution of Operating Systems.   (8)

PROCESS DESCRIPTION PROCESS DESCRIPTION AND CONTROL

Process states, Process description, Process control, Processes and threads, Types of Threads.

CONCURRENCY

Principles of Concurrency, Mutual Exclusion: Hardware support, Semaphores, Monitors.

Deadlock and Starvation: Principles of Deadlock, deadlock prevention, deadlock avoidance, deadlock detection. Windows 7 Concurrency Mechanisms.   (10)

MEMORY MANAGEMENT

Memory management requirements, Memory partitioning, Paging, Segmentation.

Virtual Memory: Hardware and Control Structures, Operating System Software, Windows Memory Management.   (12)

UNIPROCESSOR SCHEDULING

Types of Processor Scheduling, Scheduling Algorithms.   (6)

I/O MANAGEMENT, DISK SCHEDULING

I/O Devices, Organization of the I/O function, Operating System Design Issues, I/O buffering, Disk Scheduling, RAID, Windows I/O.

FILE MANAGEMENT

File Management : Overview, File Organization and Access, File directories, File sharing, Secondary Storage Management, Windows file system.   (9)

TOTAL : 45

TEXT BOOK

1. William Stallings, "Operating systems Internals and Design Principles", 7th edition, PHI, 2016.

REFERENCE BOOKS

1. Umakishore Ramachandran, William D. Leahy Jr., "Computer Systems: An Integrated Approach to Architecture and Operating
Systems", International Edition, Pearson, 2011.
2. Silberschatz A., Peterson J.L and Galvin P., "Operating System Concepts", John Wiley Publishing Company, 2002.
3. H.M.Deital, "An introduction to Operating System", Pearson Education, 2001
4. Morris Mano, "Computer System Architecture", Pearson Education,2014.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H		M				L		
CO2	H	H			M			L	
CO3	H	M			L				
CO4	M			H				L	
CO5			L			M			H

21MDS34 - DATABASE SYSTEMS

PRE- REQUISITES

Consent of the Instructor

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Describe the purpose and architecture of database systems from the perspective of persistent storage of real world data*
- *Analyse the problem statement, construct the Entity Relationship model and map it into relational model and conform the normal forms*
- *Generate Relational Algebra and SQL statements to perform queries of real-world applications and learns how transactions are performed*
- *Apply the concepts and techniques of NoSQL MongoDB in real world applications*
- *Understand and represent temporal and spatial data in real world applications*

INTRODUCTION TO DATABASES

Databases and Database Users: Introduction, Characteristics of the Database Approach – Actors – Advantages. Database system Concepts and Architecture: Data models, Schemas and Instances – Three schema architecture and Data Independence – Database Languages and Interfaces – DBMS Component Modules – Centralized and Client/Server Architecture – Classification of Database Management Systems –Relational Model Concepts, Constraints and Schemas.   **(7)**

DATABASE DESIGN AND NORMALIZATION

Database Application – Entity Types, Entity sets, Attributes and Keys – Relationship Types, Relationship Sets, Roles and Structural Constraints – Weak Entity Types – Refining the ER design – ER Diagrams, Naming Conventions – Enhanced Entity Relationship Model, ER and EER to Relational Mapping.

Normalization: Informal Design Guidelines – Functional Dependencies –Normal Forms based on Primary keys – General Definitions of 2NF and 3NF – BCNF – Inference rules, Equivalence, Minimal cover - Properties of Relational Decompositions.   **(10)**

STRUCTURED QUERY LANGUAGE AND TRANSACTION PROCESSING

SQL Data Definition and Data types – Constraints – Basic Queries – Complex Queries - Views – Triggers - Programming with PL/SQL - Relational Algebra – Unary Operations – Set Operations – Binary Operations – Additional Operations.

Transaction Processing: Introduction to Transaction Processing -   Need for Concurrency Control – Need for Recovery - Transaction states - Desirable properties of transaction   **(12)**

NOSQL DATABASES

Introduction to NOSQL Systems: Emergence of NOSQL, Characteristics of NOSQL, Categories of NOSQL – The CAP theorem – Document based NOSQL systems and Mongo DB – NOSQL Key-value stores – Column based NOSQL systems - Graph Databases and Neo4j.   **(8)**

SPATIAL AND TEMPORAL DATABASE

Temporal Database: Time representation, Incorporating time in Relational Databases, Temporal Querying constructs, Time series data.

Spatial Database: Representation, Design databases, Geographic data, spatial queries, Indexing of Spatial data.   **(8)**

TOTAL: 45

TEXT BOOKS

1. *Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2016. (Para 1-5)*
2. *Abraham Silberschatz, Henry F.Korth and S.Sudarshan, "Database System Concepts", Sixth Edition, McGraw Hill, 2006. (Para 5 – Spatial Database)*

REFERENCE BOOKS

1. *Bipin C Desai, "An Introduction to Database systems", Revised Edition, Galgotia Publications Pvt Ltd, 2012.*
2. *Date C.J, "An introduction to Database Systems" Eighth Edition, Pearson Education, 2003.*
3. *Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled A Brief Guide to the Emerging World of Polyglot Persistence", AddisonWesley, Reprint 2013.(Open Source Non Relational Databases, Implementation Of Non Relational Databases)*
4. *Brad Dayley, "Sams Teach Yourself NoSQL with MongoDB in 24 Hours", Pearson Education, 2015*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L	M	L	L					
CO2	H	M	H	H					M
CO3	H	M	H	H					M
CO4	H	H	H	H			M	M	H
CO5	H	H	H	H			M	M	H

21MDS35 - DATA STRUCTURES AND ALGORITHMS II

Contact Hours

PRE- REQUISITES

21MDS23

ASSESSMENT : THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOMES

- *Describe the organization and operations to access the data using the data structures such as binary and general tree structures, search trees, B-trees, Tries, graph , heaps, hash tables, AVL Tree, Multi way Tree .*
- *Select advanced data structures and algorithms for autonomous realization of simple programs or program parts.*
- *Recognize and apply advanced data structures to improve the performance of a problem.*
- *Formulate new solutions for programing problems or improve existing code using learned algorithms and data structures*

TREES - Preliminaries - Implementation of Trees - Tree Traversals with an Application. **BINARY TREES** – Definition - An Example: Expression Trees. **BINARY SEARCH TREES** -Searching – Insertion and deletion of elements – randomly built binary search trees- analysis. **AVL TREES** - Single rotation – double rotation - Splay trees   10)

MULTIWAY SEARCH TREES - B-Tree – Searching, insertion and deletion - B+ trees, B*-trees, Red Black trees - Tries
MULTIDIMENSIONAL SEARCH TREES - Range search -k-d trees-Quad trees – point data – R trees.   (10)

HASHING - Hash Function - Separate Chaining -Hash Tables without Linked Lists - Rehashin   (7)

HEAPS – Binary heap – Applications **-** d-Heaps- Leftist Heaps - Property and operations- Binomial heap   (9)

DATA STRUCTURES FOR DISJOINT SETS - Disjoint set operations-linked list representation of disjoint sets- disjoint set forests- path compression - analysis.
GRAPHS - Definition – Representations – Topological sort - Graph search methods (Breadth first and depth first traversals).   (9)

TOTAL : 45

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Fourth Edition , Addison-Wesley, 2014.

2. Thomas H. Cormen, Charles E. Leiserson and Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, MIT Press, 2012.

REFERENCE BOOKS:

1. Ellis Horowitz, Sartaj Sahani, "Fundamentals of Data Structures", Galgotia Publications, 1994.
2. Dinesh P. Mehta, Sartaj Sahni, " Handbook Of Data Structures And Applications", CHAPMAN & HALL/CRC, 2005

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		H	M	L					
CO2	H		M	M					L
CO3			H		M	M	M	L	
CO4				H	M			M	

21MDS36 – DATABASE SYSTEMS LABORATORY

<div align="right">

Contact Hours

</div>

PRE- REQUISITES

21MDS34

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

- *Design the conceptual data model as Entity Relationship diagram and create the database using DDL statements for a given application*
- *Formulate simple DML SQL queries to retrieve the required data for real world applications*
- *Generate DML queries with Subqueries, Joins, Group By, Order By and Aggregate functions to filter and aggregate the data of the real world applications*
- *Construct reusable PL/SQL blocks with Functions, Procedures, Packages, Triggers, Exception Handling, and Cursors*
- *Develop a database project by constructing the ER model, creating Tables and generating SQL and PL/SQL blocks using RDBMS platform*
- *Execute queries in NoSQL platform*

CONCEPTS TO BE COVERED

1. Design a database for an application and represent it through ER diagram

2. Create and manage tables

3. Execute basic SQL SELECT statements

4. Restricting and sorting data

5. Implement single row functions

6. Display data from multiple tables

7. Aggregating data using Group function, Group By

8. Working with Subqueries

9. Implement Views, Sequence, Index and Synonym

10. Perform SET operators, Date and Time functions

11. Write simple PL/SQL Programs

12. Implement Exception Handling, Cursors, Functions, Procedures, Package and Triggers

13. CRUD operations using MONGO DB

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	M	H	H			M	M	M
CO2	H	M	H	H					H
CO3	H	M	H	H					H
CO4	H	M	H	H			M	M	H
CO5	H	M	H	H			H	H	H
CO6	H	M	H	H			H	H	H

21MDS37 - DATA STRUCTURES AND ALGORITHMS LABORATORY II

Contact Hours

PRE- REQUISITES

21MDS26, 21MDS35

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

- *Apply tree data structures and its variants for real time applications.*
- *Select and apply suitable data structures in implementing practical problems.*
- *Identify suitable graph based algorithms and apply them for solving problems that arise in real world scenarios.*
- *Perform operations on heaps, for real time problems.*
- *Implement Hash Table techniques for a given application.*

CONCEPTS TO BE COVERED

1. Binary trees and its operations.
2. Applications of binary search tree and its operations.
3. AVL tree including all rotations.
4. B-tree and its operations.
5. Operations on Red Black trees.
6. Graphs - Breadth First Search, Depth First Search.
7. Construction of heap and its applications.
8. Implementation and analysis of Hash Table with collision handling.
9. Disjoint set operations and some applications.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	M	H	H					
CO2	H	M	H	H					
CO3	H	M	H	H					
CO4	H	M	H	H					
CO5	H	M	H	H					

21MDS38 – WEB TECHNOLOGY FRAMEWORK LABORATORY

Contact Hours

PRE- REQUISITES

Consent of the Instructor

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

- *Create responsive user interface web pages using HTML5, CSS, BOOTSTRAP, JSON and jQuery*
- *Employ Java Script for client side programming that uses a regular expression to validate form entry and processing.*
- *Develop simple web applications using R and SHINY.*
- *Design web applications using ReactJS and establish server side programming skills to work with Node framework.*
- *Design and develop fully functional web applications using Flask and Django.*

CONCEPTS TO BE COVERED

- Create interactive and responsive web pages using HTML5, CSS, BOOTSTRAP, JavaScript, JSON and jQuery.
- Develop an interactive web application using R, SHINY and MySQL.
- Working with REST API.
- Create an E-Commerce single page web application using ReactJS and implement CRUD operations using NodeJS with MySQL/MONGO DB.
- Develop a fully functional web application (prediction/recommendation systems) using Flask/Django.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L		H	H				H	H
CO2	L		H	H				H	H
CO3	L	M	H	H			H	H	H
CO4	L	M	H	H			H	H	H
CO5	L	M	H	H			H	H	H

21MDS41 – MULTI VARIATE DATA ANALYSIS

Contact Hours

PRE- REQUISITES

21MDS13, 21MDS22

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOMES

- *Analyze various properties like mean vector and variance-covariance matrix of multivariate data*
- *Formulate and compute multiple linear regression model and understand its properties*
- *Classify objects into different groups using discriminant function, logistic regression equation and cluster analysis techniques*
- *Identify underlying factors in multivariate data sets using principal component analysis and factor analysis*

MULTIVARIATE DATA

Variables in Multivariate Data-Mean Vector, Covariance and Correlation Matrices and their properties-Mean vectors and covariance matrices for subsets of variables–Sample properties of linear combination of variables-Estimation of missing values-Distance between vectors-Multivariate Normal Density-Visualization of multivariate data: The Scatter Plot Matrix and three dimensional plots.   **(9)**

MULTIPLE REGRESSION ANALYSIS(MLR)

Multiple Linear Regression Equation and Polynomial Regression Models- Estimation of the coefficients using method of least squares–Linear Regression using Matrices-Properties of Least Squares-Inferences in Multiple Linear Regression: ANOVA and testing the partial regression coefficients- Interpretation of R^2-Standardized Regression Coefficient and its interpretation-Inclusion of categorical or indicator variables in MLR –Multi-collinearity problem-Stepwise Regression   **(9)**

DISCRIMINATION AND CLASSIFICATION

Discriminant Function Analysis- Fisher's discriminant function. Logistic Regression: Logistic Model-Definitions of Odds and Logit-Estimation of the logistic regression coefficients-Making Predictions-Multiple Logistic Regression.   **(9)**

PRINCIPAL COMPONENT ANALYSIS AND FACTOR ANALYSIS

Data Reduction Techniques-Definition of Population Principal Components –Principal Components obtained by Standardized variables -Rules to retain number of Principal Components using Scree Plot-. Factor Analysis-Definitions-The Orthogonal Factor Model-Its Covariance Structure- Factor Loadings and Interpretations-Exploratory and Confirmatory Factor Analysis.   **(10)**

CLUSTER ANALYSIS

Definition-Measures of Similarity or Dissimilarity-Hierarchical Clustering Methods-Single linkage-Complete Linkage-Average Linkage-Centroid-Ward's Hierarchical Clustering Methods-Non-hierarchical Clustering Methods-K-means Method. **(8)**

TOTAL: 45

TEXT BOOKS

1. *Alvin C.Rencher Methods of Multivariate Analysis, 2nd Edition, Wiley Inter-science, 2002 [Para 1,Para 5]*
2. *R.E.Walpole,R.H.Myers,S.L.Myers and K.Ye, Probability and Statistics for Engineers and Scientists, 9th Edition, Prentice Hal, 2012 [Para 2]*
3. *Richard A.Johnson and Dean W.Wichern. Applied Multivariate Statistical Analysis, 6th Edition, Pearson Prentice Hall, 2007[Para 3 and Para 4]*

REFERENCE BOOK

1. *Joseph F. Hair Jr., William C. Black, Barry J.Babin and RolphE.Anderson, Multivariate Data Analysis, 7th Edition, Pearson, 2010.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H		M	M	M			M	L
CO2	M	L	H	L	H			L	M
CO3	H	H	H	M	L			H	L
CO4	H	M	L	H	M			H	M

21MDS42 - GRAPH THEORY

Contact Hours

PRE- REQUISITES

21MDS12, 21MDS23, 21MDS35

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOMES

- *Describe various fundamental terminologies of graph theory with Examples*
- *Categorize the Spanning trees, connectivity, circuits and planarity of graphs*
- *Apply matrices in studying properties of colouring and directed graphs*
- *Analyze various properties of graphs like connectedness, spanning trees and so on using algorithms including shortest path, DFS and planarity testing.*

INTRODUCTION

Graphs – Introduction – Isomorphism – Sub graphs – Walks, Paths, Circuits –

Connectedness – Components – Euler Graphs – Hamiltonian Paths and Circuits – Trees-
Properties of trees – Distance and Centers in Tree – Rooted and Binary Trees.   (9)

TREES, CONNECTIVITY, PLANARITY

Spanning trees – Fundamental Circuits – Spanning Trees in a Weighted Graph – CutSets – Properties of Cut Set – All Cut Sets – Fundamental Circuits and Cut Sets –Connectivity and Separability – Network flows – 1-Isomorphism – 2-Isomorphism –Combinational and Geometric Graphs – Planer Graphs – Different Representation of a Planer Graph.   (9)

MATRICES, COLOURING

Incidence matrix – Submatrices – Circuit Matrix – Path Matrix – Adjacency Matrix –Chromatic Number – Chromatic partitioning – Chromatic polynomial – Matching –Covering – Four Color Problem.   (9)

DIRECTED GRAPH

Directed Graphs – Types of Directed Graphs –Digraphs and Binary Relations – Directed Paths and Connectedness – Euler Graphs –Adjacency Matrix of a Digraph.   (9)

ALGORITHMS

Connectedness and Components – Spanning tree – Finding all Spanning Trees of a Graph – Set of Fundamental Circuits – Cut Vertices and Separability – Directed Circuits.   Shortest Path Algorithm – DFS – Planarity Testing – Isomorphism.

(9)

TOTAL : 45

TEXT BOOK

1.   *NarsinghDeo, Graph Theorywith Application to Engineering and Computer*

      Science,Prentice Hall of India, 2003.

REFERENCE BOOKS

1.   *R.J. Wilson, Introduction to Graph Theory, 4thEdition, Pearson Education, 2003.*

2.   *J.A.Bondy and U.S.R.Murty, Graph Theory with Applications,   Publishing, 1982.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	M	H					L	
CO2				H	M				L
CO3	M	H	L						
CO4	H	M	L		L			M	

21MDS43 - DESIGN AND ANALYSIS OF ALGORITHMS

Contact Hours

PRE- REQUISITES

21MDS23, 21MDS35

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOMES

- *Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem*
- *Enhance their expertise in algorithmic analysis and algorithm design techniques*
- *Comprehend and select algorithm design approaches in a problem specific manner to solve real world problems*
- *Select a proper pattern matching algorithm for given problem*
- *Extrapolate from them in order to apply those algorithms and techniques to solve problems*

DIVIDE AND CONQUER Merge sort - Integer multiplication, Strassen's matrix multiplication, Finding the Closest Pair of Points. (6)

GREEDY METHOD - Knapsack Problem ,Minimum cost spanning tree (Kruskal and Prim's algorithms) , Shortest Paths in a Graph **-** Dijkstra's Algorithm, Huffman codes and data compression.

DYNAMIC PROGRAMMING - Principles of dynamic programming – Multistage Graphs, all pairs shortest Paths, travelling salesman problem. (11)

BACKTRACKING - General Method - 8 Queens Problem – Sum of Subsets- Graph Coloring - Hamiltonian Cycles.

BRANCH AND BOUND - General Method - 0/1 Knapsack Problem - Traveling Salesperson Problem. (11)

STRING MATCHING: The naïve string-matching algorithm, Rabin-karp algorithm and analysis.

NETWORK FLOW: The Maximum-Flow Problem and the Ford-Fulkerson Algorithm , The Bipartite Matching Problem (10)

NP AND COMPUTATIONAL INTRACTABILITY: Basic concepts – Polynomial time reductions, satisfiability problem NP complete problems., NP Hard problem. (7)

TOTAL : 45

TEXT BOOKS

1. *Thomas H. Cormen, Charles E. Leiserson and Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms" , Third Edition , MIT Press, 2012.*
2. *Jon Kleinberg and Eve Tardos, "Algorithm Design", Pearson Education, 2013.*

REFERENCE BOOKS

1. *Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "Fundamental of Computer Algorithms", Galgotia Publications, 1998.*
2. *Michael T. Goodrich and Roberto Tamassia, "Algorithm Design, Foundations, Analysis, and Internet Examples", Wiley, 2014.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	M	M	H					
CO2	M	M	M	M					L
CO3	M	M	H	H					
CO4			M	M					
CO5			H	H					

21MDS44 - COMPUTER NETWORKS

Contact Hours

PRE- REQUISITES

Consent of the Instructor

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOMES

- *Comprehend the characteristics and applications of various networking technologies*
- *For a given network application, can identify the protocols involved at the various layers and demonstrate the role of the protocols*
- *For a given inter-network, find the best route to a destination by applying the various routing protocols*
- *Resolve various domain names in URLs*
- *Implement ML models for simple network problems*

INTRODUCTION

Uses of Computer Networks - Types of Computer Networks -Reference Models - Guided Transmission Media - Wireless Transmission (9)

DATA LINK LAYER

Data Link Layer Design Issues - Error Detection and Correction - Ethernet - Wireless LANs - Bluetooth (8)

NETWORK LAYER

Network Layer Design Issues - Routing Algorithms in Single Network - Internetworking - Software Defined Networking (8)

TRANSPORT LAYER AND APPLICATION LAYER

The Transport Service - Elements of Transport Protocols - Congestion Control - The Internet Transport Protocols: UDP, TCP. Application Layer: DNS - Electronic Mail - The World Wide Web - Streaming Audio and Video.
(13)

MACHINE LEARNING FOR NETWORKING

Introduction- Traffic- prediction, classification and routing, congestion control. (7)

TOTAL : 45

TEXT BOOKS

1. Andrew S. Tanenbaum, Nick Feamster, and David J. Wetherall, "Computer Networks", 6th Edition, Pearson Education, 2021.(Para 1- 5)
2. Raouf Boutaba, Mohammad A. Salahuddin, Noura Limam, Sara Ayoubi, Nashid Shahriar, Felipe Estrada-Solano,and Oscar M. Caicedo, "A comprehensive survey on machine learning for networking: evolution, applications and research opportunities", Boutaba et al. Journal of Internet Services and Applications (2018), https://doi.org/10.1186/s13174-018-0087-2. (Para – 5).
REFERENCE BOOKS

1. William Stallings, ―Data and Computer Communications, Pearson Education Ninth Edition, 2013
2. Larry L.Peterson and Bruce S. Davie, ―Computer Networks – A systems Approach Fifth Edition, Morgan Kaufmann Publishers, 2011
3. BehrouzA.Foruzan, ―Data Communication and Networking, Tata McGraw Hill, Fifth Edition, 2013

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1							H		L
CO2							H		M
CO3			L				H		M
CO4			M						M
CO5			M						M

21MDS45 - MACHINE LEARNING

Contact Hours

PRE- REQUISITES

21MDS13, 21MDS22, 21MDS31

ASSESSMENT: THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOMES

- *Describe the concepts, Methods and Applications of Machine Learning*
- *Apply the machine learning techniques like Bayesian, Decision theory, Parametric, Non-Parametric methods, reinforcement learning and Graphical Models to solve the real time analytical problems*
- *Compare the various machine learning techniques and choose the appropriate technique for the given problem*
- *Perform evaluation of learning algorithms and model selection.*

INTRODUCTION

Machine Learning -Examples of Machine Learning Applications- High-Performance Computing - Data Privacy and Security - Model Interpretability and Trust- Data Science- Supervised Learning - Bayesian Decision Theory.   (8)

PARAMETRIC METHODS

Maximum Likelihood Estimation - Bias and Variance - Bayes Estimator - Parametric Classification - Regression - Tuning Model - Model Selection Procedures - Multivariate Classification - Multivariate Regression.   (8)

NONPARAMETRIC METHODS

Nonparametric Density Estimation - Generalization to Multivariate Data - Nonparametric Classification - Condensed Nearest Neighbour - Distance-Based Classification - Outlier Detection - Nonparametric Regression - Smoothing Parameter.   (8)

DECISION TREES AND KERNAL MACHINES

Uni variate Trees - Pruning - Rule Extraction from Trees - Learning Rules from Data - Multivariate Trees - Ensemble learning - Bagging- Boosting- Random Forest Algorithm -Kernel Machines- SVM

(11)

GRAPHICAL MODEL AND REINFORCEMENT LEARNING

Graphical Models: Introduction-canonical cases for conditional independence-Examples of Graphical Models-Undirected Graphs.

Single State Case: K-Armed Bandit- Elements of Reinforcement Learning- Model-Based Learning Temporal Difference Learning - Generalization - Partially Observable States.   (10)

TEXT BOOKS

1. *Ethem Alpaydin, "Introduction to Machine Learning", The MIT Press Cambridge, Massachusetts London, Fourth edition, 2020 (para 1,2,3,4,5)*
2. *Kevin Patrick Murphy ,"Probabilistic Machine Learning: An Introduction", MIT Press, March 2022. (para -4, Kernel Machines, Ensemble Learning)*

REFERENCE BOOKS

1. *Machine Learning, Tom Mitchell, McGraw , 1997, 0-07-042807-7*
2. *Bishop, C. Pattern Recognition and Machine Learning. Berlin: Springer-Verlag, 2006.*

Course Outcomes(CO)	Programme Outcomes (PO)						
	PO1	PO2	PO3	PO4	PO5	PO8	PO9
CO1	H	M	L		L		L
CO2	M	M	H	H	M	M	M
CO3	M	M	H	H	H	M	M
CO4	M		M	L	H	M	M

21MDS46 - PREDICTIVE ANALYTICS LABORATORY

Contact Hours

PRE- REQUISITES

21MDS31, 21MDS41

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

- *Compute various Index Numbers used in Economics*
- *Analyze time series data and perform non parametric tests.*
- *Develop Shewhart Control charts for variables and attributes*
- *Analyze multivariate data using multiple linear regression, discriminant function, logistic regression equation models and cluster analysis tools*
- *Identify underlying factors in multivariate data by applying factor analysis and principal component analysis models*

CONCEPTS TO BE COVERED

1. Creation and access of the Data Sets.(Include Time Series Data Set).
2. Compute the descriptive statistics, variance-covariance and correlation matrix for given data.
3. Apply Principal Component Analysis and Factor Analysis to reduce the dimensions/features of the given dataset.
4. Compute index numbers such as Laspeyre, Paasche, Marshell – Edgeworth , Fisher's Ideal Index numbers
5. Apply Exponential Smoothing techniques, Trend Analysis techniques, Auto Correlation and Regression techniques to forecast the time series data generated for the system.
6. Analyse the given data for predicting the classes or numerical values using multiple linear regression, stepwise regression, logistic regression and multiple logistic regression techniques,
7. Apply Hierarchical and Non-Hierarchical(K-Means) methods to generate theclusters and allocate given input to the existing clusters.
8. Generate control charts for handling quality controls in statistical way.
9. Perform Non-parametric hypothesis tests using the techniques such as Sign test and Wilcoxon Signed Rank test

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H	H	H	M				
CO2	H	H	H	H	H	M	M	M	M
CO3	H	M	H	M	M				
CO4	H	H	H	H	H	M	M	M	M
CO5	H	H	H	H	H	M	M	M	M

21MDS47 - DESIGN AND ANALYSIS OF ALGORITHMS LABORATORY

Contact Hours

PRE- REQUISITES

L	T	P	C
0	0	4	2

21MDS26, 21MDS37, 21MDS43

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

- *Design, develop, and optimize the performance of divide-and-conquer algorithms, greedy, dynamic programming ,backtracking, and branch and bound algorithms*
- *Implement and empirically compare fundamental algorithms and data structures to real-world problems*
- *Effectively combine fundamental data structures and algorithmic techniques in building a complete algorithmic solution to a given problem*
- *Implement a proper pattern matching algorithm for given problem*

CONCEPTS TO BE COVERED

1. Problem using closest pair algorithm

2. Minimum cost spanning tree using Prims and .Kruskal's algorithm

3 Applications of all pairs shortest path problem

4. Application of N QUEENS using back tracking

5. TSP using branch – and – bound

6. String matching algorithms

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	M	H	H					
CO2	M	M	M	M					
CO3	H	M	H	H					
CO4			M	M					

21MDS48 - MACHINE LEARNING LABORATORY

Contact Hours

PRE- REQUISITES

21MDS45

L	T	P	C
0	0	4	2

ASSESSMENT: **PRACTICAL**

COURSE OUTCOMES

- *Apply various machine learning techniques to generate the analytic solutions*
- *Apply machine learning frameworks to build the learning models*
- *Evaluate the performance of machine learning models using performance metrics*
- *Identify the suitable machine learning model for the given problem*
- *Generate the Visualization model to present the insights of the data using the machine learning frameworks*

CONCEPTS TO BE COVERED

1. Develop Regression models to predict values for the real time system. Apply Cross Validation for evaluating the performance of the models.

2. Build classification models using the methods such as decision tree, Naïve Bayes Classifier, and k-Nearest neighbor Classifier. Evaluate the models using various performance metrics.

3. Implement Clustering and Dimensionality Reduction Methods. Compare the results of these two algorithms and comment on the quality of clustering.

4. Implement Ensemble methods for classification and regression problems.

5. Implement the non-parametric locally weighted regression algorithm to fit data points. select the appropriate data set for your experiment and draw graphs

6. Apply Machine Learning Frameworks such as Azure Machine Learning Workspace and Amazon Machine Learning Platform to build intelligent analytic solutions for real time analytical applications.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H	H	M	H	M	L	M	M
CO2	H	H	H	H	H	M	L	M	M
CO3	M	M	M	M				M	M
CO4	M	M	H	H	H		M	L	L
CO5	H	H	H	H	H	M	M	M	M

21MDS49 - PERSONALITY DEVELOPMENT

Contact Hours

PRE- REQUISITES

Consent of the Instructor

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

- *Ascertain the various concepts of Self like the Physical Self – Energy Self – Intellectual Self – Mental Self – Blissful Self with respect to the Western(Occidental) and Eastern(Oriental) theories of the Self and Personality Development.*
- *Outline the significant effects of Self Confidence to build team confidence, given the foundation principles of Self Motivation and Confidence.*
- *Assess the various personalities and Attitudes and choose the best attitude for making bold decisions in personal and professional contexts.*
- *Project the appropriate grooming and the right etiquette in the corporate context to excel in professional life.*
- *Set Career goals and formulate strategies by Prioritizing, organizing and scheduling the required tasks. Project the appropriate grooming and the right etiquette in the corporate context to excel in professional life.*

PERSONALITY DEVELOPMENT

One's Personality Sends Out a Signal That Others Read – Same Person: Consciously Different Personalities can be Powerful – There isn't One Right Personality; It Differs by Role – Learning about Personality Development from the Three Cases – Personality Analysis – Freudian Analysis of Personality Development – Swami Vivekananda's Concept of Personality – Development: Physical Self – Energy Self – Intellectual Self – Mental Self – Blissful Self – Personality Begets. **(7)**

LEADERSHIP QUALITIES & INTERPERSONAL SKILLS:

Resolving Conflict – A Smiling Face – Appreciative Attitude – Assertive Nature – Communication Skills – Listening Skills – Developing Empathy – The Personality Attribute of Taking Bold Decisions – Personality Types and Leadership Qualities – Mapping the Different Personality Types – Personality Tests: Example of a Personality Test: Jung Typology Test – Personality Assessment **(7)**

ETIQUETTE

Social Etiquette – Corporate Etiquette - Personal Grooming – Using minimal Body Language – Leadership and Entrepreneurship : Corporate Training – Professionalism - Self awareness – Creativity skills – Cognitive Development – Assertiveness – Positive Thinking and Attitude. **(8)**

GOAL SETTING AND TIME MANAGEMENT

Goal Setting – Immediate, Short Term and Long Term Goals – Smart Goals – Strategies to Achieve Goals - Confidence Building, Self-esteem, Motivation - Time Management –Identifying Time Wasters – Time Management Skills.

(8)

TOTAL: 30

REFERENCE BOOKS

1. Mitra K.Barun, "Personality Development and Soft Skills", Oxford University Press, 2011.

2. Krishna Mohan, Meera Banerji. "Developing Communication Skills" Mac Million Publishers, 2012.

3. Sai Lakshmi. B, "Poly Skills- A Course in Communication and Life Skills" Cambridge University Press, 2012.

4. Simon Sweeney, "English for Business Communication", Cambridge University Press, 2013.

5. Meenakshi Raman, Sangeeta Sharma, "Technical Communication - Principles and Practice", 3rd edition, Oxford University Press, New Delhi, 2015.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1						H			L
CO2					H	M			L
CO3						H			L
CO4						H			L
CO5						H			L

21MDS51- OPERATIONS RESEARCH

Contact Hours

PRE- REQUISITES

Consent of the Instructor

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Solve Linear Programming, Transportation and Assignment based problems*
- *Discuss the elementary Inventory models, Price break models and Safety stock problems*
- *Solve Job sequencing and replacement problems*
- *Categorize the Queuing models and also simulate the problems using Monte - Carlo Technique*
- *Analyze the network models using CPM and PERT*
- *Solve OR problems using classical optimization techniques*

Linear Programming Problem - canonical and standard forms - formulation - graphical solution – Simplex method-Big M method using artificial variables- **Transportation model** – Initial Basic Feasible Solution using North West Corner method, Matrix Minima method and Vogels approximation method – Optimal solution by Modified Distribution Method-Unbalanced Transportation problems and Degeneracy - **Assignment model**-Solution by using Hungarian metho

(9)

Sequencing and Replacement: : Basic assumptions of sequencing – Johnson's procedure for Sequencing of: i) n jobs on 2 machines ii) n jobs in 3 machines and iii) n jobs on m machines

Replacement: Need for replacement of equipment - failure mechanism of items - Replacement policy - Replacement of items that deteriorates gradually - Replacement of items that fail suddenly.

(9)

Inventory Models - Costs involved in inventory - Concepts of average inventory, economic order quantity - Deterministic model: Fixed ordering quantity models - EOQ model with uniform demand, finite / infinite replacement with / without shortages -EOQ with one price break. Inventory control - Buffer stock - Determination of optimum buffer stock - EOQ system of ordering - Multi item order model   -   ABC   analysis.

(9)

PERT and CPM Networks: Activities and events-Rules for forming a Network-**Critical Path Method**(CPM) for computing project completion time- network – Time estimation in CPM-Project Cost Analysis- critical path -Crashing-Least cost schedule algorithm- **PERT** - Network – Difference

between PERT and CPM-Time estimates in PERT- Critical Path estimation - Probability of meeting a scheduled date of completion of the project. **(9)**

Game theory: Decision making-Description of a game-Basic elements of game theory- the Two Person, zero-sum Games – Characteristics of a game- The maxmin and minmax principles- Steps in solving the game- Saddle point method- Principle of dominance in games- Solutions to 2 x 2 games without saddle point: (Mixed strategies)- Method of Oddments (for 2×2 games)- Solutions to $2 \times n$ or $m \times 2$ games-Graphical Method-Algebraic Method-Method of Linear Programming-Iterative Method for Approximate Solution-Bidding Problems-n- Person Zero sum games. Strategic games-Nash Equilibrium. **(9)**

TOTAL: 45

TEXT BOOK

1. *Hamdy, A Taha, "Operations Research - An introduction", Pearson Education India, 2004.*

REFERENCE BOOKS

1. *Rama Murthy P. Operations Research, New Age International, Second Edition, 2007, New Delhi*
2. *S. D. Sharma "Operations Research ", Kedar Nath Ram Nath & Co publishers, 10th edition, 1995.*
3. *Kanti Swarup, P.K. Gupta, Mani Mohan, "Operations Research", Sultan Chand & Sons, 2001.*
4. *Hillier & Lieberman, "Operations Research - An Introduction", Tata McGraw-Hill, 2004*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	H	L	M					
CO2	H	H	L	M					
CO3	H	H	M	M					
CO4	H	H	M	M					
CO5	H	H	M	M					

21MDS52 - DEEP LEARNING

COURSE OUTCOMES

- *Describe the deep learning process using deep feed forward network, CNN and RNN models.*
- *Describe the regularization and Optimization techniques*
- *Apply appropriate deep network models along with optimization and regularization techniques for the given analysis application*
- *Describe and apply the image enhancement, segmentation and representation techniques.*

DEEP FEED-FORWARD NETWORKS: Gradient-Based Learning, Hidden Units, Architecture Design, Back Propagation and other Differentiation Algorithms **(7)**

REGULARIZATION Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems Dataset Augmentation, Dropout. **OPTIMIZATION FOR TRAINING DEEP MODELS** Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies.

(10)

IMAGE PROCESSING

IMAGE SAMPLING AND QUANTIZATION- Basic Concepts - Representing Digital Images - Spatial and Intensity Resolution - Image Interpolation

IMAGE ENHANCEMENT - Spatial Domain -Histogram Processing- Histogram Equalization - Histogram Matching - Local Histogram Processing - Using Histogram Statistics for Image Enhancement - The Mechanics of Spatial Filtering - Spatial Correlation and Convolution - Vector Representation of Linear Filtering - Generating Spatial Filter Masks -Smoothing Linear Filters - Order-Statistic (Nonlinear) Filters .

IMAGE SEGMENTATION - Fundamentals - Point, Line, and Edge Detection - Detection of Isolated Points - Line Detection - Edge Models - Basic Edge Detection - More Advanced Techniques for Edge Detection - Edge Linking and Boundary Detection. **(12)**

CONVOLUTIONAL NETWORKS The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features, The

Neuroscientific Basis for Convolutional Networks, Convolutional Networks and the History of Deep Learning. **(8)**

SEQUENCE MODELING: RECURRENT AND RECURSIVE NETS Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long-Term Dependencies, Explicit Memory. **(8)**

TOTAL: 45

TEXT BOOKS

1. *Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2016.*
2. *Rafael C.Gonzalez and Richard E.Woods, "Digital Image Processing", Pearson Education, Third Edition, 2008.*

REFERENCE BOOKS

1. *Deng & Yu," Deep Learning: Methods and Applications", Now Publishers, 2013.*
2. *Michael Nielsen, "Neural Networks and Deep Learning", Determination Press, 2015.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H	H	H	L			L	L
CO2	H	H	H	M	L	L		L	L
CO3	H	H	H	H	M	M	M	M	M
CO4	H	H	H	H	M	M	M	M	M

21MDS53 – BIG DATA COMPUTING

PRE- REQUISITES

21MDS33, 21MDS44

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Analyze the analytical techniques on variety of Big data application scenarios.*
- *Apply hadoop clusters and map reduce techniques for parallel processing of big data.*
- *Understand SPARK, PIG and HIVE usage in Big Data Computing.*
- *Generate: Generate dynamic solutions for data analytics problems using map reduce framework.*
- *Given a problem, develop an efficient parallel algorithm to solve it.*
- *Design distributed system using appropriate communication protocols, synchronization mechanisms and NFS.*

INTRODUCTION TO PARALLEL COMPUTING

Parallel Programming Platforms - Implicit Parallelism - Limitations of Memory System Performance - Control Structure of Parallel Platforms - Communication Model of Parallel Platforms - Physical Organization of Parallel Platforms - Communication Costs in Parallel Machines - Impact of Process - Processor Mapping and Mapping Techniques. **(9)**

INTRODUCTION TO BIG DATA

Big data characteristics - Volume, Veracity, Velocity, Variety Value - Big data sources - Acquisition - Understanding the Big Data Project's Ecosystem - Creating the Foundation of a Long-Term Big Data Architecture -Early Big Data with NoSQL - NoSQL Landscape. **(8)**

THE HADOOP ECOSYSTEM

Big Data and the Hadoop Ecosystem- The Hadoop Ecosystem - Hadoop Core Components - Hadoop Distributions - Developing Enterprise Applications with Hadoop

STORING DATA IN HADOOP - HDFS -HBase -Combining HDFS and HBase for Effective Data Storage -Using Apache Avro - Managing Metadata with HCatalog - Choosing an Appropriate Hadoop Data Organization **(9)**

PROCESSING DATA WITH MAPREDUCE

Getting to Know First MapReduce Application - Designing MapReduce Implementations

CUSTOMIZING MAPREDUCE EXECUTION

Reading Data Way with Custom Record Readers -Organizing Output Data with Custom Output Formats - Writing Data Your Way with Custom Record Writers - Optimizing MapReduce Execution with a Combiner - Controlling Reducer Execution with Partitioners - Using Non-Java Code with Hadoop **(9)**

STREAMING ARCHITECTURE

Introduction to Apache Spark - Spark fundamentals – Writing Spark applications – The Spark API in depth –Sparkling queries with Spark SQL – Ingesting data with Spark streaming.

PIG: Installing and Running Pig - Comparison with Databases - Pig Latin -User-Defined Functions - Data Processing Operators – Pig in Practice

HIVE: Installing Hive - Running Hive -Comparison with Traditional Databases -HiveQL -Tables - Querying Data – User -Defined Functions **(10)**

TOTAL : 45

TEXT BOOKS

1. Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, Introduction to Parallel Computing, Second Edition, Pearson Education, 2009.(Para 1)

2. Bahaaldine Azarmi. "Scalable Big Data Architecture -A Practitioner's Guide to Choosing Relevant Big Data Architecture" A Press, 2016

2. Kevin T. Smith, Alexey Yakubovich, Boris Lublinsky, "Professional Hadoop® Solutions", John Wiley & Sons Inc, 2013.

3. Tom White - Beijing, "Hadoop: The Definitive Guide", O'reilly, Third Edition, Jan 2012.

4. Peter Zecevic, Marko Bonaci, "Spark in Action", DreamTech Press, 2018.

REFERENCE BOOKS

1. Norman Matloff, "Parallel Computing for Data Science - With Examples in R, C++ and CUDA", Chapman and Hall/CRC, 2015.

2. Wan Fokkink, "Distributed Algorithms: An Intuitive Approach", MIT Press, 2013.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H		H	M					M
CO2	H	H	M	M	M			L	
CO3	H	M	H	H			M		M
CO4	H	H	M	H			H		
CO5	M	H	H	M				L	

21MDS54 - ARTIFICIAL INTELLIGENCE

Contact Hours

PRE- REQUISITES

Consent of the Instructor

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Describe Intelligent Agents such as searching, knowledge-based agents and Searching Strategies*
- *Build Searching and Knowledge based systems by identifying suitable searching strategies and knowledge representation*
- *Develop Intelligent systems in the domains of Perception and Robotics*

ARTIFICIAL INTELLIGENCE

Introduction: Definition- Foundations- History-State of Art. Intelligent Agents: Agents and Environments-Concepts and Rationality-Nature of Environments-Structure of Agents   (7)

SEARCHING AGENTS

Problem Solving Agents—Examples – Searching for Solutions – Uninformed Search Strategies – Informed Search Strategies – Heuristic Functions. Beyond Classical Search: Local search algorithms and optimization problems – Local search in continuous spaces – Searching with non-deterministic actions -searching with partial observations-on line search agents and unknown environments   **(11)**

KNOWLEDGE BASED AGENTS

Logical Agents: Basics – The Wumpus world – Logic – Propositional Logic -Propositional Theorem Proving - Agents based on Propositional Logic.   Constraint Satisfaction Problems: Definitions - Constraint Propagation: Inferences -   Backtracking Search – Local Search   **(10)**

KNOWLEDGE BASE REPRESENTATION

First Order Logic: Representation – Syntax and Semantics- Using First Order Logic – Knowledge Engineering in First Order Logic. Inference in First order Logic: Propositional versus First Order Inference – Unification and Lifting – Forward Chaining – Backward Chaining – Resolution. Knowledge   Representation-   Artificial   Neural   Networks
                                                                                                                      (10)

APPLICATIONS OF AI

Perception: Basics – Image Formation - Image Processing Operations – Object Recognition by Appearance -Reconstruction 3D world – Object Recognition from structural information and Using

Vision. Robotics: Introduction – Robot Hardware – Robotic Perception – Planning To Move – Planning Uncertain Movements – Robotics Software Architectures – Application Domains

(7)

TOTAL: 45

TEXT BOOK

1. *Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" ,Pearson Eductaion Series, Prentice Hall Publishers, Third Edition, 2014.*

REFERENCE BOOKS

1. *Thomas Dean, James Allen , Yiannis Aloimonos, "Artificial Intelligence : Theory and Practice", Addison Wesley Pub.,Co*

2. *Nils J Nillsson, "Principles of Artificial Intelligence", Morgan Kauffmann Publishers , 2014*

3. *Patrick Hendry Winson, " Artificial Intelligence", Addition Wesley Publishers, Thrid Edition 1992*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	L	H	L	M			H	L
CO2	L	H	L	M	L			M	H
CO3	M	M	M	H	M			H	L

21MDS55 - DEEP LEARNING LABORATORY

Contact Hours

PRE- REQUISITES

21MDS48, 21MDS52

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

- *Apply and Implement the deep feed forward network, CNN and RNN models for analysing the complex real world systems.*
- *Apply and Implement the regularization and Optimization techniques for improving the deep forward network model.*
- *Execute the image representation, enhancement and segmentation techniques for the given analysis applications.*

CONCEPTS TO BE COVERED

1. Implementation of Viewing digital images, bits and bytes, sampling and quantization.

2. Apply scaling, translation and rotation, sums and differences with the grayscale and color images.

3. Implementation of Histograms , Linear and Non-Linear filters.

4. Construct edge detection algorithms using Operators.

5. Build a multi-layer neural networks, and analyze real data

6. Object detection using Convolution Neural Network

7. Perform Sentiment Analysis in network graph using RNN

8. Implementation of Long short term memory network

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H	H	H	H	M	M	M	M
CO2	H	H	H	H	H	M	M	M	M
CO3	M	H	H	H	M	M	L	L	M

21MDS56 - BIG DATA COMPUTING LABORATORY

Contact Hours

PRE- REQUISITES

21MDS53

L	T	P	C
0	0	4	2

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

 • *Analyze the analytical techniques on variety of Big data application scenarios.*

 • *Apply hadoop clusters and map reduce programs for parallel processing of big data.*

 • *Practice structured/unstructured data analysis using PIG and HIVE programs.*

 • *Experiment the NOSQL operations for processing of big data.*

 •*Generate dynamic solutions for data analytics problems using map reduce framework.*

 • *Given a parallel code, diagnose the errors and fix them.*

 • *Develop client/server based distributed applications.*

CONCEPTS TO BE COVERED

 1. Implementing Parallel programming concepts

 2. Import /Export the data from datacenter (website or unstructured) to HDFS

 3. Import /Export the data from SQL to HDFS

 4. Parallelize Input/output process /compute process using MAPREDUCE

 5. Storage /Process the data in NOSQL using MongoDB

 6. Perform structured/unstructured data analysis using PIG

 7. Perform structured data process/analysis using HIVE

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L	L	L	L					
CO2	H	H	H	H				H	H
CO3	H	H	H	H				H	H
CO4	H	H	H	H				H	H
CO5	H	H	H	H				H	H
CO6	H	H	H	H					

21MDS57 - COMMUNICATION SKILLS

Contact Hours

PRE- REQUISITES

Consent of the Instructor

L	T	P	C
0	0	2	1

ASSESSMENT: PRACTICAL (100 Marks)

COURSE OUTCOMES

- *Conceive appropriate verbal responses from the learners to a given social situation, using the guidelines to effective speaking skills and body language.*
- *Generate trouble shooting solutions to develop team building and interpersonal skills with case studies that focus on body language and empathy.*
- *Develop appropriate responses for business phone calls and formulate effective resolutions to professional conflicts that arise out of cross cultural communication gaps in a given managerial context.*
- *Compose appropriate written responses to professional problems faced by a team at the workplace arising out of ineffective communication skills.*
- *Generate valid points for and against a HR topic and present them with appropriate group behavior. For any job requirement, plan and prepare for a 20 minute mock interview.*

INTRODUCTION

Introduction – Code and Content – Stimulus and Response: Source – The Encoding Process – The Channel – The Decoding Process – The Receiver – Speaking Skills – Effective Speaking Guidelines – Communicating Soft Skills: A Self-assessment – Closing Tips **(4)**

SOFT SKILLS

Introduction to Soft Skills – Lessons from the Three Case Studies – Change in Today's Workplace: Soft Skills as a Competitive Weapon – Antiquity of Soft Skills – Classification of Soft Skills: Time Management - Attitude – Responsibility – Ethics, Integrity, Values and Trust – Self-confidence and Courage – Consistency and Predictability – Teamwork and Interpersonal Skills - Communication and Networking – Empathy and Listening Skills – Problem Solving, Troubleshooting and Speed reading – Leadership – Body Language

(8)

TELEPHONING SKILLS & NEGOTATIONS

Preparing to make a telephone call – Receiving calls – Taking and leaving messages – Asking for and giving repetition – The secretarial barrier – Cross-cultural communication on the telephone – Fixing appointments – Changing arrangements – Ending a call – Cross-cultural communication on the telephone – Problem-solving on the telephone – Complaints – Negotiations: Types of negotiation – Preparation for a negotiation – Making an opening statement – Bargaining and making concessions

– Accepting and confirming – Summarizing and looking ahead – Types of negotiator – Dealing with conflict - Rejecting – Ending the negotiation **(8)**

WRITING SKILLS TO CREATE AN IMPRESSION:

Introduction- Fifteen Principle to Increase Clarity in Communication – Edit-Edit-Edit: The Reader's Perspective – Clarity of Thought – Clarity of Text. **(3)**

SPEAKING

Job Interviews: Introduction - Types of Interviews – Planning and Preparing for an Interview - Importance of body Language in Interview - Need for proper Articulation - Concluding an Interview - Telephonic or Video Interview - A Mock Interview - Group Discussion: Introduction - Ability to Work as a Team – Communication Skills - Active Listening - Non-verbal Communication - Leadership and Assertiveness - Reasoning – Ability to Influence - Innovation. Creativity, and Lateral Thinking - Flexibility - Key Steps to Succeed in a Group Discussion - The Responsibility of the First Speaker - Concluding the Discussion - Dos and Don'ts during a Group Discussion **(7)**

TOTAL : 30

REFERENCE BOOKS

1. Mitra K.Barun, "Personality Development and Soft Skills", Oxford University Press, 2011.

2. Krishna Mohan, Meera Banerji. "Developing Communication Skills" Mac Million Publishers, 2012.

3. Sai Lakshmi. B, "Poly Skills- A Course in Communication and Life Skills" Cambridge University Press, 2012.

4. Simon Sweeney, "English for Business Communication", Cambridge University Press, 2013.

5. Meenakshi Raman, Sangeeta Sharma, "Technical Communication - Principles and Practice", 3rd edition, Oxford University Press, New Delhi, 2015.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1					H				L
CO2					H				L
CO3						H			
CO4					H				L
CO5						H			

21MDS61 – STOCHASTIC MODELS

Contact Hours

PRE-REQUISITES

21MDS13, 21MDS22, 21MDS31, 21MDS41

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Describe fundamentals of Stochastic Processes and their various classifications*
- *Analyze and understand Markov Chain and Markov Decision Models and their Applications*
- *Apply and Describe Queuing models and Simulation techniques for the real world problems.*

Basic Terminology: Properties of Random Variables and Distribution Functions-Joint Distribution Functions-Conditional distributions and conditional expectations-Infinite families of random variables-Characteristic Functions-Generating functions and Laplace Transforms-Examples of distribution functions: Multivariate Normal, Multinomial distributions-Limit Theorems-Convergence with probability one, convergence in probability, convergence in quadratic mean, convergence in distribution-Inequalities-Chebyshev and Schwarz. Basics of Stochastic Process: State Space S and Index Parameter T-Classical types of Stochastic Processes-Processes with Independent Increments, Martingales, Markov Processes, Stationary Processes, Renewal Processes and Point Processes. **(8)**

Classification of general Stochastic Processes: Markov Chains-Definitions-Examples-Spatially Homogeneous Markov Chains-One Step Transition Matrix of a Markov Chain and its estimation-Chapman-Kolomogorov Equation- Hypothesis Tests for Markov Chain: Anderson Goodman Test -Testing Time Homogeneity of Transition Matrices: Likelihood Ratio Test -Using Markov Chains in Predictive Analytics -Stationary Distribution- in a Markov Chain -Regular Matrix Classification of States of a Markov Chain –Accessible state-Communicating states-Recurrent and Transient states-First Passage Time and Mean Recurrence Time-Periodic State -Ergodic Markov Chain-Limiting Probability-Markov Chains with Absorbing States-Canonical Form of the Transition Matrix of an Absorbing State Markov Chain-Expected Duration to reach a State from other States-Calculation of Retention Probability and Customer Lifetime Value using Markov Chains   **(10)**

Continuous time Markov Chains and Markov Decision Process

Continuous time Markov Chains: General Pure birth processes and Poisson Process-Birth and Death Processes-Compound Poisson Process-Applications

Markov Decision Process (MDP): Policy Iteration Algorithm - Linear Programming Formulation for Finding Optimal Policy- Value Iteration Algorithm   **(10)**

Queuing system   characteristics-Describing a queuing system by i) input pattern ii) service mechanism iii) queue discipline and iv) customer behaviour- Steady, transient and explosive states in queuing systems-Designation of queue and symbols used in queuing models- M/M/1 (∞/FIFO)

model-Steady State solutions-Finite Queue Length Model: (M / M / 1) : (N/FIFO)

(8)

Simulation Modeling:-Monte Carlo Simulation-Types of Simulation-Elements of Discrete Event Simulation-Generic Definition of Events-Sampling from Probability Distributions-Generation of Random Numbers-Mechanics of Discrete Simulation-Manual Simulation of a Single Server Model-Spreadsheet based simulation of single server model-Methods of gathering statistical observations-Subinterval method, Replication method and Regenerative (cycle) method-Simulation Languages.

(9)

TOTAL :45

TEXT BOOKS

1. *Samuel Karlin and Howard M. Taylor., A First Course in Stochastic Processes, 2nd Edition, 1975, Academic Press [Para 1, 2]*
2. *Dinesh Kumar U. Business Analytics, Wiley, First Edition, 2017 [Para 1,2,3]*
3. *Rama Murthy P. Operations Research, New Age International, Second Edition, 2007, New Delhi [Para 4]*
4. *Jerry Banks.John S. Carson ,Barry L Nelson, David M Nicol, Discrete-Event System Simulation, Second Edition. Prentice Hall, 1996. [Para 5]*

REFERENCE BOOKS

1. *J.Medhi, Stochastic Processes, New Age Science, 3rd Revised Edition, 2012.*
2. *Yates R.D. and Goodman D.J., Probability and Stochastic Processes, 2nd Edition, John Wiley and Sons, 2005.*
3. *Ibe,O.C.Fundamentals of Applied Probability and Random Processes, Elsevier, 1st Indian Reprint, 2007.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	M	M	H	L			L	L
CO2	H	H	H	H	H	L	M	M	M
CO3	H	H	H	H	M	L	L	M	M

21MDS62-CLOUD COMPUTING

Contact Hours

PRE-REQUISITES

21MDS33, 21MDS34, 21MDS44

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Describe the basics of cloud computing, various platforms and technologies.*
- *Apply the elements and technologies of Distributed Computing*
- *Recognize the levels and mechanisms of virtualization, its types and infrastructure*
- *Compare the various service models offered by different service providers and ability to configure and setup cloud and virtual environment solutions for real-time applications*
- *Ability to identify security challenges in cloud and manage risks*

INTRODUCTION

The vision of Cloud Computing – Defining a Cloud - Cloud Computing Reference Model – Characteristics and Benefits – Challenges – Historical developments: Distributed Systems – Virtualization- Web2.0 – Service-oriented computing – Utility-oriented computing – Building cloud computing environments: Application development – Infrastructure and System development – Computing platforms and technologies **(9)**

PRINCIPLES OF DISTRIBUTED COMPUTING

Elements of Distributed computing: Concepts and definition, Components of a distributed system, Architectural styles, Models for Interprocess communication – Technologies of Distributed computing: Remote Procedure call, Distributed object frameworks, Service-oriented computing **(9)**

VIRTUALIZATION

Introduction – Characteristics of virtualized environments – Taxonomy of virtualization techniques: Hardware-level virtualization, Programming Language-level virtualization, Application-level virtualization, Storage virtualization, Network virtualization, Desktop virtualization, Application server virtualization – Virtualization and Cloud Computing – Pros and Cons of virtualization – Technology: Xen, VMware, Hyper-**V** **(9)**

CLOUD ARCHITECTURE AND INDUSTRIAL PLATFORMS

Introduction – Cloud reference model: Architecture, Infrastructure-as-a-service, Platform-as-a-service, Software-as-a-service – Types of clouds: Public clouds, Private clouds, Hybrid clouds, Community clouds - Challenges – Cloud Platforms in Industry: Amazon Web Services – Google App Engine – Microsoft Azure. **(9)**

SECURITY IN THE CLOUD

Cloud Security Challenges – Software as a Service Security: Security Management and Governance – Risk Management – Policies, Standards and Guidelines - Security Monitoring – Third-Party Risk Management – Business Continuity Plan - Security Architecture Design – Data Privacy and Security – Application Security – Virtual Machine Security**.**

(9)

TOTAL : 45

TEXT BOOKS

1. *Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, "Mastering Cloud Computing", Tata McGraw Hill, 2013.*
2. *John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.*

REFERENCES BOOKS

1. *Jim Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.*
2. *Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.*
3. *Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.*
4. *Danielle Ruest, Nelson Ruest, "Virtualization: A Beginner"s Guide", McGraw-Hill Osborne Media, 2009.*

5. *Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L	L	L	L				L	L
CO2	L	M	H	H			H	H	H
CO3	L	M	H	H			H	H	H
CO4	L	M	H	H			H	H	H
CO5	L		M	M			H	H	H

21MDS63 - DATA MINING

PRE- REQUISITES

21MDS34, 21MDS41, 21MDS45

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Demonstrate the need for data preprocessing and suggest appropriate methods to produce proper data sources for mining.*
- *Learning how to gather and analyze large sets of data to gain useful business understanding.*
- *Describing and demonstrating basic data mining algorithms, methods, and tools.*
- *Identifying business applications of data mining*
- *Be exposed with different data mining trends and techniques*
- *Design and create data visualizations.*

INTRODUCTION

Definition and need of data mining, Kinds of data and patterns, Applications and issues. Types of data: Data objects and attribute types, Measuring data similarity and dissimilarity. Data Preprocessing: Overview, data cleaning, data integration, data transformation and data discretization.

(13)

DATA WAREHOUSE AND OLAP TECHNOLOGY

Data warehouse-basic concepts, data warehouse modeling, data warehouse implementation.   (8)

MINING FREQUENT PATTERNS AND ASSOCIATIONS

Basic concepts, Frequent itemset mining methods. Pattern mining in Multilevel, Multidimensional Space.   (8)

ADVANCED CLASSIFICATION METHODS AND OUTLIER DETECTION

Bayesian Belief Networks, Classification by Back Propagation.

Outlier Detection: Outliers and Outlier analysis, Outlier detection methods.   (8)

DATA MINING TRENDS AND VISULAIZATION

Mining sequence data, Mining other kinds of data, Statistical data mining, Visual and Audio data mining, Web mining.

Introduction to Data Visualization – The Seven Stages of Visualizing data – Getting started with processing. Case Study: D3. (8)

TOTAL : 45

TEXT BOOKS

1. *Jiawei Han, Micheline Kamber and Jian Pei, "Data Mining - Concepts and Techniques", 3rd Edition, Elsevier Publications, 2012.*

2. *Ben Fry, "Visualizing data: Exploring and Explaining data with the processing environment", O'Reilly, 2007.*

REFERENCE BOOK

Arun K Pujari, "Data Mining Techniques", Universities Press.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	H							
CO2	L	H		H	M				
CO3	L		M	H				M	
CO4			M			H			
CO5							M	M	
CO6					M				M

21MDS64 – SOFTWARE ENGINEERING

Contact Hours

PRE- REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

L	T	P	C
3	0	0	3

COURSE OUTCOMES

- *Choose and practice the software development process based on the factors such as problem complexity, time and cost to develop the software system.*

- *Create the requirements model by specifying the use cases and actors involved in the scenario or by specifying the classes along with their responsibility and collaboration involved in the given problem to describe the requirements of the software system.*

- *Design the architecture of the system in the various perspectives such as component model, pattern model and User experience based on the type of the proposed software system.*

- *Design the test plans to conduct Component Level and Integration Level testing on the developed system.*

- *Determine the size of the product by applying LOC or Function Point metrics.*

INTRODUCTION

Software and Software Engineering – The Nature of Software – The Software Process - Process Models: Prescriptive Process Models - Agility and Process – Agility Principles – Scrum   (8)

MODELING AND DESIGN CONCEPTS

Understanding Requirements – Requirements Engineering – Requirements modelling – Scenario-based modelling – Class-based modelling

Design Concepts – Design Model - Architectural Design: Software Architecture – Agility and Architecture – Component-Level Design: Cohesion, Coupling – Specialized Component-level design - Pattern-Based Design - Design Patterns   (12)

USER EXPERIENCE DESIGN

User Experience Design: User Experience Design Elements - The Golden Rules - User Interface Analysis and Design - User Experience Analysis - User Experience Design - User Interface Design - Design Evaluation - Usability and Accessibility   (8)

SOFTWARE TESTING AND PROJECT MANAGEMENT

Software Testing – Component Level – White-box testing – Black-box testing - Integration testing

Project Management Concepts - Software Project Management Complexities – Responsibilities of a Software Project Manager - Metrics for Project Size Estimation: Lines of Code, Function Point Metric - Project Estimation Technique: Basic COCOMO Model . (10)

SOFTWARE ENGINEERING FOR DATA SCIENCE

Data Science for Software Engineers – Software Engineering for Data Analytics   - Case study   (7)

TOTAL : 45

TEXT BOOKS

1. *Roger S Pressman, "Software Engineering – A Practitioner's Approach", Ninth Edition, McGraw Hill Edition, 2020.*
2. *Rajib Mall, "Fundamentals of Software Engineering", Fourth Edition, Prentice Hall India, 2014.*
3. *Miryung Kim, "Software Engineering for Data Analytics" IEEE Software, 2020.*

REFERENCE BOOKS

1. *Ian Somerville, " Software Engineering", Tenth edition, Pearson Education, 2016.*
2. *Pankaj Jalote, "An integrated approach to software Engineering", 3rd edition, Narosa publishing house, Reprint 2013.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H	M						
CO2		H	H	L					
CO3				H	M	L			
CO4	M	L	H				M	L	
CO5	H		M						L

21MDS65 – CLOUD COMPUTING LABORATORY

Contact Hours

PRE- REQUISITES

21MDS62

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

- *Demonstrate knowledge on creating, cloning, migrating virtual machines using virtualization tool.*
- *Construct a private cloud using the open source cloud technologies.*
- *For a given system configuration, can use cloud services to acquire instances.*
- *Develop an application, launch it on Google App Engine, and access it.*
- *Develop applications and deploy in cloud container.*

CONCEPTS TO BE COVERED-

I. VIRTUALIZATION

1. Create virtual machines of different configurations
2. Establish communication between host and virtual machine
3. Establish communication between virtual machine to virtual machine

Show the virtual machi**I. VIRTUALIZATION**

4. ne migration from one node to the other.

II. PRIVATE CLOUD

Use OpenStack/O**II. PRIVATE CLOUD**

1. pen Nebula or equivalent to set up the cloud and demonstrate
2. Run the virtual machine of different configuration
3. Attach virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine
4. Install any language in the virtual machine and execute a sample program
5. Show the virtual machine migration from one node to the other
6. Install storage controller and interact with it

III. PUBLIC CLOUD

1. Create virtual server in cloud and run a java application
2. Establish communication between two Cloud instances
3. Use an object storage service to store and retrieve data
4. Set up, operate, and scale a relational database in the cloud using Relational Database Service

5. Build, train, and deploy machine learning (ML) models for any use case with fully managed infrastructure in cloud
6. Deploy an application in the Google App Engine
7. Use cloud container to develop, ship and run applications

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H		H	H			L	H	H
CO2	H		H	H			H	H	H
CO3	H		H	H			M	H	H
CO4	H		H	H			M	H	H
CO5	H		H	H			M	H	H

21MDS66 - DATA MINING AND VISUALIZATION LABORATORY

Contact Hours

PRE- REQUISITES

21MDS63

L	T	P	C
0	0	4	2

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

- *Use tools to implement data preprocessing techniques.*

- *Apply data mining techniques on real time data to provide solutions for decision making.*

- *Construct data warehouse, using various data models.*

CONCEPTS TO BE COVERED

1. Perform data cleaning techniques for a given data test.

2. Perform Data Normalization using min-max, z-score and normalization by decimal scaling methods.

3. Extract Frequent Item Sets using candidate generation and without using candidate generation.

4. Extract patterns from multidimensional data.

5. Develop a model to apply Linear Regression for prediction.

6. Implement BBN using Training dataset.

7. Find the outliers using various Outlier Detection method.

8. Evaluation of measures for text retrieval.

9. Classification of Web documents.

10. Perform OLAP operations.

11. Build Datawarehouse using multi dimensional data models.

12. Exploring D3, Tableau

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	M	H						
CO2			M	M			H	M	
CO3				M		M	M		L

21MDS71 – PROJECT WORK AND VIVA VOCE – I

Contact Hours

L	T	P	C
0	**0**	36	18

ASSESSMENT: Project Work

COURSE OUTCOMES

At the end of Project Work I the students are able to

- *Acquire knowledge on the learned concepts and techniques*
- *Choose and apply the appropriate algorithm(s) for solving the given problem*
- *Determine and apply optimized algorithm(s) for solving the given problem*
- *Enhance the communication skills for interaction with others*
- *Inculcate the team spirit and enhancing the coordination for the completion of the projects*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H	H	H	M				
CO2	H	H	H	H	H	M	M	M	M
CO3	H	H	H	H				M	M
CO4					H	M	M		
CO5					H	M	H		

21MDS81 – DATA PRIVACY AND SECURITY ANALYTICS

Contact Hours			
L	**T**	**P**	**C**
3	0	0	3

PRE-REQUISITES

21MDS34, 21MDS44

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Describe the fundamental aspects of information security and number theory, different types of cryptosystems and privacy preserving machine learning techniques*
- *Apply symmetric, asymmetric, hash algorithms, differential privacy and federated learning techniques to preserve confidentiality, integrity and privacy of information*
- *Analyze and choose suitable crypto algorithms for the security requirement of a given computing system*
- *Develop new security solutions for real-time problems in enterprises including Government, Industry, Academia and Society*

INTRODUCTION

Security: Computer Security concepts – OSI Security Architecture - Security Attacks – Security Services – Security Mechanisms – Network Security model
Number Theory: Divisibility and the Division Algorithm, The Euclidean Algorithm, Modular Arithmetic, Prime Numbers, Fermat's Theorem, Euler's Theorem, Extended Euclidean Algorithm
(8)

CRYPTOSYSTEMS

Symmetric Ciphers: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography, Data Encryption Standard, Advanced Encryption Standard
Asymmetric Ciphers: Principles of public key cryptosystems, The RSA algorithm, Diffie Hellman Key exchange, Elliptic curve cryptography
(12)

MESSAGE INTEGRITY AND AUTHENTICATION

Message Authentication Requirements, Message Authentication functions - Applications of Hash functions, Secure Hash Algorithm - Digital signatures, Elliptic Curve Digital Signature Algorithm
(8)

PRIVACY-PRESERVING MACHINE LEARNING

Privacy considerations in machine learning: Privacy complications in the AI era, Threats and attacks for ML systems, Securing privacy while learning from data: Privacy-preserving machine learning. Advanced concepts of differential privacy or machine learning - Applying differential privacy in

machine learning - Differentially private supervised learning algorithms - Differentially private unsupervised learning algorithms   (9)

FEDERATED LEARNING

Horizontal and Vertical Federated Learning, Federated Averaging, Federated Transfer Learning, Federated Learning over Non- Independent and Identically Distributed data   (8)

TOTAL : 45

TEXT BOOKS

1. *William Stallings, "Cryptography and Network Security: Principles and Practices", Fifth Edition, Prentice Hall, 2010.*
2. *Morris Chang J, Di Zhuang, Dumindu Samaraweera, "Privacy-Preserving Machine Learning", Manning Publications, 2022.*
3. *Yaochu Jin, Hangyu Zhu, Jinjin Xu, Yang Chen, "Federated Learning- Fundamentals and Advances", Springer, 2023.*

REFERENCE BOOKS

1. *Michael Whitman, Herbert J. Mattord, "Management of Information Security", Third Edition, Course Technology, 2010.*
2. *Clarence Chio, David Freeman, "Machine Learning & Security", First Edition, O-Reilly, 2018.*
3. *William Stallings, Network Security Essentials, Applications and Standards, 3rd edition, Pearson Education, 2007.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H		H	H			H	H	H
CO2	H		H	H			H	H	H
CO3	H		H	H			H	H	H
CO4	H	M	H	H			H	H	H

21MDS82 - QUANTUM MACHINE LEARNING

Contact Hours

PRE-REQUISITES

21MDS12, 21MDS32

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Ability to work with quantum programming languages and design quantum circuits*
- *Implement quantum machine learning algorithms and their analysis*
- *Able to distinguish between quantum computing paradigms relevant for machine learning*
- *Identify problems in machine learning that would benefit from using quantum resources*
- *Implement learning algorithms on quantum computers using the available public platforms*

QUANTUM MECHANICS AND COMPUTING

Introduction, The Atoms of Computation, Bloch sphere representation of a qubit, multiple qubits, representing Qubit states, Multiple Qubits and Entangled States. Quantum Circuits - Single qubit gates, multiple qubit gates, design of quantum circuits   (12)

REPRESENTING DATA ON A QUANTUM COMPUTER

Encoding Binary Inputs into Basis States- Arbitrary State Preparation for Amplitude Encoding - Encoding Inputs as Time Evolutions - Encoding a Dataset via the Hamiltonian- Data Encoding as a Feature Map   (6)

QUANTUM COMPUTING AND MACHINE LEARNING

Clustering Structure and Quantum Computing- Quantum Pattern Recognition-Quantum Classification-Boosting and Adiabatic- Quantum Computing   (8)

FAULT-TOLERANT QUANTUM MACHINE LEARNING

Linear Algebra Accelerators- Search and Amplitude Amplification- Sampling and Probabilistic Models- Superposition and Quantum Ensembles   (8)

QUANTUM LEARNING MODELS

Optimal state for learning -Channel State duality-Tomography-Quantum Neural Networks-Quantum Walk-Tensor Network applications- Hands-on Exercises. Future of QML in Research and Industry   (11)

TOTAL : 45

TEXT BOOKS

1. *Maria Schuld, Francesco Petruccione, "Machine Learning with Quantum Computers", Springer, 2021, Second edition (Para 1,2,4)*

2. *Peter Wittek , "Quantum Machine Learning, What Quantum Computing Means to Data Mining", Elsevier, 1st Edition , August 13, 2014.(Para 3)*
3. *Santanu Pattanayak, "Quantum Machine Learning: An Applied Approach: The Theory and Application of Quantum Machine Learning in Science and Industry", Apress, Berkeley, CA, 2021.(Para -5)*

REFERENCE BOOKS

1. *Olivier Ezratty, "Understanding Quantum Technologies", ebook, 2021.*
2. *Thomas G. Wong, "Introduction to Classical and Quantum Computing", ebook, 2022.*
3. *Michael A. Nielsen, Isaac L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press,2010*
4. *Santanu Ganguly, "Quantum Machine Learning: An Applied Approach", Apress, 2021.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	M	H	H					
CO2	M	H	H	H					
CO3	M	M	H	H					
CO4	M	M	M	H					
CO5	M	M	M	M	-	-	-	M	H

21MDS83 - ETHICS IN DATA SCIENCE

PRE-REQUISITES   **ContactHours**

Consent of the Instructor

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Describe the concepts and techniques used for ethical data gathering/ modelling of the big data*
- *Apply the privacy mechanisms for ethical data extraction, modelling, evaluation and deployment for facial recognition*
- *Apply appropriate framework for ensuring the ethics of big data and its evaluation*
- *Measure the ethical efficiency of the deployed model*

ETHICAL DATA GATHERING AND PREPROCESSING

Introduction to Data Science Ethics- **Ethical Data Gathering** – Privacy and Human Right – Regulations – Privacy Mechanisms – Cautionary Tale – Backdoors and Messaging Encryption - Bias - Cautionary Tale – Bumps, Gorilla and Resumes – Human Experimentation - Cautionary Tale – Dating, Happiness, and Ads

ETHICAL DATA PREPROCESSING

Defining and Measuring Privacy - Cautionary Tale – Re-identification – Defining and Selecting variables - Cautionary Tale –Face Recognition – Fair Relabelling - Cautionary Tale –Biased Language   (12)

ETHICAL MODELLING

Privacy – Preserving Data Mining – Discrimination-Aware Modelling - Cautionary Tale –Predicting Recidivism and Redlining – Comprehensive Models and Explainable AI - Cautionary Tale- Explaining Webpage Classification – Including Ethical Preferences - Self-Driving Cars   (8)

ETHICAL EVALUATION

Ethical Measurement – Ethical Interpretation of the Results – Ethical Reporting - Cautionary Tale of Diederik Stapel   (8)

ETHICAL DEPLOYMENT

Access to the System – Differ Treatments for Different Predictions - Cautionary Tales: Censoring Search and Face Recognition – Honesty and DeepFake – Governance – Unintended Consequences   (8)

ETHICS OF BIGDATA

Big Data, Big Impact – Values and Action - Current Practices – Aligning values and Actions – Methods and Tools – Alignment Methodology Framework – Inquiry – Analysis – Articulation – Action – Value Personas – Global Data Management – A case Study – Benefits of Alignment

(9)

TOTAL : 45

TEXT BOOKS

1. *Data Science Ethics – Concepts, Techniques and Cautionary Tales , "David Martens" , Oxford University Press , June , 2022*

2. *Ethics of Big Data – Balancing Risk and Innovation , "Kord Davis", O'Reilly Media, First Edition, 2012.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	H	H			H	H		
CO2	H	H	M	H		H	H	M	L
CO3	M	H	M	H		H	H	M	L
CO4	M	M	M	H		H	H	M	M

21MDS84 – DATA PRIVACY AND SECURITY ANALYTICS LABORATORY

Contact Hours

PRE-REQUISITES

L	T	P	C
0	0	4	2

21MDS81

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

- *Construct symmetric and asymmetric algorithms to preserve confidentiality, integrity and authenticity of information resources*
- *Demonstrate network security tools including Packet capturing, Port scanning, and Mac Spoofing*
- *Apply Steganography algorithms under various media including text, images and audio*
- *Apply Machine Learning algorithms to detect various security attacks*
- *Devise defensive measures for securing information resources in Machine Learning Models using Federated Learning*

CONCEPTS TO BE COVERED

1. Implementing Substitution and Transposition cipher

2. Implementing DES, AES algorithms

3. Implementing RSA, Key exchange algorithm, ECC algorithm

4. Implementing Secure Hash algorithm, Digital Signature algorithm

5. Learning to install and work with Packet capturing tool Wireshark

6. Learning to install and work with Port scanning tool Nmap

7. Learning to install and work with MAC Spoofing tool Smac.

8. Implementing Steganography techniques using Deep Neural Networks/Generative

   Adversarial Network

9. Implementing ML techniques to accomplish Intrusion detection, Malware

   detection, Fraud detection and Vulnerability detection

10. Implementing Privacy Preserving ML using Differential Privacy / Secure

Multi-party Computation / Homomorphic encryption / Federated Learning

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H		H	H			H	H	H
CO2	H	L	H	H			H	H	H
CO3	H		H	H			H	H	H
CO4	H	M	H	H			H	H	H
CO5	H	M	H	H			H	H	H

21MDS85 - QUANTUM MACHINE LEARNING LABORATORY

Contact Hours

PRE-REQUISITES

L	T	P	C
0	0	4	2

21MDS82

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

- *Practice using the quantum state, gate, and circuit*
- *Apply various Quantum machine learning techniques to generate the analytic solutions*
- *Apply Quantum machine learning frameworks to build the learning models*
- *Evaluate the performance of machine learning models using performance metrics*
- *Identify the suitable Quantum machine learning model for the given problem*

CONCEPTS TO BE COVERED

Working with IBM QISKit, PennyLane, Microsoft Q#

1. Implementation of Quantum States and gates
2. Implementation of Feature Maps
3. Quantum clustering
4. Quantum pattern recognition
5. Comparison of Classical Machine Learning with Quantum Machine Learning
6. Quantum Learning Models
7. Quantum data analysis to analyze large quantum datasets, such as those generated by quantum sensors or simulators

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	M	H	H					
CO2	M	H	H	H					
CO3	M	M	H	H					
CO4	M	M	M	H					
CO5	M	M	M	M	-	-	-	M	H

21MDS91 ECONOMETRIC ANALYSIS

Contact Hours

PRE-REQUISITES

21MDS41, 21MDS45

L	T	P	C
3	1	0	4

ASSESSMENT: THEORY

COURSE OUTCOMES

At the end of this course the students will be able to

- *Understand the analysis of economic data using Simple and Multiple Regression Models*
- *Analyse the properties of Ordinary Least Square (OLS) Estimators, assumptions underlying Multiple Linear Regression Equation and understand the properties of sampling distribution of OLS Estimator*
- *Get a good knowledge in using Dummy Variables in Regression Analysis*
- *Analyse time series data using Regression models*

REVIEW OF MATHEMATICS AND STATISTICS

The Nature of Econometrics and Economic Data-What is Econometrics? – Steps in Empirical Economic Analysis-The structure of Economic Data- Causality and the Notion of Ceteris Paribus in Econometric Analysis-Regression Analysis with Cross-Sectional Data - The Simple Regression Model-Properties of OLS on any sample of data- Units of measurement and functional form-Expected values and Variances of OLS Estimators-Assumptions of Simple Regression - Regression through the origin and Regression on a constant   (9)

MULTIPLE LINEAR REGRESSION (MLR) ANALYSIS:ESTIMATION

Motivation for Multiple Regression: The Model with two independent variables- The Model with k independent variables- Obtaining OLS Estimates-Mechanics and Interpretation of the OLS Regression Equation-Meaning of holding other factors fixed in Multiple Regression-Changing more than one independent variable simultaneously-OLS fitted values and residuals-Goodness of fit-Regression through origin-The expected values of OLS Estimators-Assumptions of MLR-Including irrelevant variables in MLR-Omitted Variable bias-Variance of the OLS –The components of the OLS Variance: Multicollinearity-Estimating :Standard errors of OLS Estimators- -Efficiency of OLS-Gauss Markov Theorem   (9)

MULTIPLE REGRESSION ANALYSIS

Inference-Sampling distribution of OLS estimators-Testing Hypotheses about a single population parameter-The t-test-Confidence Intervals- Testing hypotheses about a single linear combination – Testing Multiple Linear Restrictions: The F test-Reporting regression results Multiple Regression Analysis – Further Issues: Effects of data scaling on OLS Statistics-More on functional form- More on goodness of fit and selection of regressors-Prediction and residual analysis   (9)

MULTIPLE REGRESSION ANALYSIS WITH QUALITATIVE INFORMATION

Dummy variables-Describing qualitative information – A single dummy independent variable-Using Dummy variables for multiple categories-Interactions involving dummy variables-A binary dependent variable-The linear probability model-Interpreting Regression results with discrete dependent variables (9)

REGRESSION ANALYSIS WITH TIME SERIES DATA

Nature of Time Series Data-Examples of Time Series Regression Models-Static models-Finite distributed lag models (9)

THEORY : 45
TUTORIAL : 15
TOTAL : 60

TEXT BOOK

1.*Wooldridge J.M. Introductory Econometrics, A Modern Approach, Fifth Edition, South-Western(2009)*

REFERENCE BOOKS

1. *"Gujarati, Basic Econometrics", Fourth Edition, The McGraw Hill Companies, 2004.*
2. *" Econometric Analysis", William H.Greene, Fifth Edition, Prentice Hall (2002).*
3. *"Theory of Econometrics", Koutsoyiannis, A., Second Edition,Palgrave Macmillian (2001).*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H	H	M	M	L	L	M	L
CO2	H	H	H	M	M	L	L	M	L
CO3	H		M	L				M	M
CO4	H	H	H	M	M	L	L	M	M

21MDS92 - WEB ANALYTICS

Contact Hours			
L	**T**	**P**	**C**
3	**0**	**0**	**3**

PRE-REQUISITES

21MDS34, 21MDS38, 21MDS41

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Understand the value of web analytics data and how it can be leveraged across all digital marketing functional teams*
- *Understand basic concepts from web analytics such as KPI"s, funnels and product analysis*
- *Know how to deploy & implement web analytics including server log files and page tagging*
- *Learn how to pull and interpret all the standard reports from the Google Analytics platform Use Google Analytics reports to provide actionable insights and recommendations to a business*

INTRODUCTION

Understanding web analytics – The foundations of Web analytics - Methodologies and their Accuracy - Web Analytics Fundamentals – Present and Future of Web analytics   (5)

DATA COLLECTION

Importance and Options –Web server log files - Page tagging - Clickstream data – Outcomes Data - Research Data - Competitive Data - Critical Components - Web Analytics Fundamentals

(9)

WEB ANALYTICS STRATEGY

Key performance indicators – Web Analytics as Competitive Intelligence - Web analytics process –

Choosing a Web Analytics Tool - Essence of Customer Centricity - Lab Usability Testing -

Heuristics evaluations – Site visits – Surveys   (9)

GOOGLE ANALYTICS

Creating Analytics Account - The Settings Dashboard - Account Dashboard Basics - Setting Up E-Commerce Advanced Dashboard features - Filtering Analytics Data - Funneling Visitors to their Destination - Google Adwords Integration   (10)

REPORTS

Reports - Analyzing Visitors - Traffic Sources - Content Overview - Site Search - Event Tracking - E-commerce Tracking   (12)

TOTAL : 45

TEXT BOOKS

1. *Avinash Kaushik, "Web Analytics2.0", John Wiley & Sons, 2010. (UNIT I, UNIT II, UNIT III)*

2. *Jerri L. Ledford, Joe Teixeira and Mary E. Tyler, "Google Analytics", John Wiley &Sons, 2013. (UNIT IV , UNIT V)*

REFERENCES BOOKS

1. *Brian Clifton, "Advanced web metrics with Google analytics", John Wiley & Sons, 2012.*
2. *Bernard J. Jansen, "Understanding User-Web Interactions via Web analytics", Morgan and Claypool, 2009.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	M	H	M	L				
CO2	L	H	M	M					
CO3	M	M	H	H					
CO4	M	M	M	H	H				L

21MDS93 - HEALTHCARE ANALYTICS

	Contact Hours		
L	T	P	C
3	1	0	4

PRE-REQUISITES

21MDS63, 21MDS81

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Describe the fundamental concepts of Healthcare data analytics*
- *Analyze and process different types of healthcare data stored in health data sources*
- *Apply the appropriate biomedical image and text analysis techniques for analyzing biomedical image and clinical text data*
- *Generate prediction health care model using temporal, sensor and text mining techniques*
- *Apply the healthcare analytic techniques to various applications and practical systems for real-time healthcare data*

INTRODUCTION

Introduction- Healthcare Data Sources and Basic Analytics - Healthcare Data Sources: Electronic Health Records: Components of HER- Coding system- Benefits of EHR - Barriers to Adopting EHR - Challenges of Using EHR Data   (8)

HEALTHCARE DATA SOURCES

Biomedical Image Analysis-Biomedical Imaging Modalities, Object Detection, Image Segmentation, Image Registration, Feature Extraction. Natural Language Processing and Data Mining for Clinical Text-Natural Language Processing, Mining Information from Clinical Text, Challenges of Processing Clinical Reports, Clinical Applications   (8)

HEALTHCARE DATA ANALYTICS

Social Media Analytics for Healthcare- Social Media Analysis for Detection and Tracking of Infectious Disease Outbreaks, Social Media Analysis for Public Health Research, Analysis of Social Media Use in Healthcare   (8)

ADVANCED DATA ANALYTICS FOR HEALTHCARE

Temporal Data Mining for Healthcare Data-Association Analysis, Temporal Pattern Mining, Sensor Data Analysis, Other Temporal Modelling Methods. Information Retrieval for Healthcare-Knowledge-Based Information in Healthcare and Biomedicine, Content of Knowledge-Based Information Resources, Indexing, Retrieval, Evaluation. Privacy-Preserving Data Publishing Methods in Healthcare- Data Overview and Pre-processing, Privacy-Preserving Publishing Methods, Challenges with Health Data   (12)

APPLICATIONS AND PRACTICAL SYSTEMS FOR HEALTHCARE

Fraud Detection in Healthcare, Mobile Imaging and Analytics for Biomedical Data-Image Formation, Data Visualization, Image Analysis, Image Management and Communication   (9)

THEORY : 45

TUTORIAL : 15

TOTAL : 60

TEXT BOOK

1. *Chandan K. Reddy and Charu C. Aggarwal, "HealthCare Data Analytics", CRC Press.*

REFERENCE BOOKS

1. *Laura B. Madsen, "Data-Driven Healthcare: How Analytics and BI are Transforming the Industry", Wiley and SAS Business*
2. *Series, 2014.*
3. *Trevor L. Strome, "Healthcare Analytics for Quality and Performance Improvement", John Wiley & Sons, Inc., 2013.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L	L	L	L					
CO2	M	H	H	H				H	H
CO3	H	H	H	H			M	H	H
CO4	H	H	H	H			M	H	H
CO5	H	H	H	H			M	H	H

]

21MDS94 - ECONOMETRIC ANALYSIS LABORATORY

Contact Hours			
L	**T**	**P**	**C**
0	0	4	2

PRE-REQUISITES

21MDS91

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

- *Implement simple Linear Regression Model using Gretl*

- *Implement Regression with incremental variable*

- *Implement the Polynomial models, Log Linear models using Gretl*

- *Implement Multi Linear Regression and Logistic Regression Models*

- *Compare and evaluate the above models*

CONCEPTS TO BE COVERED

1. Installing Gretl –Gretl Basics

2. Importing data

3. Using Gretl Language:Console, Scripts, Sessions and generating new variables

4. Statistical Analysis using Gretl

5. Simple Linear Regression model, Graph the data

6. Estimate the food expenditure relationship: Elasticity, Prediction and estimating varince

7. Estimating Nonlinear relationship

8. Regression with indicator variable

9. Prediction, Goodness of Fit and Modelling issues-Prediction in the Food Expenditure Model, Coefficient of determination

10. Choosing a functional form, linear log specification, residual plots, testing for normality

11. Polynomial Models

12. Log-linear models

13. Prediction intervals

14. Multiple Linear Regression Model

15. Logistic Regression Models

16. Regression with Time Series Data

TEXT BOOK

1. *Lee C.Adkins. Using Gretl for Principles of Econometrics, 5th Edition, 2018*
   [http://www.LearnEconometrics.com/gretl.html]

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H	H	H	H	L	M	M	M
CO2	H	H	H	H	H	L	M	M	M
CO3	H	H	H	H	H	L	M	M	M
CO4	H	H	H	H	H	L	M	M	M
CO5	M	M	H	M	M			M	M

21MDS95 - WEB ANALYTICS LABORATORY

Contact Hours			
L	T	P	C
0	0	4	2

PRE-REQUISITES

21MDS92

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

- *Learn the fundamentals of analyzing and reporting from Google and Adobe.*
- *Know common KPIs and map them to your online objectives*
- *Examine data concerning visits and visitors: bounce rate, traffic sourcesNavigate around Google and Adobe Analytics*
- *Analytics to access your reports and dashboards.*
- *Create a well-thought **web experience** for users, including an easily discoverable web presence*

CONCEPTS TO BE COVERED

1. Data collection using different analytics tools
2. Web log analysis
3. Identifying reach
4. Measuring acquisition
5. Calculating the conversion from search to purchase
6. Retain ratio computation
7. Report generation
8. Implementing the working of Google analytics
9. Implementing the working of Adobe Analytics

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	H	M	M					
CO2	H	L	H	H					
CO3	H	M	H	H					
CO4	M	M	M	M	H				
CO5	L	L	L	L	H				

21MDSE1 - BUSINESS INTELLIGENCE

Contact Hours

PRE- REQUISITES

21MDS34,21MDS64, 21MDS63

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Be exposed with the basic rudiments of business intelligence system*
- *Understanding the modeling aspects behind business Intelligence*
- *Understand the business intelligence lifecycle and the techniques used in it*
- *Be exposed with different data analysis tools and techniques*

BUSINESS INTELLIGENCE

Effective and timely decisions - Data, information and knowledge - Role of mathematical models - Business intelligence architectures: Cycle of a business intelligence analysis - Enabling factors in business intelligence projects - Development of a business intelligence system - Ethics and business intelligence.   (9)

KNOWLEDGE DELIVERY

The business intelligence user types, Standard reports, Interactive Analysis and Ad Hoc Querying, Parameterized Reports and Self-Service Reporting, dimensional analysis, Alerts/Notifications, Visualization: Charts, Graphs, Widgets, Scorecards and Dashboards, Geographic Visualization, Integrated Analytics, Considerations: Optimizing the Presentation for the Right Message.

(9)

EFFICIENCY

Efficiency measures - The CCR model: Definition of target objectives- Peer groups - Identification of good operating practices; cross efficiency analysis - virtual inputs and outputs - Other models. Pattern matching - cluster analysis, outlier analysis.

(9)

BUSINESS INTELLIGENCE APPLICATIONS

Marketing models - Logistic and Production models - Case studies.   (9)

FUTURE OF BUSINESS INTELLIGENCE

Future of business intelligence - Emerging Technologies, Machine Learning, Predicting the Future, BI Search & Text Analytics -Advanced Visualization - Rich Report, Future beyond Technology.

(9)

TOTAL: 45

TEXT BOOK

1. *Efraim Turban, Ramesh Sharda, Dursun Delen, "Decision Support and Business Intelligence Systems", 9th edition 2013*

REFERENCE BOOKS

1. *Larissa T. Moss, S. Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making", Addison Wesley, 2003.*

2. *Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley publications, 2009*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H	M	M	M				M
CO2	H	M	H	H	H				
CO3	M	H	M	M	H			M	
CO4	M	H	H	H	M			M	
CO5									

21MDSE2 – NATURAL LANGUAGE PROCESSING

Contact Hours

L	T	P	C
3	0	0	3

PRE- REQUISITES

21MDS32, 21MDS54

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Describe the mathematical and linguistic foundations, underlying approaches to the areas in NLP.*
- *Apply Hidden Markov Model for Word Processing and Speech Recognition.*
- *Evaluate approaches to syntax, semantic and pragmatic processing in NLP.*
- *Design models using CFG, PCFG, Lexical and Computational concepts for syntax and semantic processing based applications.*
- *Design, implement and test algorithms for NLP problems.*

INTRODUCTION

Knowledge in Speech and Language processing - Ambiguity - Models and Algorithms - Language, Thought and Understanding - Brief History.

Words and Transducers : Finite-State Morphological Parsing - Building a Finite-State Lexicon - Finite-State Transducers - Sequential Transducers and Determinism - FSTs for Morphological Parsing -Transducers and Orthographic Rules – Combining FST Lexicon and Rules - Lexicon-Free FSTs -Word and Sentence Tokenization -Detecting and Correcting Spelling Errors - Minimum Edit Distance. (9)

WORDS PROCESSING

N-grams : Counting words - Training and test sets - Evaluating N-grams - smoothing. Parts-of-speech tagging : English word classes - Tagsets - POS tagging - Rule based POS tagging - HMM POS tagging - Transformation based tagging - Evaluation and error analysis. Hidden Markov Model : Markov chains - HMM - Forward algorithm - Viterbi algorithm - Training HMM. (9)

SYNTAX

Formal grammars of English: Context free grammars - Grammar rules - Treebanks - Normal forms - Finite state and CFG - Dependency grammar - spoken language syntax. Parsing with CFG: Parsing as search - Ambiguity - Dynamic programming parsing methods. Statistical Parsing: Probabilistic CFG - Probabilitic CKY parsing - Problems with PCFGs - Improving PCFGs. (9)

SPEECH

Phonetics: Articulatory phonetics - Phonological categories. Speech Synthesis: Text normalization - Phonetic analysis – Prosodic analysis. Automatic Speech Recognition: Architecture - HMM to

speech - Feature extraction - Lexicon and Language model - Search and Decoding - Embedding training - Evaluation. (9)

SEMANTICS, PRAGMATICS AND APPLICATIONS

Representing meaning – Semantic Analysis - Lexical semantics

Applications: Information Retrieval – Statistical Alignment and Machine Translation – Text Categorization. (9)

TOTAL : 45

TEXT BOOKS

1. *Daniel Jurafsky and James H Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice-Hall, Upper Saddle River, NJ, 2000. (Para 1,2,3,4)*
2. *Manning, Christopher D. and Hinrich Schutze, "Foundations of Statistical Natural Language Processing", MIT Press., Cambridge, MA:, 1999. (Para 5)*

REFERENCE BOOKS

1. *James Allen,"Natural language Understanding", Pearson Education, Second Edition, 1994.*
2. *Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python, First Edition, O_Reilly Media, 2009.*
3. *Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	M	M	M					
CO2	L		M	M					
CO3	L		L	L					
CO4	L		L	M					
CO5	H	L	M	H					

21MDSE3 - COMPUTATIONAL INTELLIGENCE

Contact Hours

PRE- REQUISITES

Consent of the Instructor

L	T	P	C
3	0	0	3

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Apply Evolutionary programming techniques to solve a given application*
- *Apply swarm intelligence techniques to solve a given application*
- *Develop and implement a basic trainable neural network for a computing application*
- *Develop and implement a basic fuzzy logic system for a typical computing application*
- *Analyze a given problem, and identify and define the computing requirements appropriate to its solution*

INTRODUCTION

Introduction to Computational Intelligence - Computational Intelligence Paradigms

(7)

ARTIFICIAL NEURAL NEWORKS

Artificial Neuron – Supervised Learning Neural Networks – Unsupervised Learning Neural Networks – Radial Basis Function Networks – Reinforcement Learning

(10)

EVOLUTIONARY COMPUTATION

Introduction – Genetic Algorithms – Genetic programming – Evolutionary Programming

(9)

COMPUTATIONAL SWARM INTELLIGENCE

Basic Particle swarm optimization – Social Network Structure – Basic variations – Basic PSO parameters – Single solution Particle optimization – Applications

(10)

ARTIFICIAL IMMUNE SYSTEM and FUZZY SYSTEMS

AIS: Natural Immune system – Artificial immune models. Fuzzy Systems: Fuzzy sets – Fuzzy logic reasoning – Fuzzy controllers – Fuzzy Sets.

(9)

TOTAL: 45

TEXT BOOK

1.   *Andries P. Engelbrecht, Computational intelligence: an introduction, edition 2, John Wiley and Sons, 2007.*

REFERENCE BOOKS

1.   *Eberhart, E. and Y. Shi., Computational Intelligence:Concepts and Implementations, Morgan Kaufmann, San Diego, 2007*

2.   *Konar, A., Computational intelligence : Principles, Techniques, and Applications , Springer, Berlin, Germany, 2005.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	M	H	M					
CO2				H	M		L		
CO3	M		H	L				H	
CO4	M		H	L				H	
CO5	H	M			H		L		L

21MDSE4 - GEOGRAPHICAL INFORMATION ANALYSIS

Contact Hours

L	T	P	C
3	0	0	3

PRE- REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Differentiate the concepts of geographic information systems from other types of information systems*

- *Use modern industry-standard GIS software for conducting basic GIS analysis and producing cartographic output*

- *Apply GIS analysis to address geospatial problems*

- *Apply mathematical concepts, including statistical methods, to data to be used in geospatial analysis*

INTRODUCTION

Systems, Sciences and Society - Applications   (9)

PRINCIPLES

Nature of Geographic Data - Representing Geography - Geo referencing - Uncertainty - The GeoWeb   (9)

TECHNIQUES

GI System software - Geographic modeling - GIS Data collection - Creating and maintaining Geographic databases- Geo Web   (9)

ANALYSIS

Cartography and Map Production - Geovisualization - Spatial Data Analysis - Spatial Analysis and Inference- Spatial Modeling with GI System   (9)

MANAGEMENT AND POLICY

Managing GI Systems - Information and Decision making - The Risks   (9)

TOTAL : 45

TEXT BOOK

1. Longley, P.A., Goodchild, M.F., Maguire, D.J., and Rhind, D.W., "Geographic Information Systems and Science", New York, John Wiley & Sons, 2015.

REFERENCE BOOK

1. Gorr and Kurland, "GIS Tutorial: Basic Workbook 1", ESRI Press, 2011.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	H	M	M					
CO2	H	M	H	H					
CO3	H	M	H	H					
CO4	H	M	H	H					

21MDSE5 - ROBOTIC PROCESS AUTOMATION

Contact Hours			
L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent to the Instructor

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Understand the basic concepts and components of RPA*
- *Deploy process in RPA platforms*
- *Describe the different types of variables, control flow and data manipulation techniques*
- *Understand various control techniques in RPA*
- *Describe various types and strategies to handle exceptions*

INTRODUCTION TO RPA

Scope and techniques of automation, Robotic process automation - Benefits of RPA, Components of RPA, RPA platforms, The future of automation   (7)

RPA PLATFORM

About UiPath - Record and Play - Installing and Learning Ui Path Studio- - Task recorder - Step-by-step examples using the recorder   (9)

SEQUENCE, FLOWCHART AND CONTROL FLOW

Sequencing the workflow- Activities- Control flow, various types of loops, and decision making-Step-by-step example using Sequence and Flowchart- Step-by-step example using Sequence and Control flow, Data Manipulation: Variables and Scope - Collections-Arguments Purpose and use-Data table usage- Clipboard management- File operation- CSV/Excel to data table and vice versa

(10)

ACT ON CONTROLS

Finding and attaching windows- Finding the control- Techniques for waiting for a control- Act on controls – mouse and keyboard activities- Working with UiExplorer- Handling events- Revisit recorder- Screen Scraping- When to use OCR- Types of OCR available- How to use OCR- Avoiding typical failure points   (9)

HANDLING USER EVENTS AND EXCEPTIONS

Assistant Bots- Monitoring system event, image and element triggers- Launching an assistant bot, Exception Handling, Debugging, and Logging: Exception handling- Common exceptions and ways to handle them- Logging and taking screenshots Debugging techniques- Collecting crash dumps-Error reporting- Future of RPA   (10)

TOTAL : 45

TEXT BOOK
1. Alok Mani Tripathi, Learning Robotic Process Automation, Packt Publishing Publications, 2018

REFERENCE BOOKS

1. Tom Taulli, The Robotic Process Automation Handbook : A Guide to Implementing RPA Systems, A press Publications, 2020
2. Frank Casale, Rebecca Dilla, Heidi Jaynes ,Lauren Livingston,"Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.
3. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant
4. Srikanth Merianda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation
5. https://www.uipath.com/rpa/robotic-process-automation

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L		M	M					L
CO2	H	L	H	H				H	H
CO3	L		M	M				M	M
CO4	L		H	H				M	M
CO5	L		M	M				M	M

21MDSE6 - MACHINE LEARNING IN INDUSTRY 4.0

Contact Hours

L	T	P	C
3	0	0	3

PRE-REQUISITES

21MDS45, 21MDS48

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Describe the components and technologies used in Industry 4.0*
- *Highlight the importance of machine learning in Industry 4.0*
- *Apply the machine learning techniques for manufacturing process*
- *Analyze the insights on machine learning techniques used for Industry4.0*

INDUSTRY 4.0 FRAMEWORK

Basics - Main Concepts and Components of Industry 4.0 - Proposed Framework for Industry 4.0 - Proposal Framework - Business Models - Key Business Model Components of Smart and Connected Products - Proposed Framework - Lean Production Systems for Industry 4.0 - Technology Roadmap for Industry 4.0   (9)

TECHNOLOGIES AND APPLICATIONS

Data Analytics in Manufacturing - Role of Machine Learning in Industry 4.0- Internet of Things in Industry 4.0 - Advances in Robotics in the Era of Industry 4.0   (10)

ROLE OF AUGMENTED REALITY IN THE AGE OF INDUSTRY 4.0

Additive Technologies and Applications in Healthcare   (8)

MACHINE LEARNING FOR SUSTAINABLE MANUFACTURING IN INDUSTRY 4.0

Machine Learning for Sustainable Manufacture : Introduction; Frameworks and Challenges -Role of Machine Learning in Cyper-Physical Systems to Improve Manufacturing Process - Machine Learning for Resource Optimization   (9)

SUPERVISED LEARNING ASSISTED MODELS FOR MANUFACTURING OF SUSTAINABLE COMPONENTS

Machine Learning Approach for Supply Chain and Operations in Industry 4.0 - Applications of Machine Learning in Manufacturing Sector   (9)

TOTAL : 45

TEXT BOOKS

1. Apl Ustundag, Emre Cevikcan, "Industry 4.0 - Managing Digital Transformation", Springer, 2018.
2. Raman Kumar, Sita Rani, et.al., "Machine Learning for Sustainable Manufacturing in Industry 4.0", CRC Press, 2023.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H	M	L				L	L
CO2	M	M	H	M			L	M	L
CO3	H	H	H	H	M	L	M	M	M
CO4	M	H	H	H	M	L	L	M	M

21MDSE7 - CYBER SECURITY ANALYTICS

Contact Hours			
L	T	P	C
3	0	0	3

PRE-REQUISITES

21MDS81, 21MDS84

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Understand the basics of cyber security and possible solutions*
- *Determine supervised learning for signature detections*
- *Apply machine learning algorithm for anomaly detections*
- *Determine machine learning algorithms for network analysis and intrusion detections*
- *Develop algorithm to detect insider threat and to ensure web security*

INTRODUCTION

Cybersecurity -Data Mining- Machine Learning - Review on Cybersecurity Solutions - Proactive Security Solutions - Reactive Security Solutions - Successful ML applications in Cyber security   (6)

SUPERVISED LEARNING FOR MISUSE/SIGNATURE DETECTION

Misuse/Signature Detection -Machine Learning in Misuse/Signature Detection -Machine-Learning Applications in Misuse Detection – Malware Analysis - Static – Dynamic – Smartphone security   (8)

MACHINE LEARNING FOR ANOMALY DETECTION

Introduction -Anomaly Detection -Machine learning in Anomaly Detection Systems -Machine-Learning Applications in Anomaly Detection Supervised Anomaly detection - Spam detection - Unsupervised Anomaly Detection   (8)

MACHINE LEARNING FOR PROFILING NETWORK TRAFFIC – Introduction - Network Traffic Profiling and Related Network Traffic Knowledge -Machine Learning and Network Traffic Profiling -Data-Mining and Machine-Learning Applications in Network Profiling -   Network IDS – DDOS -Emerging Challenges in Intrusion Detection – Log Analysis   (8)

 BOTNETS AND INSIDER THREATS -   Botnet topologies, botnet detection using NetFlow analysis - Botnet detection using DNS analysis, introduction to insider threats, Insider threat profiles-masquerader detection strategies–Using honey tokens for insider threat   (8)

WEB SECURITY, EMAIL, SOCIAL NETWORK SECURITY

Web threat detection via web server log analysis -Alert aggregation for web security -Spam detection, Phishing detection -: Detecting compromised accounts, detecting social
 network spam   (7)

TOTAL : 45

TEXT BOOK

1. Dua, Sumeet, and Xian Du. "Data Mining and Machine Learning in Cyber Security", CRC press, 2016.

REFERENCE BOOKS

1. Jacobs Jay and Bob Rudis, "Data Driven Security Analysis, Visualization, and Dashboards", John Wiley & Sons, 2014.
2. Stolfo, Salvatore J., Bellovin S M, Hershkop S., Keromytis, A.D., Sinclair S, Smith.S, " Insider Attack and Cyber Security: Beyond The Hacker", Springer, 2008.
3. Bhattacharyya, Dhruba Kumar, and Jugal Kumar Kalita. "Network Anomaly Detection: A Machine Learning Perspective", CRC Press, 2013.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L		L	L				L	L
CO2	H	M	H	H				H	H
CO3	H	H	H	H				H	H
CO4	H	M	H	H				H	H
CO5	H	H	H	H				H	H

21MDSE8 - KNOWLEDGE ENGINEERING

Contact Hours			
L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Describe how the integrated KM cycle combines the advantages of other KM life-cycle models*
- *Link the KM frameworks to key KM concepts and the major phases of the KM cycle*
- *Describe the major techniques used to elicit tacit knowledge from subject matter experts*
- *Analyze the type of knowledge to be captured and codified, select the best approach to use, and discuss*
- *Discuss how communities can be linked to organizational memory in order to foster organizational learning and innovation*

KNOWLEDGE MANAGEMENT

KM Myths - KM Life Cycle - Understanding Knowledge - Knowledge intelligence - Experience - Common Sense - Cognition and KM - Types of Knowledge - Expert Knowledge - Human Thinking and Learning (9)

KNOWLEDGE MANAGEMENT SYSTEM LIFE CYCLE

Challenges in Building KM Systems - Conventional Vs KM System Life Cycle (KMSLS) - Knowledge Creation and Knowledge Architecture - Nonaka's Model of Knowledge Creation and Transformation - Knowledge Architecture (9)

CAPTURING KNOWLEDGE

Evaluating the Expert - Developing a Relationship with Experts - Fuzzy Reasoning and the Quality of Knowledge - Knowledge Capturing Techniques, Brainstorming - Protocol Analysis - Consensus Decision Making - Repertory Grid- Concept Mapping – Blackboarding (9)

KNOWLEDGE CODIFICATION

Modes of Knowledge Conversion - Codification Tools and Procedures - Knowledge Developer's Skill Sets - System Testing and Deployment - Knowledge Testing - Approaches to Logical Testing, User Acceptance Testing - KM System Deployment Issues - User Training - Post implementation (9)

KNOWLEDGE TRANSFER AND SHARING

Transfer Methods - Role of the Internet - Knowledge Transfer in e-world - KM System Tools - Neural Network - Association Rules - Classification Trees - Data Mining and Business Intelligence - Decision Making Architecture - Data Management - Knowledge Management Protocols - Managing Knowledge Workers (9)

TOTAL : 45

TEXT BOOKS

1. *Elias.M. Award & Hassan M. Ghaziri,"Knowledge Management" Pearson Education, 2007.*

2. *KimizDalkir, Knowledge Management in Theory and Practice, MIT Press, 2011.*

REFERENCE BOOKS

1. Guus Schreiber, Hans Akkermans, Anjo Anjewierden, Robert de Hoog, Nigel Shadbolt, Walter Van de Velde and Bob Wielinga, "Knowledge Engineering andManagement", Universities Press, 2001.
2. C.W. Holsapple, "Handbooks on Knowledge Management", International Handbooks on Information Systems, Vol 1 and 2, 2003.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L	M	H	M					
CO2	L	H	H	M					
CO3	L	M	M	H					
CO4	L	M	H	M	M				
CO5		L			M	M		H	

21MDSE9 - RECOMMENDER SYSTEMS

Contact Hours			
L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Understanding of recommender systems and their applications*
- *Analyze the different approaches towards recommendation*
- *Evaluate the effectiveness of the recommender system*
- *Design recommender systems*

INTRODUCTION TO RECOMMENDER SYSTEMS

Goals of Recommender Systems - Basic Models of Recommender Systems - Domain Specific Challenges in Recommender Systems - Advanced Topics and Applications

Neighborhood-Based Collaborative Filtering - Introduction - Key Properties of Ratings Matrices - Predicting Ratings with Neighborhood-Based Methods - Clustering and Neighborhood-Based Methods - Dimensionality Reduction and Neighborhood Methods - A Regression Modeling View of Neighborhood Methods - Graph Models for Neighborhood-based Methods   (9)

MODEL-BASED COLLABORATIVE FILTERING

Introduction - Decision and Regression Trees - Rule-Based Collaborative Filtering - Naive Bayes Collaborative Filtering - Using an Arbitrary Classification Model as a Black Box - Latent Factor Models - Integrating Factorization and Neighborhood Models   (9)

CONTENT-BASED RECOMMENDER SYSTEMS

Introduction - Basic Components of Content-Based Systems - Preprocessing and Feature Extraction - Learning User Profile and Filtering - Content-based Versus Collaborative recommendations - Using Content-Based Models for Collaborative Filtering

Knowledge-Based Recommender Systems: Introduction - Constraint-Based Recommender Systems - Case-Based Recommendations - Persistent Personalization in Knowledge-Based Systems

                (9)

ENSEMBLE-BASED AND HYBRID RECOMMENDER SYSTEMS

Introduction - Ensemble Methods from the Classification Perspective - Weighted Hybrids - Switching Hybrids - Cascade Hybrids - feature Augmentation Hybrids- Meta-Level Hybrids - feature Combination Hybrids - Mixed Hybrids

EVALUATING RECOMMENDER SYSTEMS

Introduction - Evaluation paradigms - General Goals of Evaluation Design - Design Issues in Offline Recommender Evaluation - Accuracy Metrics in Offline Evaluation - Limitations of evaluation Measures   (9)

CONTEXT-SENSITIVE RECOMMENDER SYSTEMS

Introduction - The Multidimensional Approach - Contextual Pre-filtering: A Reduction-Based Approach - Post-Filtering Methods - Contextual Modeling

Time and Location-Sensitive Recommender Systems: Introduction - Temporal Collaborative Filtering - Discrete Temporal Models - Location-Aware Recommender Systems

                                                                                                    (9)

TOTAL : 45

TEXT BOOKS

1. *Charu C.Aggarwal, Recommender Systems: The Textbook, Springer International Publishing, Switzerland, 2016.*
2. *Dietmar Jannach, Markus Zanker, Alexander Felfernig, Gerhard Friedrich, Recommender Systems: An Introduction, Cambridge University Press, First Edition.*

REFERENCE BOOK

1. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer (2011), 1st ed.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L	M	L	L					
CO2	L	H	L	L					
CO3	M	L	L	L					
CO4	H	L	M	M					

21MDSE10- SOCIAL NETWORK ANALYSIS

Contact Hours			
L	T	P	C
3	0	0	3

PRE-REQUISITES

21MDS53, 21MDS63

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Work on the internal components of the social network*
- *Model and visualize the social network*
- *Mine the behaviour of the users in the social network*
- *Predict the possible next outcome of the social network*
- *Preserving privacy in social networks and real time social network application*

INTRODUCTION

Introduction to Web - Limitations of current Web - Development of Semantic Web - Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks   (9)

MODELING AND VISUALIZATION

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data - Random Walks and their Applications -Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships   (9)

MINING COMMUNITIES

Aggregating and reasoning with social network data, Advanced Representations - Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities - Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.   (9)

EVOLUTION

Evolution in Social Networks - Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing – Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation - Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction - Bayesian Probabilistic Models - Probabilistic Relational Models   (9)

PRIVACY IN SOCIAL NETWORKS AND APPLICATIONS

Introduction - Privacy breaches in Social Networks - Privacy definitions for publishing data - privacy preserving mechanisms. APPLICATION : A learning based approach for Real Time Emotion Classification of Tweets - Assessing the opinion of users in Social Network environment.   (9)

TOTAL : 45

TEXT BOOKS

1. *Peter Mika, "Social Networks and the Semantic Web", Springer, 1st edition, 2007.*
2. *Borko Furht, "Handbook of Social Network Technologies and Applications, Springer", 1st edition, 2011.*
3. *Charu C. Aggarwal, "Social Network Data Analytic", Springer; 2014.*

REFERENCE BOOKS

1. *Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, "Computational Social Network Analysis: Trends, Tools and Research*
Advances", Springer, 2012
2. *Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.*
3. *Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking - Techniques and applications", Springer,*
1st edition, 2012
4. *Przemyslaw Kazienko, Nitesh Chawla,"Applications of Social Media and Social Network Analysis", Springer, 2015 CP5007 BIO-INSPIRED CO.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L		L	L					
CO2	H	M	H	H				H	H
CO3	H	M	H	H				H	H
CO4	H	M	H	H				H	H
CO5	H	M	H	H				H	H

21MDSE11 - HUMAN RESOURCE ANALYTICS

Contact Hours			
L	**T**	**P**	**C**
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Describe the theory, concepts, and business application of human resources research, data, metrics, systems, analyses, and reporting*
- *Develop an understanding of the role and importance of HR analytics, and the ability to track, store, retrieve, analyse and interpret HR data to support decision making*
- *Apply benchmarks/metrics to conduct research and statistical analyses related to Human Resource Management*
- *Employ Power BI software to record, maintain, retrieve and analyse human resources information*
- *Apply quantitative and qualitative analysis to understand trends and indicators in human resource data; understand and apply various statistical analysis methods*

INTRODUCTION

Evolution of HR Analytics, HR information systems and data sources, HR Metric and HR Analytics, Evolution of HR Analytics; HR Metrics and HR Analytics; Intuition versus analytical thinking; HRMS/HRIS and data sources; Analytics frameworks like LAMP, HCM:21(r) Model

(8)

DIVERSITY ANALYSIS

Equality, diversity and inclusion, measuring diversity and inclusion, Testing the impact of diversity, Workforce segmentation and search for critical job roles (8)

RECRUITMENT AND SELECTION ANALYTICS

Evaluating Reliability and validity of selection models, Finding out selection bias, Predicting the performance and turnover (8)

PERFORMANCE ANALYSIS

Predicting employee performance, Training requirements, evaluating training and development, Optimizing selection and promotion decisions (8)

MONITORING IMPACT OF INTERVENTIONS

Tracking impact interventions, Evaluating stress levels and value-change. Formulating evidence based practices and responsible investment. Evaluation mediation process, moderation and interaction analysis (7)

POWER BI

HR data structuring - Modeling - Editing -Visualizing - Publishing   (6)

TOTAL : 45

TEXT BOOKS

 1. *Edwards Martin R, Edwards Kirsten, "Predictive HR Analytics: Mastering the HR Metric",
Kogan Page Publishers, 2016.*
2. *Fitz-enz Jac, "The new HR analytics: predicting the economic value of your company's human
capital investments", AMACOM, 2010.*
3. *Fitz-enz Jac, Mattox II John , "Predictive Analytics for Human Resources", Wiley, 2014.*
4. *Roger F.Silva, " Power BI Academy - HR Recruitment: Step by Step Guide to Create an Easy
Dashboard for Human Resources, Amazon Digital Services LLC-KDP, 2020.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H							
CO2	H	H		H					L
CO3			H						M
CO4									M
CO5	H	H							M

21MDSE12 - MARKETING ANALYTICS

Contact Hours			
L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent to the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Understanding of how to use marketing analytics to predict outcomes and systematically Allocate resources*
- *Measure customer lifetime value and improve Customer Retention*
- *Evaluate strategic marketing alternatives based on whether they improve customer Retention and lifetime value*
- *Design and conduct effective experiments that test your marketing campaigns--and then Use the results to make future marketing decisions*
- *Analyse and Interpret outputs using regression and explore confounding effects and Biases*

MARKETING ANALYTICS

Introduction to the marketing process - Resource Allocation – Steps in Resource Allocation – Resource Allocation and New product performance – Measuring ROI – Using Text Analytics to improve marketing strategy - Use case for Resource allocation and ROI   **(9)**

CLUSTER ANALYSIS

Customer Segmentation – Bases of Segmentation – Cluster Analysis in Segmentation – Steps in Cluster Analysis – Use Case for Cluster Analysis in segmenting customers – Multiple Regression in Marketing Mix models – Elasticity Models – Building a Comprehensive model – Variables of Comprehensive models–Koyck Model–Use Case for Application of Marketing Mix Elements
(9)

CUSTOMER LIFETIME VALUE

Quantifying customer relationship – Cohort and Incubate - CLV Model – Calculating CLV – Limitations of CLV Model –Model Based on Purchase occasion rate - Prospect Life Time Value – Issues with PLV- Customer Retention and CLV – Use case for application of CLV   **(9)**

 Determining Cause and Effect through Experiments-Designing Basic Experiments-Designing Before - After Experiments-Designing Full Factorial – Field Experiments - Web Experiments – Designing an Experiment - Analyzing an Experiment - Pitfalls of Marketing Experiments - Maximizing Effectiveness: - Use Case in application of experimentation   **(9)**

AUTOMATION OF MARKETING MODELS

Marketing and Artificial Intelligence – Applications of AI to Marketing. Implementing Marketing Analytics: Organisation Structure – Function and Process – Organisation Metrics – Business Cycle

and Marketing Cycle match – Marketing collaboration and Technology – Analytics process – Organisation change – Use case in AI application in Marketing **(9)**

TOTAL: 45

TEXT BOOK

1. *Rajkumar Venkatesan, Paul.W.Farris and Ronald . T.Wilcox, Marketing Analytics: Essential tools for Data Driven Decisions, Darden Business Publiching, University of Virgina Press, London, First Edition,2021.*

REFERENCE BOOKS

1. *Mike Grigsby, Marketing Analytics :A Practical Guide to Improving Consumer Insights using Data Techniques, Kogan Page Publisher, Third Edition,2022.*
2. *Moutusy Maity and Pavankumar Gurazada, Marketing Analytics, Oxford University Press, First Edition, 2021.*
3. *Mirza Rahim Baig, Gururajan Govindan and Vishwesh Ravi Shrimali, Data Science for Marketing Analytics, Packt Publishing,Second Edition, 2021.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H		M		L				
CO2	H	M		L		H			
CO3				H	H	M			
CO4									
CO5			H	H		L	M		L

21MDSE13 - DATA ANALYTICS SOFTWARE DEVELOPMENT

Contact Hours			
L	T	P	C
3	0	0	3

PRE-REQUISITES

21MDS45, 21MDS64

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Gain knowledge on the foundations of machine learning in software engineering*
- *Investigate emerging techniques and paradigms and implement them into prototype.*
- *Design ML Component using software architecture.*
- *Describe quality assurance issues.*
- *Learn the guidelines for process, teams, and responsible practices.*

INTRODUCTION

Data scientists and Software Engineers – Machine Learning challenges in software projects. From models to systems :ML and Non-ML components in a system – Systems thinking. Machine learning for software engineers: Machine Learning- Models-Predictions –Technical Concepts: Model architectures- Model Parameters-Hyperparameters- Model Storage–Machine learning pipelines   (9)

REQUIREMENTS ENGINEERING

Machine learning: Problems that benefit from machine learning - Tolerating Mistakes and ML Risk - Continuous Learning – Costs and benefits – The business Case: Machine Learning as Predictions. Setting and measuring goals: Self-help legal chatbot – Setting goals .Gathering requirements: Fall detection - Untangling Requirements - Eliciting Requirements - How much requirements engineering and when- Planning for mistakes: Designing for Failures - Hazard Analysis and Risk Analysis   (9)

ARCHITECTURE AND DESIGN

Understanding the Architectural Components in ML-enabled Systems - Developing a Software Architect's Mindset - Evaluating the Quality Attributes - Strategies and Considerations for Deployment - Automation of the Pipeline - Scaling Machine Learning Systems - Planning for Operations: Maintenance, Monitoring, and Error Handling   (9)

QUALITY ASSURANCE

Introduction - Defining Model Quality - Measuring Prediction Accuracy - Model Quality: Exploring Slicing, Capabilities, Invariants, and Testing Strategies - Ensuring Data Quality in Machine Learning - Assessing Pipeline Quality - Quality Assurance: Monitoring, Maintenance, and Error Handling - Integration and System Testing (9)

PROCESS, TEAMS, AND RESPONSIBLE PRACTICES

Understanding the Process Models - Agile, Waterfall, and Hybrid Approaches - Interdisciplinary Teams: Importance, Roles and Responsibilities, Effective Communication and Collaboration Strategies - Technical Debt. Responsible ML Engineering: Principles, Addressing Ethical Considerations and Bias - Ensuring Versioning, Provenance, and Reproducibility - Interpretability and Explainability for Transparency - Safety Measures - Security and Privacy Considerations - Ensuring Fairness in Decision Making - Accountability and Transparency for machine Learning Systems (9)

TOTAL: 45

TEXTBOOKS

1. *Christian Kästner," Machine Learning in Production: From Models to Products", 2022.*
2. *Andriy Burkov , " Machine Learning Engineering " , True Positive Inc. 2020.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	M	M	L	L				
CO2	M	H	H	M	M		L	L	M
CO3	M	H	H	L	L			L	L
CO4		M	H	M	M				M
CO5		L	M	L	M	M	M	M	M

21MDSE14 - FINANCIAL ANALYTICS

Contact Hours		
L	T	P	C
3	0	0	3

PRE-REQUISITES

21MDS31, 21MDS41

ASSESSMENT: THEORY

COURSE OUTCOMES

- *Describe the concepts learned in Corporate Finance, Finance returns, Portfolio, Technical and Credit risk analysis*
- *Apply the models to perform corporate financial analysis, financial market analysis, portfolio analysis, technical analysis and credit risk analysis*
- *Compare and Choose the models for the given data*
- *Evaluate the models generated for financial, portfolio, technical and credit risk analysis models*

CORPORATE FINANCIAL ANALYSIS: Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model- Payback, NPV, IRR **(9)**

FINANCIAL MARKET ANALYSIS: Estimation and prediction of risk and return (bond investment and stock investment) –Time series- examining nature of data, Value at risk, ARMA, ARCH and GARCH **(9)**

PORTFOLIO ANALYSIS: Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility **(9)**

TECHNICAL ANALYSIS: Prediction using charts and fundamentals – RSI, ROC, MACD, moving average and candle charts, simulating trading strategies. Prediction of share prices **(9)**

CREDIT RISK ANALYSIS: Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model **(9)**

TOTAL: 45

TEXT BOOKS

1. Mark J. Bennett, Dirk L. Hugen, "Financial analytics with R", Cambridge university press, 2016.
2. Ruey S. Tsay, "An Introduction to Analysis of Financial Data with R", John Wiley, 2012.
3. Edward E Williams, John A Dobelman. "Quantitative Financial Analytics: The Path To Investment Profits", World Scientific Publishing, 2018.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M						L		
CO2	M						L		M
CO3	M		H				L		M
CO4	H	H					L		M

21MDSE15- GPU COMPUTING

Contact Hours			
L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Describe the architecture of Modern GPUs for parallel Programming.*
- *Demonstrate parallel applications using OpenACC, CUDA programming Model,OpenCL Programming Model for matrix applications.*
- *Apply appropriate CUDA threading Models in constructing Parallel Applications.*
- *Analyze the performance of the CUDA applications and OpenCL applications with different memory types and threading models.*
- *Estimate the speed-up that could be achieved by parallel code using tools and techniques that are available for CUDA code and OpenCL code.*

INTRODUCTION

GPU as parallel computers, Architecture of Modern GPUs, Motivation, Parallel programming Models - OpenACC, CUDA, OpenCL (10)

OpenACC Introduction, Memory Model, Execution Model, Basic OPenACC programs (5)

BASICS OF CUDA

CUDA Program structure, Example - Matrix-Matrix Multiplication, Device Memories and Data Transfer, Kernel Functions and Threading. (10)

CUDA THREAD ORGANIZATION

Using BlockIdx and ThreadIdx, Synchronization and Transparent Scalability, Thread Assignment, Thread Scheduling and Latency Tolerance. (10)

CUDA MEMORY

Memory Hierarchy, Strategy for reducing global memory traffic, Memory as a limiting factor to parallelism. Efficiently using GPU memory- Techniques to increase Parallelism (10)

TOTAL : 45

TEXT BOOKS

1. *David. B. Krik and Wen-Mei W. Hwu, "Programming Massively parallel processors- A Hands on Approach", Second Edition,*

2. *Margan and Kaufmann Publishers, 2010.*
3. *Anath Grama, Anshul Gupta, George Karypis and Vipin Kumar, "Introduction to Parallel Computing" Second Edition, Pearson*
4. *Education, 2003.*
5. *Michael J Quinn, " Parallel Programming in C and OpenMP", Tata McGraw-Hill Edition, 2003.*

REFERENCE BOOKS
1. *Rob Farber, "Parallel Programming with OpenACC",First Edition,Morgan Kaufman, 2016*
2. *Rob Farber,"CUDA Application Design and Development", Morgan Kaufman, 2011.*
3. *Jason Sanders and Edward Kandrot, "CUDA BY EXAMPLE- An introduction to General Purpose GPU Programming",*
4. *Addison-Wesley, 2010*
5. *OpenCL Programming Guide for the CUDA Architecture, Version 3.2, 2010.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L	L	L	L					
CO2	H	H	H	H				H	H
CO3	H	H	H	H				H	H
CO4	H	H	H	H				H	H
CO5	H	H	H	H					

21MDSE16 - MOBILE APPLICATION DEVELOPMENT

Contact Hours		
L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent to the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Demonstrate the fundamentals of mobile application development*
- *Illustrate the basic concepts of KOTLIN programming*
- *Develop and customize application user interfaces*
- *Develop interactive applications in android using databases with multiple activities including audio, video and notifications, using Maps, Location based services*
- *Create and deploy interactive applications using Flutter Framework*

INTRODUCTION

Introduction – Native and Hybrid Mobile Apps Frameworks – iOS with Swift – React Native with Javascript, Android with Kotlin, Flutter with Dart, Xamarin with C# - Tools – Android Studio, Xcode, Visual Studio Code   (6)

KOTLIN PROGRAMMING

Introduction to KOTLIN programming - Basics of Kotlin, Operations and Priorities, Decision Making. Loop Control, Data Structures(Collections), Functions, Object Oriented Programming: Inheritance, abstract, interface, super and this, visibility modifiers   (12)

INTRODUCTION TO ANDROID

Basics of an ANDROID application, introduction to manifest, externalizing resources, application lifecycle, ANDROID activities, Widgets: Button, TextView, ImageView, ProgressBar, ListView, EditText, Calendar, DateTime etc, Working with Intent and Files   (6)

PREFERENCES, DATABASE AND CONTENT PROVIDER

Creating and Saving Shared Preferences, Retrieving Shared Preferences. Databases and Content Providers - Introducing SQLite, Creating Content Providers. Hardware Sensors - Using Sensors and the Sensor Manager, Interpreting Sensor Values. Maps, Geocoding and Location-Based Services - Using Location based services, finding your current location, Using the Geocoder, Creating a map-based activity. Audio, Video and using the Camera - Playing audio and video with the Media Player. Telephony and SMS - Hardware Support for Telephony, Introducing SMS and MMS   (12)

INTRODUCTION TO FLUTTER

Meet Flutter, A brief intro to Dart, Breaking into Flutter, Flutter UI: Important widgets, themes, and layout, User interaction: Forms and gestures, Pushing pixels: Flutter animations and using the canvas

(9)

TOTAL : 45

TEXT BOOKS

1. *Wei-Meng Lee, Beginning Android™ 4 Application Development, 2012 by John Wiley &*
2. *Sons, Inc., Indianapolis, Indiana, ISBN: 978-1-118-19954-1*
3. *Learn Kotlin for Android Development – Peter Spath – Apress – 2019*
4. *Reto Meier, Ian Lake, " Professional Android, 4th Edition", 2018*
5. *Flutter in Action,- Eric Windmill- Manning, 2020.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	L	M	H	M				
CO2	H	H	H	M	H			M	M
CO3	L	H	L	M	M			M	H
CO4	M	H	M	H	L			M	L
CO5	M	M	M	L	M			L	M

21MDSE17- BLOCKCHAIN TECHNOLOGY

Contact Hours			
L	T	P	C
3	0	0	3

PRE-REQUISITES

21MDS81, 21MDS84

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Describe the basics of distributed environment and decentralization*
- *Describe the fundamentals of Blockchain*
- *Analyze the working principles of Bitcoin, Develop Cryptography algorithms to protect Cryptocurrencies*
- *Analyze the concepts of smart contracts and ethereum*
- *Examine the development platform ethereum and Hyperledger*

BLOCKCHAIN

Introduction - Distributed Systems, History of blockchain, Introduction to blockchain, Types of blockchain, CAP theorem and blockchain, Benefits and limitations of blockchain. Decentralization - Decentralization using blockchain, methods of decentralization, routes to decentralization, blockchain and full ecosystem decentralization, smart contract, decentralized autonomous organization, corporations, societies, application, Platforms for decentralization   (10)

CRYPTOCURRENCIES

Cryptographic primitives - Hash Functions, Bitcoin, transactions, blockchain, bitcoin payments, Alternative coins - theoretical foundations, bitcoin limitations   (10)

SMART CONTRACTS AND ETHEREUM

Smart Contracts, Ethereum - Introduction, ethereum blockchain, elements, precompiled contracts, accounts, block, ether, messages, mining, clients and wallets, trading and investment, symbols, ethereum network, applications, scalability and security   (9)

CONTRACT DEVELOPMENT AND DEPLOYMENT

Ethereum development - Setting up a development environment, development tools and clients, Solidity, Web3   (9)

HYPERLEDGER

Hyperledger - Fabric, Sawtooth lake, CORDA   (7)

TOTAL: 45

TEXT BOOK

1. *Imran Bashir, "Mastering Blockchain", Packt Publishing, First Edition, 2017.*

REFERENCE BOOKS

1. *Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies", Princeton University Press, 2016.*
2. *Roger Wattenhofer, "The Science of the Blockchain", Inverted Forest Publishing, First Edition, 2016.*
3. *Don and Alex Tapscott, "Blockchain Revolution". Portfolio Penguin 2016.*
4. *Andreas M. Antonopoulos, "Mastering Bitcoin: Programming the Open Blockchain", O'Reilly, Second Edition, 2017.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L		L	L					
CO2	L		L	L					
CO3	H	L	H	H			H	H	H
CO4	H	L	H	H			H	H	H
CO5	H	L	H	H			H	H	H

21MDSE18 - INTERNET OF THINGS

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Differentiate the levels of the IoT stack and explain the key technologies and protocols employed at each layer of the stack*
- *Given an application, assess the different IoT technologies that suits the application*
- *Design simple IoT systems comprising sensors, edge devices, wireless network connections and data analytics capabilities.*
- *Differentiate the prevalent architectures – distributed, centralized, and edge.*
- *Identify analytics/Machine learning techniques to apply on sensor data to define context, find faults, ensure quality, and extract actionable insights.*

INTRODUCTION TO IoT

Overview : Genesis of IoT – IoT and Digitization – IoT Impact – High Level view of Practical IoT use cases – Convergence of IT and OT – IoT Challenges. IoT Network Architecture: Drivers behind New Network Architectures – Constrained Devices and Networks – Comparing IoT Architectures – IT and OT responsibilities in the IoT Reference Model – Core IoT Functional Stack – IoT Data Management and Compute Stack (9)

END POINTS AND COMMUNICATION

End Points: Sensing Devices – Smart end points – Sensor Fusion – Functional Example – Energy Sources. Non-IP based WPAN : IEEE802.15.4 – Zigbee – Zigwave IP based WPAN: 6LoWPAN

Long Range Communication Systems: Cellular Connectivity – LoRa and LoRaWAN (9)

EDGE / CLOUD PROTOCOLS

Routers and Gateways: Routing Functions – Software Defined Networking. IoT Edge and Cloud Protocols: MQTT – MQTT-SN – Constrained Application Protocol (8)

ANALYTICS IN IoT

Constraints of Cloud Architecture for IoT – Fog Computing: OpenFog Reference Architecture -Fog Topologies – Edge Computing: Overview – Empowering Edge Applications with Deep Learning – Challenges. (11)

IoT SECURITY

Anatomy of IoT Cyber Attacks - Security Critical Application areas of IoT – Sources of Security Threats in IoT Applications – Improvements and Enhancements required for Upcoming IoT Applications – Solutions - Software Defined Perimeter - IoT Security best practices. (8)

TOTAL : 45

TEXT BOOKS

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press, 2017.(Para-1)

2. Perry Lea, "Internet of Things for Architects: Architecting IoT Solutions by Implementing Sensors, Communication Infrastructure, Edge Computing, Analytics, and Security" , Packt 3. 3.Publishing, 2018.(Para 2-5)Fanning Wang, Xiaoqiang Ma, Miao Zhang , Xiangxiang Wang, And Jiangchuan Liu, "Deep Learning for Edge Computing Applications: A State-of-the-Art Survey", IEEE Access, April 2020. (Para 4)

4.Vikas Hassija , Vinay Chamola , Vikas Saxena, Divyansh Jain, Pranav Goyal, And Biplab Sikdar, "A Survey on IoT Security: Application Areas, Security Threats, and Solution Architectures" , IEEE Access, March 2020 (Para 5).

REFERENCE BOOKS

1. J.-P. Vasseur, A. Dunkels, "Interconnecting Smart Objects with IP: The Next Internet", Morgan Kaufmann, 2010.

2.Z. Shelby, C, Bormann, "6LoWPAN: The Wireless Embedded Internet", Wiley, 2009

3.Arsheep Bahga, Vijay Madisetti, "Internet of Things: A Hands-On Approach", Paperback, 2014.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1									
CO2	L								
CO3									L
CO4									L
CO5			L						L

21MDSE19– FOG AND EDGE COMPUTING

Contact Hours			
L	T	P	C
3	0	0	3

PRE-REQUISITES

21MDS62

ASSESSMENT : THEORY

COURSE OUTCOMES

- Understand the basics of Fog and Edge computing
- Analyze the optimization problems in Fog computing
- Work with the Fog and Edge computing middleware
- Develop Fog data management and security systems
- Design Fog and Edge methodologies for various applications

INTRODUCTION

Fog and Edge Computing Completing the Cloud, Avantages of FEC, FEC Achieves, Hierarchy of Fog and Edge Computing, Addressing the Challenges in Federating Edge Resources   (9)

OPTIMIZATION PROBLEMS IN FOG AND EDGE COMPUTING

The Case for Optimization in Fog Computing, Formal Modeling Framework for Fog Computing, 6 Metrics, Performance, Resource Usage, Energy Consumption, Financial Costs, Further Quality Attributes, Optimization Opportunities along the Fog Architecture, Optimization Opportunities along the Service Life Cycle Toward a Taxonomy of Optimization Problems in Fog Computing, Optimization Techniques   (9)

MIDDLEWARE FOR FOG AND EDGE COMPUTING

Need for Fog and Edge Computing Middleware, Design Goals, State-of-the-Art Middleware Infrastructures, System Model, Proposed Architecture   (9)

DATA MANAGEMENT IN FOG COMPUTING. MODULE

Fog Data Management, Fog Data Life Cycle, Data Acquisition, Data Characteristics, Data Pre-Processing and Analytics, Data Privacy, Data Storage and Data Placement, e-Health Case Study, Proposed Architecture   (9)

APPLICATIONS AND ISSUES

Fog Computing in Health Monitoring, Fog-Based IoT Applications.   (9)

TOTAL : 45

TEXT BOOK

1. *Rajkumar Buyya, Satish Narayana Srirama, "Fog and Edge Computing: Principles and Paradigms", Wiley Publications, First edition, 2019.*

REFERENCES BOOKS

1. *Javid Taheri, Shuiguang Deng, "Edge Computing: Models, technologies and applications", IET, 2020*
2. *Pethuru Raj, Kavitha Saini, Chellammal Surianarayanan, "Advances in Computers- Edge/Fog Computing Paradigm: The Concept, Platforms and Applications", Academic Press, 2022.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L		L	L					
CO2	M	M	M	M				H	H
CO3	H	M	H	H				H	H
CO4	H	M	H	H				H	H
CO5	H	M	H	H				H	H

21MDSE20 – AUGMENTED AND VIRTUAL REALITY

Contact Hours		
L	T	P	C
3	0	0	3

PRE-REQUISITES

Consent to the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

- Understand the basics of Augmented Reality and displays
- Explain the concepts of tracking in AR systems
- Understand the components of Virtual Reality
- Know the input and output devices
- Understand the human factors in VR

INTRODUCTION

Augmented Reality - Displays: Multimodal displays, visual perception, Requirements and characteristics, spatial displays, visual displays   (9)

TRACKING

Tracking, Calibration and Registration, Coordinate Systems, Characteristics of tracking technology, stationary tracking system, optical tracking, Marker tracking, natural feature tracking by detection, outdoor tracking   (9)

VIRTUAL REALITY

Introduction, three I's of VR, Components of VR system, Input Devices: Three-dimensional position trackers, navigation and manipulation interfaces, gesture interfaces   (9)

OUTPUT DEVICES

Graphics display, Sound display, Haptic display   (9)

HUMAN FACTORS IN VR

Methodology and Terminology, User performance studies, VR health and safety issues, VR and Society   (9)

TOTAL : 45

TEXT BOOKS

1. *Deiter Schmalstieg, Tobias Hollerer, Augmented Reality Principles and Practice'', Addison-Wesley Professional, 2016.*
2. *Grigore C Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley Publications, Second Edition, 2003.*

REFERENCE BOOKS

1. *Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann, 2013*
2. *Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2019*
3. *William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design", Morgan Kaufmann Publishers, 2002.*
4. *Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", Springer, 2005.*
5. *Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L		L	L					
CO2	M		M	M				H	H
CO3	M		M	M				H	H
CO4	L		M	M				H	H
CO5	L		M	M				H	H

21MDSE21 - DESIGN THINKING

Contact Hours			
L	T	P	C
3	0	0	3

PRE-REQUISITES

21MDS64

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Analyze and determine the drivers and target groups of the given problem*
- *Generate an idea for addressing the issues based on the problem study*
- *Design and Present the creative ideas in an understandable way using appropriate methods*
- *Modify the generated ideas based on thinking in visual forms*
- *Develop the prototype for the generated idea and implement it using appropriate techniques*

OVERVIEW OF DESIGN PROCESS
Stages of thinking: The design process - Define - Research - Ideate - Prototype - Select-Implement-Learn - Example project. Research-Identifying drivers - Information gathering - Target groups - Samples and Feedback   (10)

IDEA GENERATION

Basic design directions- Themes of thinking - Inspiration and references-Brainstorming -Value - Inclusion - Sketching -Presenting ideas   (12)

REFINEMENT

Thinking in images - Thinking in signs - Appropriation - Humour - Personification - Visual metaphors - Modification - Thinking in words - Words and language - Thinking in shapes - Thinking in proportions - Thinking in color   (12)

PROTOTYPING AND IMPLEMENTATION

Prototyping: Developing of designs - Types of prototype - Vocabulary. Implementation: Format - Materials- Finishing - Media- Scale - Series   (11)

TOTAL : 45

TEXT BOOK

1. Gavin Ambrose and Paul Haris, "Basic Design 08 Design Thinking", AVA Publishing, 2010.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		L			M		L	L	M
CO2		L			M				M
CO3		L	L		M		L	L	M
CO4				M	M				
CO5			L	M	M				

21MDSE22 -ENTERPRISE COMPUTING

Contact Hours			
L	T	P	C
3	0	0	3

PRE-REQUISITES

21MDS24

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Describe the role of Component Technologies in developing reusable and easy accessible enterprise application*
- *Develop the client applications (browser / Java client) using J2EE platform by analyzing the requirements of the given system*
- *Design and develop the web tier components of an enterprise application using Servlet*
- *Construct the application components includes Process and Data components using Enterprise Java Bean Technologies*
- *Integrate the transaction management activities with the developed applications using the various components of enterprise*

USING J2EE PLATFORM

INTRODUCTION

Java EE 7 Platform highlights – Java EE application model – Distributed multitiered applications – Java EE Containers – Java EE application assembly and deployment – Development roles – Java EE 7 APIs – Java EE 7 APIs in the Java platform standard edition 7. Platform Basics : Resource creation – Packaging **(9)**

THE WEB TIER

Java Servlet Technology – Servlet Life Cycle – Sharing information – Creating and initializing a Servlet – Writing Service methods - Filtering requests and responses – Invoking other web resources – Accessing the web context – Maintaining client state – Asynchronous processing **(9)**

JAVA SERVER PAGES

Elements of JSP – JSP Syntax and Semantics – Expression, Scriptlets and Declarations – Request dispatching – Session and Thread Management.

JSP Tag extensions : Introduction to custom tags – Expression Language – The JSP standard tag library (JSTL) – JSP fragments **(9)**

ENTERPRISE BEANS

Session Bean – Message Driven Bean – Accessing enterprise Beans – Contents – Naming conventions – Life cycle – Getting started with Enterprise Beans – Running the enterprise

Bean examples – Using the embedded enterprise bean container – Using Asynchronous method invocation in session beans **(9)**

INTRODUCTION TO THE JAVA PERSISTENCE API

Entities – Entity Inheritance – Managing Entities – Querying Entities – The Java Persistence Query Language – Query Language Terminology – Creating Queries using the Java Persistence Query Language – Simplified Query Language Syntax – Example Queries – Full Query Language Syntax – Using the criteria API to create queries **(9)**

TOTAL: 45

TEXT BOOKS

1. *Eric Jendrock, Ricardo Cervera – Navarro, Ian Evans, "The Java EE 7 Tutorials" Volume I & II, Fifth Edition, Addison – Wesley Publications, 2014. Para(1,2, 4,5)*
2. *Phil Hanna, "The Complete Reference JSP 2.0", McGraw Hill Education, Second Edition, 2017.(Para - 3)*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		M	M		M	L		M	H
CO2		H	M	L	M				M
CO3		H	M	L	M				M
CO4		H	M	L	M				M
CO5		H	M	M	M				M

21MDSE23 - BUSINESS PROCESS MANAGEMENT

	Contact Hours		
L	**T**	**P**	**C**
3	0	0	3

PRE-REQUISITES

Consent of the Instructor

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Discover the processes associated with the given business problem*
- *Analyze the business process and identify the issues of the process*
- *Design the business process by applying the necessary changes*
- *Develop the IT solution to automate the business process*
- *Infer Business Process Management as a cross-disciplinary field, striking a balance between business management and IT aspects*

INTRODUCTION TO BUSINESS PROCESS MANAGEMENT (BPM)

Business Process Definition - Origin and History of BPM - The BPM Lifecycle   (7)

PROCESS IDENTIFICATION AND MODELING

Focusing on Key Processes - Designing a Process Architecture - BPMN Initiation - Branching and Merging - Information Artifacts - Resources   (9)

ADVANCED PROCESS MODELING

Process Decomposition - Process Reuse - Rework and Repetition - Handling Events - Handling Exceptions - Processes and Business Rules   (10)

PROCESS DISCOVERY

The Setting of Process Discovery - Discovery Methods - Process Modeling Method - Process Model Quality Assurance   (9)

PROCESS ANALYSIS AND REDESIGN

Qualitative Process Analysis: Value-Added Analysis - Root Cause Analysis - Issue Documentation and Impact Assessment
Quantitative Process Analysis: Performance Measures - Flow Analysis - Queues - Simulation.
Redesign: Definition and Need - Heuristic Process Redesign - The Case of a Health Care Institution - Product-Based Design   (10)

TOTAL : 45

TEXT BOOK

1. *Marlon Dumas, Marcello La Rosa, Jan Mendling and Hajo A. Reijers, "Fundamentals of Business Process Management", Springer-Verlag Publication, 2013.*

REFERENCE BOOK

1. *Forrest W. Breyfogle III, "The Business Process Management Guidebook: An Integrated Enterprise Excellence BPM System", Citius Publishing, 2013.*

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	H	M	M	M				
CO2	M	H	M	M	M				
CO3	H	M	H	H	H				
CO4	H	M	H	H	H				
CO5	H	M	H	H	H				

21MDSE24 - SOFTWARE ARCHITECTURE AND DESIGN PATTERNS

	Contact Hours		
L	**T**	**P**	**C**
3	0	0	3

PRE-REQUISITES

21MDS64

ASSESSMENT : THEORY

COURSE OUTCOMES

- *Describe the various types of software patterns and their needs in software development*
- *Apply design patterns to solve the issues in designing the objects*
- *Design the software architectures using appropriate architectural patterns based on the quality attributes and documenting them*

INTRODUCTION TO PATTERNS

Definition - Making a pattern - Pattern categories - Relationship between patterns - Patterns and software architecture (8)

DESIGN PATTERNS

Introduction - Creational patterns - Structural patterns - Behavioral patterns - Case study (10)

INTRODUCTION TO SOFTWARE ARCHITECTURE

Software architecture definition and needs. Introduction: Architectural patterns - Reference models - Reference architecture - Architectural structures and views (8)

ARCHITECTURAL STYLES

Pipes and filters - Data abstraction and object oriented organization - Event based, Implicit invocation - Layered style – Repository - Interpreter - Process control - Distributed –
Case study (9)

THE ARCHITECTURAL BUSINESS CYCLE

Creating an architecture: Understanding quality attributes - Achieving qualities - Designing the architecture - Documenting the architecture - Case study (10)

TOTAL : 45

TEXT BOOKS

1. *Frank Buschmann, Regine Meunier, Hans Rohnex, Peter Sommerland & Michael, "Pattern - Oriented Software Architecture - A Systems of Patterns Volume - I", 1996 (Reprint 2001)*
2. *Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, "Design Patterns - Elements of reusable Object Oriented Software", Pearson Education, 1999.*

3. Mary Shaw, David Garlan, "Software Architecture - Perspectives on an Emerging Discipline", PHI,1996
4. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", 2nd Edition, Pearson Education, First Indian Reprint, 2003.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	L		L				L	L
CO2	M	M	L	L		L	L		M
CO3	M	H	M	M			L	L	M

21MDSEL1 - BUSINESS INTELLIGENCE LABORATORY

Contact Hours

PRE- REQUISITES

21MDSE1

ASSESSMENT : PRACTICAL

L	T	P	C
0	0	4	2

COURSE OUTCOMES

• *Design appropriate data warehouse model for a given decision making problem.*

• *Generate the different views of analyzed data.*

• *Develop a dashboard to present the analyzed data in a format that help the decision makers to do the prediction.*

CONCEPTS TO BE COVERED

1. Create highly formatted templates, reports, and documents such as flash reports, checks, KPI and Score cards

2. Create BI dashboards and reports to turn insights into actions by providing the ability to invoke business processes

3 .Design the analysis template to enable the business analyst to create new analyses from scratch or modify existing analyses

4. Present the analyzed data using maps and spatial visualizations format

5. Generate a powerful, multi-step alert engine that can trigger workflows based on business events and notify stakeholders via their preferred medium and channel

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H	M		H		M		
CO2	M	H	L	M					
CO3	H	M	H	H	M		M		
CO4									
CO5									

21MDSEL2 - NATURAL LANGUAGE PROCESSING LABORATORY

Contact Hours

PRE- REQUISITES

21MDSE2

L	T	P	C
0	0	4	2

ASSESSMENT:PRACTICAL
COURSEOUTCOMES

- *Acquire knowledge in Fundamentals of Natural Language Processing.*

- *Apply various techniques to access and process text from the Web.*

  Gain experience in categorizing and tagging words.

- *Develop models for text classification using Supervised Learning Algorithms*

- *Apply and analyze sentence structure using context free grammar.*

CONCEPTS TO BE COVERED

1. Access Text Corpora and Lexical Resources
   (i)   Conditional Frequency Distribution
   (ii)   WordNet
2. Processing Raw Text
   (i)   Accessing Text from the Web
   (ii)   Regular Expression for Detecting Word Patterns
   (iii)   Normalizing the Text
   (iv)   Regular Expression for Tokenizing text
3. Categorizing and Tagging Words
   (i)   Automatic Tagging
   (ii)   N-Gram Tagging
   (iii)   Transformation-Based tagging
4. Text Classification using Supervised Learning Algorithm
5. Extracting Information from Text
   (i)   Chunking
   (ii)   Named Entity Recognition
   (iii)   Relation Extraction
6. Analyzing Sentence Structure using Context Free Grammars
7. Analyzing the Synonym of Sentences

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	L	L						
CO2	M	M	M	L					
CO3	M		L		L				L
CO4	H	M	M	H					
CO5	L	L	M	M					

21MDSEL3 - COMPUTATIONAL INTELLIGENCE LABORATORY

Contact Hours

PRE- REQUISITES

21MDSE3

L	T	P	C
0	0	4	2

ASSESSMENT:PRACTICAL

COURSEOUTCOMES

- *Apply intelligent systems technologies in a variety of engineering applications*
- *Employ Evolutionary programming techniques to solve any real world scenarios*
- *To solve a given application, can apply swarm intelligence techniques*
- *Develop and implement a basic trainable neural network for a computing application*
- *Develop and implement a basic fuzzy logic system for a typical computing application*

CONCEPTS TO BE COVERED

1. Implement Artificial Neural Network Algorithms to simulate logical gates.

2. Implement ANN techniques to solve simple classification problems.

3. Implement Genetic Algorithm to solve optimization problem.

4. Implement PSO to solve optimization problem.

5. Implement Artificial Immune System to solve optimization problem.

6. Implement the different Fuzzy Membership functions, Fuzzy set operations and its properties and composition of Fuzzy and Crisp Relations.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H	M	L	M				
CO2				H		L		M	M
CO3	H	H	H	M					
CO4	H	H		H			M	L	L
CO5	H		H	H			M	L	L

21MDSEL3 - COMPUTATIONAL INTELLIGENCE LABORATORY

Contact Hours

PRE- REQUISITES

21MDSE3

L	T	P	C
0	0	4	2

ASSESSMENT:PRACTICAL

COURSEOUTCOMES

- *Apply intelligent systems technologies in a variety of engineering applications*
- *Employ Evolutionary programming techniques to solve any real world scenarios*
- *To solve a given application, can apply swarm intelligence techniques*
- *Develop and implement a basic trainable neural network for a computing application*
- *Develop and implement a basic fuzzy logic system for a typical computing application*

CONCEPTS TO BE COVERED

1. Implement Artificial Neural Network Algorithms to simulate logical gates.

2. Implement ANN techniques to solve simple classification problems.

3. Implement Genetic Algorithm to solve optimization problem.

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Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	M	L		H				M
CO2	M	M	L		H				M
CO3	M	M	L		H				M
CO4	M	M	L		H				M
CO5	M	M	L		H				M

21MDSEL4 - GEOGRAPHICAL INFORMATION ANALYSIS LABORATORY

Contact Hours

L	T	P	C
0	0	4	2

PRE- REQUISITES

21MDSE4

ASSESSMENT: PRACTICAL

COURSE OUTCOMES

- *Prepare the different geospatial layers*
- *Compute geometric measurements and perform spatial analysis*
- *Create high-quality maps and associated graphics*
- *Integrate different geospatial layers*

TOPICS TO BE COVERED:

- Importing maps and layers from various sources
- Georeferencing and projection
- Digitization of Points and Lines
- Editing Map Elements
- Attribute Data Entry and Manipulation
- Cleaning, Building and Transformation
- Data Analysis – Overlay, Buffer
- Map Generation with Patterns and Legends
- Buffer Analysis
- Network Analysis

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M	H	M	M					
CO2	H	M	H	H					
CO3	H	M	H	H					
CO4	H	M	H	H					
CO5									

21MDSEL5 - INTERNET OF THINGS LABORATORY

Contact Hours

PRE- REQUISITES

21MDSE18

ASSESSMENT: PRACTICAL

L	T	P	C
0	0	4	2

COURSE OUTCOMES

- *For a given requirement, choose the required sensors and calibrate.*
- *Devise interface circuit for connecting a chosen sensor to a microcontroller board.*
- *Develop software for microcontroller board to interact with the sensor to meet the requirements.*
- *Develop software to interact (send/receive data) with web/application server located in the internet.*
- *Use data analytics tools to analyse the data collected and present the report to the end user.*

THE STUDENTS MUST BE TRAINED FOR

1. Gaining knowledge on working of smart sensors for IoT applications.
2. Developing applications using open source microcontroller boards, exploiting all the features of the board.
3. Developing an end-to-end IoT project covering – collect, transport, store, analyse and archive phases.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1									
CO2									
CO3									
CO4			L						
CO5			L					L	L

21MDSEL6 -ROBOTIC PROCESS AUTOMATION LABORATORY

Contact Hours

L	T	P	C
0	0	4	2

PRE-REQUISITE

21MDSE5

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

- *Understand the basics of RPA functioning*

- *Analyse the RPA functionalities in UiPath*

- *Work with conditional statements and Iteration in UiPath*

- *Develop code to process and manipulate data*

- *Implement Image, Text and Email automation*

CONCEPTS TO BE COVERED

1. Installation of RPA packages

2. Creating variables and data types

3. Implementing Control flow - Conditional Statements, Iteration

4. Data Manipulation- scalar variables, collections, tables, text manipulation

5. Recording-basic, desktop and web

6. Scrapping - Screen scrapping, Data scrapping

7. Selectors

8. Image and text automation

9. Excel and Data tables

10. Email Automation

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	L		L	L					
CO2	H		H	H				H	H
CO3	H		H	H				H	H
CO4	H		H	H				H	H
CO5	H		H	H				H	H

21MDSEL7 - MOBILE APPLICATION DEVELOPMENT LABORATORY

Contact Hours			
L	T	P	C
0	0	4	2

PRE-REQUISITE

21MDS16

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

- *Develop an application that using the GUI components*
- *Create, test and debug Android application by setting up Android development*
- *Demonstrate methods in storing, sharing and retrieving data in Android applications*
- *Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces*
- *Create interactive applications in android using databases with multiple activities including audio, video and notifications and deploy them in marketplace*

CONCEPTS TO BE COVERED

1. Develop an application that uses GUI components, Font, Layout Managers and event listeners
2. Develop an application that makes use of databases
3. Develop a native application that uses GPS location information
4. Implement an application that creates an alert upon receiving a message
5. Develop an application that makes use of RSS Feed
6. Create an application using Sensor Manager
7. Create an android application that converts the user input text to voice
8. Develop a Mobile application using Flutter for simple and day to day needs

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	H	H	M	H	M			H	M
CO2	H	H	H	M	M			M	H
CO3	H	L	L	H	M			H	H
CO4	L	M	M	M	H			L	M
CO5	M	M	M	L	H			M	L

21MDSEL8 - BLOCKCHAIN TECHNOLOGIES LABORATORY

Contact Hours			
L	T	P	C
0	0	4	2

PRE-REQUISITES

21MDS81, 21MDS84

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

- *Illustrate the role of cryptography in securing blockchain*
- *Interact with a blockchain system by sending and reading transactions*
- *Design, build, and deploy distributed applications*

CONCEPTS TO BE COVERED

1. Test the properties of cryptographic Hashing

2. Perform Using JavaScript

a. Creating a Blockchain

b. Implementing Proof of Work

c. Miner rewards & generating transactions

d. Signing transactions

3. Create a private Ethereum Blockchain.

4. Test the properties of Ethereum transactions and Cryptographic Hashing – the

   authenticity and security of Ethereum transactions

5. Develop smart contracts for Ethereum Blockchain

6. Interacting with smart contracts via the web.

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	M		H	H			H	H	H
CO2	H		H	H			H	H	H
CO3	H		H	H			H	H	H

21MDSEL9 - ENTERPRISE COMPUTING LABORATORY

Contact Hours

L	T	P	C
0	0	4	2

PREREQUISITES

21MDS24, 21MDSE22

ASSESSMENT : PRACTICAL

COURSE OUTCOMES

- *Develop the client application using HTML or Java Server Page*
- *Construct web components to process the client request and generate response in online using Java Servlet*
- *Design and develop reusable business logic using Session EJB framework*
- *Generate persistent entities using Entity EJB frameworks*
- *Develop the enterprise applications for the given scenario by identifying the suitable components*

CONCEPTS TO BE COVERED

1. Understand and design the generic business process model of an enterprise

2. Design and implement the client side applications using JSP

3. Design and implement online business processing through Servlet components

4. Develop reusable business logics using Session EJB components

5. Develop persistent entity objects using Entity EJB components

Course Outcomes(CO)	Programme Outcomes (PO)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		H	M		L			L	M
CO2		H	M		L				M
CO3		H	M		L				M
CO4		H	M		L				M
CO5		H	M		L		M		M