UNIVERSITY SCHOOL

OF

INFORMATION AND COMMUNICATION TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

PROGRAMME STRUCTURE

MASTER OF COMPUTER APPLICATIONS (MCA)

&

MASTER OF SCIENCE (M. Sc.) COMPUTER SCIENCE

WITH SPECIALIZATION IN DATA SCIENCE

WITH SPECIALIZATION IN DATA SCIENCE

2 YEAR PROGRAMME

2022-24

GAUTAM BUDDHA UNIVERSITY
GAUTAM BUDH NAGAR, GREATER NOIDA, UP, INDIA

Passed B.Sc/ B.Com/ B.A with Mathematics at 10+2 level or at Graduation level with having at least 50% marks (45% for SC/ST candidates of Haryana only) in aggregate, along with the students admitted with this eligibility will have to simultaneously undertake additional *bridge course as prescribed by the University during the first semester.

Note: * It is compulsory for each student to pass out bridge course (three additional theory papers and one practical as prescribed in scheme of examination of bridge course) as per University norms during the 1st year of MAI-2 year course and the degree will be awarded after the completion of bridge course. However, these papers under bridge course will be taught only in the 1st semester of the course.

OR

Passed BCA/B.Sc.(Hons.)Computer Science/ B.E. or B.Tech.(CSE/IT)/ B.Voc.(Software Development/IT) or an equivalent degree with having at least 50% marks (45% for SC/ST candidates of Haryana only) in aggregate.

BRIDGE COURSE

S.No.	Course Code	Course Name	L	T	P	Credits	Types
1	MCB001	Computer Fundamental and Programming	3	1	0	4	BC1
2	MCB003	Introduction to Internet Technology	3	0	0	3	BC2
3	MCB005	Fundamental of Operating Systems	3	0	0	3	BC3
4	MCB081	Operating System Lab	0	0	3	2	BC-L1
5	MCB083	Internet Technology Lab	0	0	3	2	BC-L2
		Total Hours and Credits	**9**	**1**	**6**	**14**	

Semester I

S.No.	Course Code	Course Name	L	T	P	Credits	Types
1	MDS101	Computer Fundamental and MS Excel	3	0	0	3	CC1 / FC
2	MDS103	Software Engineering	3	0	0	3	CC2
3	MDS105	Artificial Intelligence	3	0	0	3	CC3 / FC
4	MDS107	Discrete Mathematics	3	0	0	3	CC4
5	MDS109	Theory of Automata	3	0	0	3	CC5
6	MDS111	Operating System	3	0	0	3	CC6
7	MDS113	Data Base Management System	3	0	0	3	CC7
8	ES401	Fundamental of Environmental Science	3	0	0	3	OE1 / AECC
9	MDS181	MS Excel Lab	0	0	3	2	CC-L1 / SEC
10	MDS183	Data Base Management System Lab	0	0	3	2	CC-L2 / SEC
11	GP	General Proficiency	Non Credit				
		Total Hours and Credits	**24**	**0**	**6**	**28**	

Semester II

S.No.	Course Code	Course Name	L	T	P	Credits	Types
1	MDS102	Data Modelling and Visualization-I	3	0	0	3	CC8 / SEC
2	MDS104	Data Structure and Algorithms	3	0	0	3	CC9 / SEC
3	MDS106	Data Security and Privacy	3	0	0	3	CC10
4	MDS108	Data Analytics using R	3	0	0	3	CC11
5	MDS110	Data Mining	3	0	0	3	CC12
6		Elective-1	3	0	0	3	E1 / DSE
7		Elective-2	3	0	0	3	E2 / DSE
8	EN532	Fundamental of Language Science	3	0	0	3	OE2 / AECC
9	MDS182	Data Structure and Algorithms Lab	0	0	3	2	CC-L3 / SEC
10	MDS184	Data Analytics using R Lab	0	0	3	2	CC-L4 / SEC
11	GP	General Proficiency	Non Credit				
		Total Hours and Credits	**24**	**0**	**6**	**28**	

Semester III

S.No.	Course Code	Course Name	L	T	P	Credits	Types
1	MDS201	Analysis and Design of Algorithm	3	0	0	3	CC11
2	MDS203	Data Modeling and Visualization-II	2	0	0	2	CC12
3	MDS205	Intelligent Information Retrieval	3	0	0	3	CC13
4	MDS207	Python Programming	2	0	0	2	CC14 / SEC
5		Elective-3 (MOOC)	3	0	0	3	E3 / DSE
6		Elective-4	3	0	0	3	E4 / DSE
7	MAI 209	Numerical Algorithms for Machine Learning	3	0	0	3	GE1
8	MDS291	Minor Project	0	0	10	5	MP1
9	MDS281	Analysis and Design of Algorithm Lab	0	0	3	2	CC-L 5 / SEC
10	MDS283	Python Programming Lab	0	0	3	2	CC-L 6 / SEC
11	GP	General Proficiency	Non Credit				
		Total Hours and Credits	**19**	**0**	**16**	**28**	

Semester IV

S.No.	Course Code	Course Name	L	T	P	Credits	Types
1	MDS290	Seminar	0	0	3	2	S / E
2	MDS292	Major Project	0	0	20	10	MP2 / E
3	MDS294	Industrial Traning / Intenship	0	0	32	16	I / E
4	GP	General Proficiency	Non Credit				
		Total Hours and Credits	**0**	**0**	**55**	**28**	

GRANT TOTAL OF CREIT = 112

Swayam/NPTEL courses will also be offered as **Discipline Specific Elective** during the II and III semester and Swayam/NPTEL courses list will be provided by the deptt. OR if USICT will offer the course as an Discipline Specific Elective, students will complete it through regular class. It will be evaluated as per University Examination Rules.

In the **Seminar**, student need to study and present individually, on latest research paper of their specialized area and It will be evaluated as per University Examination Rules.

The **Internship** in Industry will be done by candidate individually during the 4th semester and it will be for a minimum of 4 (-6) months. It will be evaluated as per University Examination Rules.

Minor and Major Project will be in a group and It will be evaluated as per University Examination Rules.

USICT will provide a **mentor/supervisor** for seminar, internship, minor and major projects

ELECTIVES

S.No.	Course Code	Course Name	L	T	P	Credits	Types
1	MDS112	Data Science Life Cycle	3	0	0	3	E1
2	MDS114	Integrated Development Environment	3	0	0	3	E1
3	MDS116	Machine Learning Techniques	3	0	0	3	E1
4	MDS118	Internet of Things	3	0	0	3	E1
5	MDS120	Advanced Java Programming (J2EE Technologies)	3	0	0	3	E2
6	MDS122	Data Storage Technologies and Networking	3	0	0	3	E2
7	MDS124	Introduction to Statistical Learning	3	0	0	3	E2
8	MDS126	Research Tecniques for Data Science	3	0	0	3	E2
9	MDS209	High Performance Computing	3	0	0	3	E3
10	MDS211	Big Data Platforms	3	0	0	3	E3
11	MDS212	Introduction to Blockchain Technologies	3	0	0	3	E3
12	MDS214	Business Intelligence	3	0	0	3	E3
13	MDS216	Data Visualization using Tableau	3	0	0	3	E4
14	MDS217	Web Analytics	3	0	0	3	E4
15	MDS218	Social Media Analytics and Techniques	3	0	0	3	E4
16	MDS220	Time Series Aanlysis	3	0	0	3	E4
17	MA033	Numerical Algorithms for Machine Learning	3	0	0	3	GE1
18	ES401	Fundamentals of Environmental Science	3	0	0	3	OE1
19	ES507	Energy and Environment	3	0	0	3	OE1
OE10	OE9 OE8	OE7 OE6 OE5 OE4 OE3	OE2	OE1	OE0	OE1	OE2

MDS Master of Computer Applications and **D**ata Science for Course Code

MCA	Master of Computer Applications	**SEC**	Skill Enhancement Course
CC	Core Course from USICT for Course Type	**DSE**	Discipline Specific Course
FC	Foundation Course	**BC**	Bridge Course
CC-L	Core Course Lab from USICT	**BC-L**	Bridge Course Lab
GE	General Elective from related discipline of other Deptt./School	**MP**	Minor / Major Project
AECC	Ability Enhancement Compulsary Course	**S**	Seminar
OE	Open Elective from other discipline of other Deptt./School	**I**	Industrial Training / Internship

Computer Fundamental and MS Excel

Course Code:	**MDS101**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. The course aims to provide students with hand-on experience in using Microsoft Excel for Data Analytics
2. In this course, students will learn how to analyse data
3. visual representations; how to work with data models using multiple worksheets and files
4. and how business calculations can be expressed using the Excel Data Analysis Expressions (DAX).
5. data through flexible data aggregations using Excel tables, pivot tables
COURSE OUTCOMES
At the end of the course the students should be able to:
1. Apply Excel functions and formulas for basic data analysis and interpretation
2. Make use of PivotTables for data aggregation and summarization
3. Build Dashboards for data visualization
4. Build Data Models using multiple worksheets and files
5. Make use of Excel Macros to perform routine tasks

UNIT I EXCEL FUNCTIONS AND TABLES FOR DATA ANALYSIS:
Excel Functions: Text functions, Logical functions, Lookup and Reference functions, Statistical Functions; Excel Tables: Overview, Excel Tables and Pivot Tables, Creating and Formatting Tables,Pivot Tables and Pivot Charts: Overview, Creating Pivot Tables to analyse worksheet data.

UNIT II DATA VISUALIZATON USINGEXCEL:
Dashboards: Overview, Using multiple Pivot Tables, Pivot Charts and PivotTable tools to create a dynamic dashboard, Using multiple Pivot Tables, Pivot Charts and PivotTable tools to create a dynamic dashboard.

UNIT III DATA ANALYSIS AND EXPRESSION:
PowerPivot, Power Query, Basics of Data Analysis Expressions (DAX),
DAX in PowerPivot, Calculations in PowerPivot, Data Models:Creating Data Models in Excel, Creating PivotTable/PivotChart through Data Models.

UNIT IV MACROS AND EXCEL VBA :

Creating Macros in Excel, Macros in a single workbook, Absolute References, Relative References, Assigning Macros to Objects; VBA-Excel Macros, Objects, Variables, Conditional statements and loops.

UNIT V POWER BI USING EXCEL :

Introduction to Power BI, Overview of Power BI Desktop, Creating Table visualizations, Formatting Table visualizations Matrix visualizations, Aggregation methods, Score Cards, Multi-row Cards, Percentage calculations, Filtering data – Slicers, Visual filters, Filtering data – Page filters, Drill-through , filters Graphical visualizations – Column graphs, Clustered column graphs, Stacked column graphs,Trend analysis graphs, Area graphs, Ribbon, graphs, Creating dashboards, Using custom visualizations, , Using Power BI Service, Publishing reports to Power BI Service, Date functions, Date Master tables, Creating Relationships,DAX calculated columns, DAX measures, Power BI Query editor

Books Recommended:

1. Stephen L. Nelson and Elizabeth C. Nelson: “Microsoft Excel Data Analysis for Dummies”, John Wiley and Sons
2. Rob Collie, Avichal Singh: “Power Pivot and Power BI: The Excel User's Guide to DAX, Power Query, Power BI & Power Pivot in Excel 2010-2016”, Holy Macro! Books
3. John WalkenBach: “Excel VBA Programming For Dummies”, John Wiley and Sons
4. Ken Bluttman: “Excel Formulas & Functions For Dummies”, John Wiley and Sons
5. Alberto Ferrari: “Analyzing Data with Power BI and Power Pivot for Excel (Business Skills)”, Microsoft Press
6. “Business Intelligence Practices, Technology and Management”, Rajiv Sabherwal and Irma Becerra-Fernandez, John Wiley and Sons

Online Resources/ Reference Material:

- https://support.microsoft.com
- https://www.tutorialspoint.com
- https://www.excel-easy.com
- https://www.datacamp.com
- “Introducing Microsoft Power BI”, Alberto Ferrari and Marco Russo, Microsoft Press, Available at https://download.microsoft.com/download/0/8/1/0816F8D1-D1A5-4F60-9AF5-BC91E18D6D64/Microsoft_Press_ebook_Introducing_Power_BI_PDF_mobile.pdf

Software Engineering			
Course Code:	**MDS103**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. Knowledge of basic SW engineering methods and practices and application.
2. A general understanding of software process models.
3. Understanding of software requirements and the SRS documents
4. Understanding of software design process
5. Understanding of software coding, testing and maintenance
COURSE OUTCOMES
At the end of the course the students should be able to:
1. Basic knowledge and understanding of the analysis and design of complex systems.
2. Ability to apply software engineering principles and techniques.
3. Ability to develop, maintain and evaluate large-scale software systems
4. To produce efficient, reliable, robust and cost-effective software solutions
5. Ability to perform independent research and analysis

UNIT I SOFTWARE ENGINEERING

Introduction to software engineering: definitions, role of software engineering, planning a software project, defining the problem, developing a solution strategy, planning the development process, software engineering process paradigms, principles of software engineering, software engineering activities.

UNIT II SOFTWARE LIFE CYCLE MODELS

Software Development Life Cycle (SDLC), SDLC models, waterfall model and its variations, prototype model, iterative enhancement model, spiral model, RAD model, comparison of these models, software development teams, software development environments, validation and traceability, maintenance, prototyping requirements, Software project management.

UNIT III REQUIREMENT ANALYSIS AND DESIGN

Software Requirement Specification (SRS): Introduction, need of SRS, significance, characteristics of SRS, Structure of SRS, IEEE standards for SRS design, functional and

non-functional requirements, Requirement gathering and analysis, requirement engineering and management.

UNIT IV SOFTWARE DESIGN PROCESS

Software Design: Introduction, design process activities: architectural design, Abstract specification, Interface design, component design, data structure design, algorithm design modular approach, top-down design, bottom-up design, design methods: data-flow model: data flow diagram, entity-relation-attribute model: E-R diagram, structural model: structure charts, context diagrams, object models: use case modeling, use case diagrams, sequence diagrams, cohesion and coupling.

UNIT V SOFTWARE CODING, TESTING AND MAINTENANCE

Coding, Testing Methods: UNIT testing, integration testing, system testing, acceptance testing, testing techniques: white box testing, black box testing, thread testing, regression testing, alpha testing, beta testing, static testing, dynamic testing, Evolution of software products, economics of maintenance, category of software maintenance, Role of product development life cycle, deployment model, adaptive maintenance, corrective maintenance, perfective maintenance, enhancement request, proactive defect prevention, problem reporting, problem resolution, software maintenance from customers' perspective, maintenance standard: IEEE-1219, ISO-12207.

Reference Books:

1. Pankaj Jalote, An Integrated Approach to Software Engineering, Narosa Publishing House, New Delhi 1997.
2. Ian Sommerville, Software Engineering, Pearson Education, 2009.
3. Pressman Roger S., Software Engineering: Practitioner's Approach, McGraw-Hill Inc., 2004.
4. Software Engineering: Software Reliability, Testing and Quality Assurance, Nasib S. Gill, Khanna Book Publishing Co (P) Ltd., New Delhi, 2002.

Artificial Intelligence			
Course Code:	**MDS105**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. Gain a historical perspective of AI and its foundations.
2. Become familiar with basic principles of AI toward problem-solving, inference,
3. perception, knowledge representation, and learning
4. Investigate applications of AI techniques in intelligent agents, expert systems, and machine learning models.
5. Explore the current scope, potential, limitations, and implications of intelligent system
COURSE OUTCOMES
At the end of the course the students should be able to:
1. Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents
2. Analyze and formalize the problem as a state space, graph, design heuristics, and select different search or game-based techniques to solve them
3. Develop intelligent algorithms for constraint satisfaction problems and also design intelligent .systems for Game Playing
4. Attain the capability to represent various real-life problem domains using logic-based techniques and use this to perform inference or planning.
5. Solve reasoning problems with Expert Systems.

UNIT I INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Basic concept of artificial intelligence (AI), history of AI, AI and consciousness, weak and strong AI, physical symbol system hypothesis, comparison of computer and human skills, practical systems based on AI, development of logic, components of AI, Turing Test in AI, Advantages and Disadvantages of AI, Intelligence, Intelligent System, Role of IS, Comparison of various IS, Mind-Body Problem in AI, Chinese Room Experiment in AI, Parallel and Distributed AI.

UNIT II PROBLEM SOLVING THROUGH AI

Defining the problem as state-space search, analyzing the problem, representing the problems from AI viewpoint, production system, developing production rules, characteristics of the production system, algorithm for problem-solving using AI technique.

UNIT III SEARCH TECHNIQUES

Use of search in AI problem solution, blind search techniques, heuristic search techniques, concept of heuristic knowledge, designing of the heuristic function, types of heuristic search techniques: generate and test, best first search, problem reduction using AND-OR graph, local search technique, branch and bound search, memory bounded search technique, local beam search, properties of heuristic search techniques, overestimation and underestimation of heuristic function hill climbing search, simulated annealing search, constraint satisfaction means ends analysis, Tic-Tac Toe Problem, Water Jug problem, Chess Problem, Tower of Hanoi problem, Travelling Salesman problem, Monkey and Banana Problem, Magic Square.

UNIT IV INTRODUCTION TO LOGIC

Introduction, proposition calculus, syntax o propositional calculus, semantics of propositional calculus, well-formed formula, properties of statements, inferencing of propositional logic, predicate logic, syntax of predicate logic, semantics of predicate logic, concept of resolution, resolution algorithm, skolemization, types of resolution UNIT resolution, binary resolution.

UNIT V AI TECHNIQUES AND APPLICATIONS

Introduction to Machine Learning, Introduction to Deep Learning, Introduction to Expert system: Introduction phases in building expert systems, Expert system versus traditional systems, rule-based expert systems, blackboard systems, application of expert systems, list of shells and tools, Introduction to Natural Language Processing, AI in future, AI in social Media, AI in Entertainment and education, AI in drones, AI in Automated Computer support, AI in personalized shopping experience, AI in Finance, AI in smart Cars, AI in travel and navigation, AI in smart home devices, AI in security and surveillance, Ai in education, AI in health care, AI in E commerce.

Text Books:

1. Artificial Intelligence, Elanie Reich: Tata mcgraw Hill publishing house, 2008.
2. Artificial Intelligence, Peterson, TataMcGraw Hill, 2008.
3. Artificial Intelligence, Russel and Norvig, Pearson Printice Hall Publication, 2006.
4. Artificial Intelligence, Winston, PHI publication, 2006

Discrete Mathematics			
Course Code:	**MDS107**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. Simplify and evaluate basic logic statements including compound statements, implications, inverses, converses, and contrapositives using truth tables and the properties of logic.
2. .Express a logic sentence in terms of predicates, quantifiers, and logical connectives
3. Apply the operations of sets and use Venn diagrams to solve applied problems; solve problems using the principle of inclusion-exclusion.
4. Determine the domain and range of a discrete or non-discrete function, graph functions, identify one-to-one functions, perform the composition of functions, find and/or graph the inverse of a function, and apply the properties of functions to application problems.
5. Apply rules of inference, tests for validity, proof by contradiction, proof by cases, and mathematical induction and write proofs using symbolic logic and Boolean Algebra.
COURSE OUTCOMES
At the end of the course the students should be able to:
1. To express a logic sentence in terms of predicates, quantifiers, and logical connectives.
2. Apply the rules of inference, proof by contradiction, and mathematical induction.
3. Students will be able to evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.
4. Students will be able to learn about predicates, quantifiers, and logical connectives
5. Student will be able to use tree and graph algorithms to solve problems.

UNIT 1 MATHEMATICAL LOGIC

Statements and notations, connectives, well formed formulas, truth tables, tautology, equivalence implication, normal forms, predicates: predicative logic, free & bound variables, rules of inference, consistency, proof of contradiction, automatic theorem proving.

UNIT II SET THEORY

Set Theory: Introduction, Combination of sets, Multi sets, ordered pairs, Set Identities, Properties of binary relations, equivalence, compatibility and partial ordering relations, Hasse diagram. functions: Operations on functions, inverse function Classification of functions, recursive functions, lattice and its properties, algebraic structures: algebraic systems examples and general properties, semi groups and monads, groups sub groups‟ homomorphism, isomorphism.

UNIT III ELEMENTARY COMBINATORICS

Basis of counting, combinations & permutations, with repetitions, constrained repetitions, binomial coefficients, binomial multinomial theorems, the principles of inclusion – exclusion, pigeon hole principles and it's application.

UNIT IV RECURRENCE RELATION

Generating functions, function of sequences calculating coefficient of generating function, recurrence relations, solving recurrence relation by substitution and generating funds, characteristics roots solution of in homogeneous recurrence relation.

UNIT V GRAPH THEORY

Representation of graph, Trees: Definition, Binary tree, Binary tree traversal, Binary search tree. DFS, BFS, spanning trees, planar graphs. graph theory and applications, basic concepts isomorphism and sub graphs, multi graphs and euler circuits, hamiltonian graphs, chromatic numbers.

Text Books :

1. Discrete and Combinational Mathematics- An Applied Introduction-5th Edition – Ralph. P.Grimaldi, Pearson Education
2. Discrete Mathematical Structures with applications to computer science Trembly J.P. & Manohar.P, TMH
3. Discrete Mathematics and its Applications, Kenneth H. Rosen, Fifth Edition.TMH.
4. Discrete Mathematical structures Theory and application-Malik & Sen
5. Discrete Mathematics for Computer science, Garry Haggard and others, Thomson.
6. Logic and Discrete Mathematics, Grass Man & Trembley, Person Education

Theory of Automata			
Course Code:	**MDS109**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. Determine the various categories of automata (deterministic and nondeterministic finite state automata, and variants of Turing machines)
2. Understand the various categories of languages and grammars in the Chomsky hierarchy
3. Define the notions of computability and decidability
4. Recognize to which class in the Chomsky hierarchy the language described (by a grammar or machine)
5. Discover the problems reducible to/from well-known decidable/undecidable problems
COURSE OUTCOMES
At the end of the course the students should be able to:
1. Model, compare and analyse different computational models using combinatorial methods.
2. Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.
3. Construct algorithms for different problems and argue formally about correctness on different restricted machine models of computation.
4. Identify limitations of some computational models and possible methods of proving them.
5. Have an overview of how the theoretical study in this course is applicable to and engineering application like designing the compilers.

UNIT I INTRODUCTION

Introduction; alphabets, strings and languages; automata and grammars, deterministic finite automata (DFA)-formal definition, simplified notation: state transition graph, transition table, language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transition, language of NFA, equivalence of NFA and DFA, minimization of finite automata, distinguishing one string from other, Myhill-Nerode Theorem

UNIT II REGULAR EXPRESSIONS

Regular expression (RE), definition, operators of regular expression and their precedence, algebraic laws for regular expressions, Kleen‟s theorem, regular expression to FA, DFA to regular expression, arden theorem, non regular languages, pumping lemma for regular languages. application of pumping lemma, closure properties of regular languages, decision properties of regular languages, FA with output: moore and mealy machine, equivalence of moore and mealy machine, applications and limitation of FA.

UNIT III CFG

Context Free Grammar (CFG) and Context Free Languages (CFL): definition, examples, derivation, derivation trees, ambiguity in grammar, inherent ambiguity, ambiguous to unambiguous CFG, useless symbols, simplification of CFGs, normal forms for CFGs: CNF and GNF, closure properties of CFLs, decision properties of CFLs: emptiness, finiteness and membership, pumping lemma for CFLs.

UNIT IV PUSH DOWN AUTOMATA

Push Down Automata (PDA): description and definition, instantaneous description, language of PDA, acceptance by final state, acceptance by empty stack, deterministic PDA, equivalence of PDA and CFG, CFG to PDA and PDA to CFG, two stack PDA

UNIT V TURING MACHINES (TM)

Basic model, definition and representation, instantaneous description, language acceptance by TM, variants of turing machine, TM as computer of integer functions, universal TM, church‟s thesis recursive and recursively enumerable languages, halting problem, introduction to undecidability, undecidable problems about TMs. Post Correspondence Problem (PCP), modified PCP, introduction to recursive function theory.

References Books:

1. Hopcroft, Ullman, “Introduction to Automata Theory, Languages and Computation”, Pearson Education
2. K.L.P. Mishra and N.Chandrasekaran, “Theory of Computer Science : Automata, Languages and Computation”, PHI
3. Martin J. C., “Introduction to Languages and Theory of Computations”, TMH
4. Papadimitrou, C. and Lewis, C.L., “Elements of the Theory of Computation”, PHI

Operating System			
Course Code:	**MDS111**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. Understand how Operating System is Important for Computer System.
2. Make aware of different types of Operating System and their services.
3. Learn different process scheduling algorithms and synchronization techniques to achieve better performance of a computer system
4. Know virtual memory concepts and secondary memory management
5. Understanding of Security & protection in Operating System
COURSE OUTCOMES
At the end of the course the students should be able to:
1. Understand the different services provided by Operating System at different level
2. Learn real life applications of Operating System in every field.
3. Understands the use of different process scheduling algorithm and synchronization techniques to avoid deadlock.
4. bLearn different memory management techniques like paging, segmentation and demand paging etc.
5.Perform implementation of protection mechanisms in operating system

UNIT I INTROUCTION

Types of operating systems, Different views of the operating system, Principles of Design and Implementation. The process and threads, System programmer's view of processes, Operating system's views of processes, Operating system services for process management, Process scheduling, Schedulers, Scheduling algorithms, Overview of Linux operating system.

UNIT II PROCESS MANAGEMENT

Interprocess synchronization, Mutual exclusion algorithms, Hardware support, Semaphores, Concurrent programming using semaphores.

UNIT III DEADLOCK

Conditional critical regions, Monitors, Interprocess communication, Messages, Pipes. Deadlocks: Characterization. Prevention, Avoidance, detection and recovery, Combined approach to deadlock handling.

UNIT IV MEMORY MANAGEMENT

Contiguous allocation. Static and dynamic partitioned memory allocation, Segmentation, Non-contiguous allocation, Paging, Hardware support, Virtual Memory.

UNIT V FILE SYSTEM

Need for files, File abstraction, File naming, File system organization, File system optimization, Reliability, Security and protection, I/O management and disk scheduling, Recent trends and developments.

TEXT BOOKS

1. Gary: operating systems- a modern perspective, (2/e), addison wesley,2000.
2. M.milenkovic: operating systems, concepts and design, mcgraw hill,1992. Reference books 1. C. Crowley: operating systems, irwin,1997.
2. J.l. peterson & a.s. chatz: operating system concepts, addison wesley,1985.
3. W. Stallings: operating systems, (2/e), prentice hall,1995.

Data Base Management System			
Course Code:	**MDS113**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1.Describe the fundamental elements of relational database management systems
2. Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
3. Design ER-models to represent simple database application scenarios
4. Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.
5. Improve the database design by normalization.
COURSE OUTCOMES
At the end of the course the students should be able to:
1. Understand of database concepts and thorough knowledge of database software's.
2.Model an application's data requirements using ER diagrams
3. Write SQL commands to create tables and query data in a relational DBMS
4. Execute various advanced SQL queries related to transactions, concurrency
5.Explain the principle of transaction management design.

UNIT I DATA BASE SYSTEM

Data base system vs. file system, view of data, data abstraction, instances and schemas, data models, ER model, relational model, database languages, DDL, DML, database access for applications programs, data base users and administrator, transaction management, data base system structure, storage manager, query processor, history of data base systems, data base design and ER diagrams, beyond ER design entities, attributes and entity sets, relationships and relationship sets, additional features of ER model, concept design with the ER model, and conceptual design for large enterprises.

UNIT II RELATIONAL DATA BASE MODEL

Introduction to the relational model, integrity constraint over relations, enforcing integrity constraints, querying relational data, and logical data base design, destroying /altering tables and views. relational algebra and calculus: relational algebra, selection and projection set operations, renaming, joins, division, relational calculus, tuple relational calculus, domain relational calculus, expressive power of algebra and calculus.

UNIT III SQL QUERY

Examples of basic SQL queries, nested queries, correlated nested queries set, comparison operators, aggregative operators, NULL values, comparison using null values, logical connectivity's, AND, OR and NOTR, impact on SQL constructs, outer joins, disallowing NULL values, complex integrity constraints in SQL triggers and active data bases.

UNIT IV NORMAL FORM

Problems caused by redundancy, decompositions, problem related to decomposition, reasoning about FDS, FIRST, SECOND, THIRD normal form, BCNF, forth normal form, fifth normal form, lossless join decomposition, dependency preserving decomposition, schema refinement in data base design, multi valued dependencies.

UNIT V TRANSACTION MANAGEMENT

ACID properties, transactions and schedules, concurrent execution of transaction, lock based concurrency control, performance locking, and transaction support in SQL, crash recovery, concurrency control, Serializability and recoverability, lock management, lock conversions, dealing with dead locks, specialized locking techniques, concurrency without locking, crash recovery: ARIES, log, other recovery related structures, the write, ahead log protocol, check pointing, recovering from a system crash, media recovery, other approaches and interaction with concurrency control.

References Books:

1. Elmasri Navrate, Data Base Management System, Pearson Education, 2008.
2. Raghurama Krishnan, Johannes Gehrke, Data Base Management Systems, TMH, 3rd edition, 2008.
3. C. J. Date, Introduction to Database Systems, Pearson Education, 2009.
4. Silberschatz, Korth, Database System Concepts, McGraw hill, 5th edition, 2005.
5. Rob, Coronel & Thomson, Database Systems Design: Implementation and Management, 2009.

MS EXCEL LAB			
Course Code:	**MDS181**	**Course Credits:**	**2**
Course Category:	**CC-L**	**Course (U / P)**	**P**
Course Year (U / P):	**1P**	**Course Semester (U / P):**	**1P**
No. of Lectures + Tutorials +Lab (Hrs/Week):	**0+ 0+3**	**Mid Sem. Exam Hours:**	
Total No. of Lectures (L + T+P):	**0+ 0+ 10**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Understand the basics and functions of MS excel.			
2. Clear understanding and use of data validations and templates.			
3. Purpose of sorting and filtering features.			
4. Use of reports in business organizations.			
5. Purpose and advantage of charts for top management in any work place.			
COURSE OUTCOME			
At the end of the course the students should be able to:			
1. Learn to understand the functions in Excel.			
2. Understand the validations.			
3. Make reports in excel.			
4. Learn to work with pivot tables.			

5. Learn how to make charts in MS excel.

List of Experiments

1. Create a new workbook and save the file with the name "Payroll". Enter the labels and values in the exact cells locations as desired. Use AutoFill to put the Employee Numbers into cells A6:A8. Set the columns width and rows height appropriately.

2. Create a workbook and enter relatable data of some employees. Calculate the Gross Pay for employee; enter a formula in cell E4 to multiply Hourly Rate by Hours Worked. Calculate the Social Security Tax (S.S Tax), which is 6% of the Gross Pay; enter a formula in cell F4 to multiply Gross Pay by 6%.

3. Create a workbook. Enter data as required. Calculate the Net Pay; enter a formula in cell G4 to subtract Social Security Tax from Gross Pay. Set the work sheet vertically and horizontally on the page.

4. Create a workbook having relatable data of sales of various models of cars in a showroom. Create a 3- dimensional column chart comparing sales data for men and women sales person.

5. Create a pie chart to compare the favourite films data for 15-25 year olds only (be careful not to include any unnecessary blanks rows or columns in your selected data).

6. Create a pivot table from this data, then use the filters within to view the average prices of holidays that have a Travel Method of Plane and a Resort Name that begins with the letter S.

Wise Owl Travel Agents

Country	Resort Name	No of Days	Travel Method	Price	Holiday ID
Australia	Great Barrier Reef	32	Plane	£750	I990AUS
Australia	Perth	28	Plane	£985	AUS112J
Chile	Santiago	21	Plane	£1,259	CH266H
England	London	3	Train	£69	I456UK
England	Bognor	1	Coach	£12	BG726H
France	Lyon	14	Plane	£399	A7995FR
France	Paris - Euro Disney	5	Train	£269	TH789FR
France	Paris - Euro Disney	3	Train	£125	TH788FR

7. Create an If function to calculate whether each movie was a flop or a success. Use the following criteria: If the profit was less than 100,000,000 then the movie is a flop otherwise the movie is a success.

8. Create an If function to rate the players based on the following criteria: If a player scores more than 15 points he has a High score otherwise he must try harder.

9. Convert this data into a pivot table and find the overall average speed of all rides that satisfy the following criteria: The Type is Steel, The Design is Sit Down, The Amusement Park has the word adventure somewhere in the title.

Roller Coaster	Amusement Park	Type	Design	Status	Opened	Speed (mph)
Air	Alton Towers	Steel	Flying	Operating	2002	46.6
Boomerang	Pleasure Island Family Theme Park	Steel	Sit Down	Operating	1993	47
Cobra	Paultons Park	Steel	Sit Down	Operating	2006	31.1
Colossus	Thorpe Park	Steel	Sit Down	Operating	2002	45
Corkscrew	Alton Towers	Steel	Sit Down	Operating	1980	40
Corkscrew	Flamingo Land Theme Park & Zoo	Steel	Sit Down	Operating	1983	40
Crazy Mouse	South Pier	Steel	Sit Down	Operating	1998	29.1
Crazy Mouse	Brighton Pier	Steel	Sit Down	Operating	2000	29.1
Enigma	Pleasurewood Hills	Steel	Sit Down	Operating	1995	34
Express	M&Ds Scotland's Theme Park	Steel	Sit Down	Operating	2006	28
Fantasy Mouse	Fantasy Island	Steel	Sit Down	Operating	2000	29.1

10. Create a worksheet and add desired data. Find TAX (If ITEM PRICE is less than 100, TAX is 50, otherwise it should be 100). TOTAL PRICE BEFORE TAX =NO. OF ITEMS * ITEM PRICE. TOTAL PRICE AFTER TAX = TOTAL PRICE BEFORE TAX + TAX. RATE (If TOTAL PRICE AFTER TAX > 3500 then the rate is “HIGH”, otherwise it is REASONABLE. Find Count of Items, Average of Taxes, Min Item PRICE and Max Item PRICE.

DATA BASE MANAGEMENT SYSTEM LAB			
Course Code:	**MDS183**	**Course Credits:**	**2**
Course Category:	**CC-L**	**Course (U / P)**	**P**
Course Year (U / P):	**1P**	**Course Semester (U / P):**	**1P**
No. of Lectures + Tutorials +Lab (Hrs/Week):	**0+ 0+3**	**Mid Sem. Exam Hours:**	
Total No. of Lectures (L + T+P):	**0+ 0+ 10**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Understand the basics and functions of MS excel.			
2. Clear understanding and use of data validations and templates.			
3. Purpose of sorting and filtering features.			
4. Use of reports in business organizations.			
5. Purpose and advantage of charts for top management in any work place.			
COURSE OUTCOME			
At the end of the course the students should be able to:			
1. Learn to understand the functions in Excel.			
2. Understand the validations.			
3. Make reports in excel.			

4. Learn to work with pivot tables.
5. Learn how to make charts in MS excel.

LIST OF EPERIMENTS

1. Write the queries for Data Manipulation and Data Definition Language.
2. Write SQL queries using logical operations and operators.
3. Write SQL query using group by function.
4. Write SQL queries for sub queries, nested queries
5. Write SQL queries to create views.
6. Write an SQL query to implement JOINS.
7. Write a query for extracting data from more than one table.
8. Write a query to understand the concepts for ROLL BACK, COMMIT & CHECK POINTS.
9. Create tables according to the following definition.

CREATE TABLE DEPOSIT (ACTNO VARCHAR2(5) ,CNAME VARCHAR2(18) , BNAME VARCHAR2(18) , AMOUNT NUMBER(8,2) ,ADATE DATE);

CREATE TABLE BRANCH(BNAME VARCHAR2(18),CITY VARCHAR2(18));

CREATE TABLE CUSTOMERS(CNAME VARCHAR2(19) ,CITY VARCHAR2(18));

CREATE TABLE BORROW(LOANNO VARCHAR2(5), CNAME VARCHAR2(18), BNAME VARCHAR2(18), AMOUNT NUMBER (8,2));

10. Retrieve all data from employee, jobs and deposit.

a. Give details of account no. and deposited rupees of customers having account opened between dates 01-01-06 and 25-07-06.

b. Display all jobs with minimum salary is greater than 4000.

c. Display name and salary of employee whose department no is 20. Give alias name to name of employee.

d. Display employee no,name and department details of those employee whose department lies in(10,20)

SEMESTER II

Data Modelling and Visualization-I			
Course Code:	**MDS102**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1 Understand basic of data handling			
2.Understand the various visualization technologies			
3. Understand and verify the underlying assumptions of a particular analysis			
4. Understanding & Visualizing Bar, grouped Plots & stacked plots			
5.Understand histograms, distribution analysis, statistics analysis.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Understand basics of Data Visualization.			
2. Implement visualization of distributions			

3. Write programs on visualization of time series, proportions & associations
4. Apply visualization on Trends and uncertainty
5. Explain principles of proportions

UNIT I INTRODUCTION TO VISUALIZATION

Visualizing Data-Mapping Data onto Aesthetics, Aesthetics and Types of Data, Scales Map Data Values onto Aesthetics, Coordinate Systems and Axes- Cartesian Coordinates, Nonlinear Axes, Coordinate Systems with Curved Axes, Color Scales-Color as a Tool to Distinguish, Color to Represent Data Values ,Color as a Tool to Highlight, Directory of Visualizations- Amounts, Distributions, Proportions, x–y relationships, Geospatial Data.

UNIT II VISUALIZATION TECHNIQUES AND ASSOCIATIONS

Visualizing Amounts-Bar Plots, Grouped and Stacked Bars, Dot Plots and Heatmaps, Visualizing Distributions: Histograms and Density Plots- Visualizing a Single Distribution, Visualizing Multiple Distributions at the SameTime, Visualizing Distributions: Empirical Cumulative Distribution Functions and Q-Q Plots-Empirical Cumulative Distribution Functions, Plots, Visualizing Many Distributions at Once Visualizing Distributions Along the Vertical Axis, Visualizing Proportions-A Case for Pie Charts, A Case for Side-by-Side Bars, A Case for Stacked Bars and Stacked Densities, Visualizing Proportions Separately as Parts of the Total ,Visualizing Nested Proportions- Nested Proportions Gone Wrong, Mosaic Plots and Treemaps, Nested Pies ,Parallel Sets. Visualizing Time Series and Other Functions of an Independent Variable-Individual Time Series , Multiple Time Series and Dose–Response Curves, Time Series of Two or More Response Variables

UNIT III PRINCIPLE OF PROPORTIONALINK

The Principle of Proportional Ink-Visualizations Along Linear Axes, Visualizations Along Logarithmic Axes, Direct Area Visualizations, Handling Overlapping Points-Partial Transparency and Jittering, 2D Histograms, Contour Lines, Common Pitfalls of Color Use-Encoding Too Much or Irrelevant Information ,Using Nonmonotonic Color Scales to Encode Data Values, Not

UNIT IV VISUALIZING UNCERTAINTY

Visualizing Trends-Smoothing, Showing Trends with a Defined Functional Form, Detrending and Time Series Decomposition, Visualizing Geospatial Data-Projections, Layers, Choropleth Mapping, Cartograms, Visualizing Uncertainty-Framing Probabilities as Frequencies, Visualizing the Uncertainty of Point Estimates, Visualizing the Uncertainty of Curve Fits, Hypothetical Outcome Plots

UNIT V DATA HANDLING AND VISUALIZATION USING TABLEAU

Introduction to tableau , Tableau products suite , file type , Connection to data source , Creating basic charts andgraphs , handling filter data , sorting grouping data in tableau , working with dates , waterfall chart and bump chart in tableau , heat and tree map in tableau .

Text Books

1. Claus Wilke, “Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures”, 1st edition, O’Reilly Media Inc, 2019.

2. Ryan Sleeper “Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master “, O’Reilly Media

Reference Books

1. Tony Fischetti, Brett Lantz, R: Data Analysis and Visualization,O’Reilly ,2016 2. Ossama Embarak, Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems,Apress, 2018

3. Joshua N. Milligan : Learning Tableau

Data Structure and Algorithms			
Course Code:	**MDS104**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1.To emphasize the importance of appropriate data structure in developing and implementing efficient algorithms			
2.Understand basic data structures such as arrays, stacks, queues, hash tables and linked list			
3.To analyze the asymptotic performance of various algorithms			
4.Solve problems using graphs, trees and heaps			
5.Apply important algorithmic design paradigms and methods of analysis			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.Define basic static and dynamic data structures and relevant standard algorithms for them.			
2.Select basic data structures and algorithms for autonomous realization of simple programs or program parts.			
3.Determine and demonstrate bugs in program, recognise needed basic operations with data			

structures
4.Formulate new solutions for programming problems or improve existing code using learned algorithms and data structures
5.Evaluate algorithms and data structures in terms of time and memory complexity of basic operations.

UNIT I INTRODUCTION TO DATA STRUCTURES

Abstract data types, sequences as value definitions, data types in C, pointers in C, data structures and C, arrays in C, array as ADT, one dimensional array, Implementing one dimensional array, array as parameters, two dimensional array, structures in C, implementing structures, Unions in C, implementation of unions, structure parameters, allocation of storage and scope of variables, recursive definition and processes: factorial function, fibonacci sequence, recursion in C, efficiency of recursion, hashing: hash function, open hashing, closed hashing: linear probing, quadratic probing, double hashing, rehashing, extendible hashing.

UNIT II STACK, QUEUE AND LINKED LIST

Stack definition and examples, primitive operations, example -representing stacks in C, push and pop operation implementation, queue as ADT, C Implementation of queues, insert operation, priority queue, array implementation of priority queue, inserting and removing nodes from a list-linked implementation of stack, queue and priority queue, other list structures, circular lists: stack and queue as circular list - primitive operations on circular lists, header nodes, doubly linked lists, addition of long positive integers on circular and doubly linked list.

UNIT III TREES

Binary trees: operations on binary trees, applications of binary trees, binary tree representation, node representation of binary trees, implicit array representation of binary tree, binary tree traversal in C, threaded binary tree, representing list as binary tree, finding the Kth element, deleting an element, trees and their applications: C representation of trees, tree traversals, evaluating an expression tree, constructing a tree.

UNIT IV SORTING AND SEARCHING

General background of sorting: efficiency considerations, notations, efficiency of sorting, exchange sorts: bubble sort; quick sort; selection sort; binary tree sort; heap sort, heap as a priority queue, sorting using a heap, heap sort procedure, insertion sorts: simple insertion, shell sort, address calculation sort, merge sort, radix sort,sequential search: indexed sequential search, binary search, interpolation search.

UNIT V GRAPHS

Application of graph, C representation of graphs, transitive closure, Warshall's algorithm, shortest path algorithm, linked representation of graphs, Dijkstra's algorithm, graph traversal, traversal methods for graphs, spanning forests, undirected graph and their traversals, depth first traversal, application of depth first traversal, efficiency of depth first traversal, breadth first traversal, minimum spanning tree, Kruskal's algorithm, round robin algorithm.

Text Books:

1.Aaron M. Tenenbaum, Yeedidyah Langsam, Moshe J. Augenstein, 'Data structures using C', Pearson Education, 2004 / PHI.
2.E. Balagurusamy, 'Programming in Ansi C', Second Edition, TMH, 2003.
3.Robert L. Kruse, Bruce P. Leung Clovis L.Tondo, 'Data Structures and Program Design in C',Pearson Education, 2000 / PHI.

Data Security and Privacy			
Course Code:	**MDS106**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1 To develops fundamental understanding of data, information and the security requirements.			
2 To create awareness about information security principles, assets and risk management.			
3 To learn and understand cryptographic algorithms and related operations.			
4 To develop the ability to understand entity verification in networks and web security protocols and applications			
5 To Acquire understanding of information security related policies, violations, cybercrimes, laws and standards.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1 Understand the information and the security requirements fundamentals.			

2 Understand the security principles and risk management procedure.
3 Understand the cryptographic algorithms with their applications.
4 Understand network and web security protocols.
5 .Understand the requirement of policies, standards, cyber security crimes and laws.

UNIT I: Introduction to Information Security:
Definition of information, data, security, need of information security and requirements, CIA, principles of information security, Risk management, Physical security; Asset definition, types of assets, asset classification, Security goals, attacks, services and mechanisms,

UNIT II Cryptography: cryptography:
Classical encryption techniques-substitution ciphers and transposition ciphers. Stream and block ciphers. Data encryption standard (DES), Triple DES, Advanced Encryption Standard (AES), Principals of public key crypto systems, RSA & DHKE algorithm.

UNIT III Authentication:
Authentication of human entities, machines, messages, authentication requirements, message authentication code, hash functions, security of hash functions, Secure hash algorithm (SHA) Digital Signatures: Digital signature standards (DSS), Key Management and distribution: Symmetric & Public key distribution, Public key Infrastructure.

UNIT IV Web Security: Applications:
Kerberos, Electronic mail security: pretty good privacy (PGP), S/MIME. IP Security, Secure Socket Layer, Secure electronic transaction (SET) System Security: Intrusion & Intrusion detection, Viruses, firewalls.

UNIT V Legal Perspectives:
Policy, Types of policies, Need of an Information Security Policy, Standards, Procedures, Guidelines, ISO 27001 Standard. Cyber-crimes, Types of cyber-crimes, introduction of IT ACT 2000.

Text Books:
[1] William Stallings, "Cryptography and Network Security: Principals and Practice", Pearson Education.
[2] Behrouz A. Frouzan: Cryptography and Network Security, Tata McGraw Hill.

Reference Books:
[1] Merkow, "Information Security Principles & Practices"
[2] Christof Paar & Jan Pelzel, Understanding Cryptography, Springer.
[3] Bare Act Information Technology ACT 2000.
[4] C K Shyamala, N Harini, Dr. T.R. Padmnabhan Cryptography and Security, Wiley.
[5] Bruce Schiener, "Applied Cryptography". John Wiley & Sons.
[6] Bernard Menezes," Network Security and Cryptography", Cengage Learning.
[7] Atul Kahate, "Cryptography and Network Security", Tata McGraw Hill.
[8] Thomas R. Peltier, Justin Peltier, John Blackley, Information Security Fundamentals.

Data Analytics using R			
Course Code:	**MDS108**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1 Understanding Data Analysis			
2 To learn R as a programming language			
3 Able to do visualizations with R			
4 Implementing R for statistical analysis			
5 Implementing R for prescriptive analysis			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1 How to analyze the data			

2 Able to use R for Decision making
3 Able to do any visualization with R
4 Ability to apply statistical techniques using R Programming
5 Act like a data analyst

UNIT I INTRODUCTION TO DATA ANALYSIS

Overview of Data Analytics, Need of Data Analytics, Nature of Data, Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics.

UNIT II R PROGRAMMING BASICS

Overview of R programming, Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages.

UNIT III DATA VISUALIZATION USING R

Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files.

Working with R Charts and Graphs: Histograms,Boxplots,Bar Charts, Line Graphs, Scatterplots, Pie Charts

UNIT IV STATISTICS WITH R

Random Forest, Decision Tree, Normal and Binomial distributions,Time Series Analysis,Linear and Multiple Regression, Logistic Regression, Survival Analysis.

UNIT V PRESCRIPTIVE ANALYTICS

Creating data for analytics through designed experiments,Creating data for analytics through active learning, Creating data for analytics through reinforcement learning

Text Book

1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team. Version 3.0.1 (2013-05-16). URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

Reference Book

1. Jared P Lander, R for everyone: advanced analytics and graphics, Pearson Education, 2013.
2. Dunlop, Dorothy D., and Ajit C. Tamhane. Statistics and data analysis: from elementary to intermediate. Prentice Hall, 2000.
3. G Casella and R.L. Berger, Statistical Inference, Thomson Learning 2002.
4. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)
5. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
6. Hastie, Trevor, et al.The elements of statistical learning.Vol. 2. No. 1. New York: springer, 2009.
7. Montgomery, Douglas C., and George C. Runger.Appliedstatistics and probability for engineers. John Wiley &Sons, 2010

8. Joseph F Hair, William C Black etal , “Multivariate Data Analysis” , Pearson Education, 7th edition, 2013.
9. Mark Gardener, “Beginning R - The Statistical Programming Language”, John Wiley & Sons, Inc., 2012.
10. W. N. Venables, D. M. Smith and the R Core Team, “An Introduction to R”, 2013.

Data Mining			
Course Code:	**MDS110**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. To Understand Data mining principles and techniques.
2. To Understand DM as a cutting edge business intelligence.
3. To expose the students to the concepts of Data ware housing Architecture and Implementation.
4. To study the overview of developing areas – Web mining, Text mining and ethical aspects of Data mining.
5. To identify Business applications and Trends of Data mining.

COURSE OUTCOMES
At the end of the course the students should be able to:
1. Perform the preprocessing of data and apply mining techniques on it.
2. Identify the association rules, classification, and clusters in large data sets.
3. Solve real world problems in business and scientific information using data mining.
4. Use data analysis tools for scientific applications.
5. Implement various supervised machine learning algorithms.

UNIT I INTRODUCTION TO DATA MINING (DM)

Motivation for Data Mining - Data Mining-Definition and Functionalities – Classification of DM Systems - DM task primitives - Integration of a Data Mining system with a Database or a Data Warehouse - Issues in DM – KDD Process.

UNIT II DATA PRE-PROCESSING

Data summarization, data cleaning, data integration and transformation, data reduction, data discretization and concept hierarchy generation, feature extraction, feature transformation, feature selection, introduction to Dimensionality Reduction, CUR decomposition.

UNIT III CONCEPT DESCRIPTION

Mining Frequent Patterns, Associations and Correlations

What is concept description? - Data Generalization and summarization-based characterization - Attribute relevance - class comparisons, Basic concept, efficient and scalable frequent item-set mining methods, mining various kind of association rules, from association mining to correlation analysis, Advanced Association Rule Techniques, Measuring the Quality of Rules.

UNIT IV CLASSIFICATION AND PREDICTION

Classification vs. prediction, Issues regarding classification and prediction, Statistical-Based Algorithms, Distance-Based Algorithms, Decision TreeBased Algorithms, Neural Network-Based Algorithms, Rule-Based Algorithms, Combining Techniques, accuracy and error measures, evaluation of the accuracy of a classifier or predictor. Neural Network Prediction methods: Linear and nonlinear regression, Logistic Regression Introduction of tools such as DB Miner / WEKA / DTREG DM Tools.

UNIT V CLUSTER ANALYSIS

Clustering: Problem Definition, Clustering Overview, Evaluation of Clustering Algorithms, Partitioning Clustering -K-Means Algorithm, KMeans Additional issues, PAM Algorithm; Hierarchical Clustering – Agglomerative Methods and divisive methods, Basic Agglomerative Hierarchical Clustering, Strengths and Weakness; Outlier Detection, Clustering high dimensional data, clustering Graph and Network data.

TextBooks:

1. Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, third edition 2011, ISBN: 1558604898.

2. Alex Berson and Stephen J. Smith, " Data Warehousing, Data Mining & OLAP", Tata McGraw Hill Edition, Tenth Reprint 2007.
3. G. K. Gupta, "Introduction to Data Min Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006.
4. Data Mining:Practical Machine Learning Tools and Techniques,Third edition,(Then Morgan Kufmann series in Data Management systems), Ian.H.Witten, Eibe Frank and Mark.A.Hall, 2011
5. Statistical and Machine learning –Learning Data Mining, techniques for better Predictive Modeling and Analysis to Big Data

Reference Books:

1. J. Han, M. Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann
2. M. Kantardzic, "Data mining: Concepts, models, methods and algorithms, John Wiley &Sons Inc.
3. M. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson Education.
4. Ning Tan, Vipin Kumar, Michael Steinbanch Pang, "Introduction to Data Mining", Pearson Education

Data Structure and Algorithms Lab			
Course Code:	**MDS182**	**Course Credits:**	**2**
Course Category:	**CC-P**	**Course (U / P)**	**U**
Course Year (U / P):U	**3P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**02(3 hrs)**		
Total No. of Labs:	**10**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1.Introduce the concept of data structures through ADT including List, Stack, Queues .			
2.To design and implement various data structure algorithms.			
3.To introduce various techniques for representation of the data in the real world.			
4.To develop application using data structure algorithms			

5.Compute the complexity of various algorithms.
COURSE OUTCOMES
At the end of the course the students should be able to:
1. Select appropriate data structures as applied to specified problem definition
2.Implement operations like searching, insertion, and deletion, traversing mechanism etc. on various data structures.
3.Students will be able to implement Linear and Non-Linear data structures.
4. Implement appropriate sorting/searching technique for given problem.
5. Design advance data structure using Non-Linear data structure

List of Experiments:

1. Run time analysis of Fibonacci Series
2. Study and Application of various data Structure
3. Study and Implementation of Array Based Program
   a. Searching (Linear Search, Binary Search)
   b. Sorting (Bubble, Insertion, Selection, Quick, Merge etc) c. Merging
4. Implementation of Link List
   a. Creation of Singly link list, Doubly Linked list
   b. Concatenation of Link list
   c. Insertion and Deletion of node in link list
   d. Splitting the link list into two link list
5. Implementation of STACK and QUEUE with the help of a. Array
   b. Link List
6. Implementation of Binary Tree
7. Implementation of Binary Search Tree.
8. Write a program to simulate various traversing Technique
9. Representation and Implementation of Graph
   a. Depth First Search
   b.Breadth First Search
   c. Prims Algorithm
   d. Kruskal's Algorithms
10. Implementation of Hash Table

Data Analytics using R Lab			
Course Code:	**MDS18**	**Course Credits:**	**2**
Course Category:	**CC-P**	**Course (U / P)**	**U**
Course Year (U / P):U	**3P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**02(3 hrs)**		
Total No. of Labs:	**10**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Understand the main concepts of visual analytics with a hands-on tutorial using R			

2.	Understand and describe the main concepts of data visualization
3.	Understand the main chart types and their recommended usage
4.	Create ad-hoc reports, data visualizations, and dashboards using R
5.	Understand data manipulation with R
COURSE OUTCOMES	
At the end of the course the students should be able to:	
1.	Learn the main concepts of visual analytics with a hands-on tutorial.
2.	To describe the main concepts of data visualization and Simple Calculations.
3.	Learn the main chart types and their recommended usage.
4.	Able to Create ad-hoc reports, data visualizations, and dashboards
5.	Able to perform different matrix operations.

Program List:

Study of data analysis using MS-Excel(Prerequisite)

1. Study of basic Syntaxes in R
2. Implementation of vector data objects operations
3. Implementation of matrix, array and factors and perform va in R
4. Implementation and use of data frames in R
5. Create Sample (Dummy) Data in R and perform data manipulation with R
6. Study and implementation of various control structures in R
7. Data Manipulation with dplyr package
8. Data Manipulation with data.table package
9. Study and implementation of Data Visualization with ggplot2
10. Study and implementation data transpose operations in R

SEMESTER III

ANALYSIS & DESIGN OF ALGORITHMS			
Course Code:	**MDS201**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**

Total No. of Lectures (L + T):	45	End Sem. Exam Hours:	3
COURSE OBJECTIVES			
1.Analyze the asymptotic performance of algorithms.			
2.Write rigorous correctness proofs for algorithms.			
3.Demonstrate a familiarity with major algorithms and data structures.			
4.Apply important algorithmic design paradigms and methods of analysis.			
5.Synthesize efficient algorithms in common engineering design situations.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.Argue the correctness of algorithms using inductive proofs and invariant			
2.Explain the major graph algorithms and their analyses. Employ graphs to model engineering problems, when appropriate. Synthesize new graph algorithms and algorithms that employ graph computations as key components, and analyze them.			
3.Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.			
4.Define the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize dynamic-programming algorithms, and analyze them.			
5.Analyze worst-case running times of algorithms using asymptotic analysis.			

UNIT I BASIC CONCEPT OF ALGORITHMS

What is an algorithm, notion of algorithm, fundamentals of algorithmic solving, Mathematics for Algorithmic sets, Functions and Relations, Vectors and Matrices, linear Inequalities and Linear Equations, fundamentals of analysis framework, the efficient algorithm, Average, Best and Worst case analysis, asymptotic notation, Analyzing Control statement, Loop invariant and the correctness of the algorithm.

UNIT II MATHMATICAL ASPECTS AND ANALYSIS OF ALGORITHM

Mathematical analysis of non- recursive algorithm , mathematical analysis of recursive algorithm, example: fibonacci numbers, empirical analysis of algorithms, algorithm visualization.

UNIT III ANALYSIS OF SORTING AND SEARCHING ALGORITHM

Sorting Algorithms and Analysis: Bubble sort, Selection sort, Insertion sort,Shell sort Heap sort, Sorting in linear time: Bucket sort, Radix sort and Counting sort. sequential search and brute-force string matching, divide and conquer, merge sort, binary search, binary tree, traversal and related properties, depth first search and breadth forst search.

UNIT IV ALGORITHM TECHNIQUES

Transform and conquer, presorting, balanced search trees, avl trees, heaps and heap sort, dynamic programming, Warshall's and Floyd's algorithm, optimal binary search trees, greedy techniques, Prim's algorithm, Kruskal's algorithm, Dijkstra's algorithm, Huffman trees.

UNIT V ALGORITHM DESIGN METHODS

Backtracking, n-Queen's problem, Hamiltonian circuit problem, subset-sum problem, branch and bound, assignment problem, knapsack problem, traveling salesman problem.

Text Books:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithm", Pearson Education Asia, 2003

References Books:

1. T.H. Cormen, C.E. Leiserson, R. L. Rivest and C. Stein, "Introduction to Algorithm", PHI Pvt. Ltd., 2001

2. Sara Baase and Allen Van Gelder,"Computer Algorithms-Introduction to the Design and Analysis ", Pearson Education Asia,2003

3. A. V. Aho, J.E. Hopcroft and J.D. Ullman, "the Design and Analysis of Computer Algorithms", Pearson Education Asia,2003.

DATA MODELING AND VISUALIZATION-II			
Course Code:	**MDS203**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**

Total No. of Lectures (L + T):	45	End Sem. Exam Hours:	3
COURSE OBJECTIVES			
1. get an introduction to Data Analytics and its role.			
2. To extend student's knowledge in the area of Data Science.			
3. emphasis on Predictions utilizing associated statistical methods and software tools..			
4. Identify the techniques for analysing different types ofData.			
5. Provide different Use cases of Data ScienceApplications..			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Identify the various steps of Data Science projectdevelopment.			
2. Understand the need of data collection storage and processing of data for better insights..			
3.Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.			
4. Ability to apply specific statistical and regression analysis methods applicable to predictive analytics to identify new trends and patterns, uncover relationships, create forecasts, predict likelihoods, and test predictive hypotheses			
5. Ability to develop and use various quantitative and classification predictive models based on various regression and decision tree methods.			

UNIT I INTRODUCTION TO DATA ACQUISITION

Applications, process, data extraction, data cleaning and annotation, data integration, data reduction, data transformation, visualization-introduction terminology, basic charts and plots-multivariate data visualization, data visualization techniques, pixel-oriented visualization techniques, geometric projection visualization techniques, icon-based visualization techniques-hierarchical visualization techniques, visualizing complex data and relations.

UNIT II DATA VISUALIZATION TOOLS

Rank analysis tools- trend analysis tools- multivariate analysis tools- distribution analysis tools-correlation analysis tools- geographical analysis tools.

UNIT III REGRESSION MODEL BUILDING FRAMEWORK

Problem definition, data pre-processing; model building; diagnostics and validation simple linear regression: coefficient of determination, significance tests, residual analysis, confidence and prediction intervals.

UNIT IV MULTIPLE LINEAR REGRESSION

Coefficient of multiple coefficient of determination, interpretation of regression coefficients, categorical variables, heteroscedasticity, multi-collinearity, outliers, auto regression and transformation of variables, regression model building**.**

UNIT V DEFINING DATA VISUALIZATION

Defining data visualization; visualization workflow: describing data visualization workflow, process in practice; data representation: chart types: categorical, hierarchical, relational, temporal & spatial; 2-d: bar charts, clustered bar charts, dot plots, connected dot plots, pictograms, proportional shape charts, bubble charts, radar charts, polar charts, range chart, box-and-whisker plots, univariate scatter plots, histograms word cloud, pie chart, waffle chart, stacked bar chart, back-to-back bar chart, treemap and all relevant 2-d charts. 3-d: surfaces, contours, hidden surfaces, pm3d coloring, 3d mapping; multi-dimensional data visualization; manifold visualization; graph data visualization; annotation**.**

TEXT BOOKS

1. Andy kirk, data visualization a handbook for data driven design, sage publications, 2016
2. philipp k. Janert, gnuplot in action, understanding data with graphs, manning publications, 2010.
3. alberto cordoba, “understanding the predictive analytics lifecycle”, wiley, 2014.
4. Eric siegel, thomas h. Davenport, “predictive analytics: the power to predict who will click, buy, lie, or die”, wiley, 2013.
5. James r evans, “business analytics – methods, models and decisions”, pearson 2013.
6. R. N. Prasad, seema acharya, “fundamentals of business analytics”, wiley, 2015.

INTELLIGENT INFORMATION RETRIEVAL			
Course Code:	**MDS203**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**P**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**2P**
No. of Lectures + Tutorials	**03 +0**	**Mid Sem. Exam Hours:**	**1.5**

(Hrs/Week):			
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. To understand the theoretical basis behind the standard models of IR (Boolean, Vector-space, Probabilistic and Logical models)
2. To understand the difficulty of representing and retrieving documents, images, speech, etc.
3. To understand the standard methods for Web indexing and retrieval
4. To be familiar with various algorithms and systems
COURSE OUTCOMES
At the end of the course the students should be able to:
1. To learn the theories and techniques behind Web search engines, E-commerce recommendation systems, etc
2. Get hands on project experience by developing real-world applications, such as intelligent tools for improving search accuracy from user feedback, email spam detection, recommendation system, or scientific literature organization and mining.
3. Learn tools and techniques to do cutting-edge research in the area of information retrieval or text mining
4. be able to implement, run and test a standard IR system
Configure changes and manage risks using project management tools.

UNIT I INFORMATION RETRIEVAL FUNDAMENTALS

Overview of IR systems, historical perspectives, basic evaluation, document representation: statistical characteristics of text, basic query processing, data structure and file organization for ir, examples of information retrieval, need of maintain the global information base, use of information for planning, reliability of information storage, redundancy in information storage, report on 21st century intelligent system, role of intelligent system in e-governance.

UNIT II INFORMATION RETRIEVAL MODELS

Information retrieval using the boolean model, dictionary and postings, dictionary-based approaches of information retrieval, list, adhoc information retrieval method, indexing, scoring and term weighting, random vs sequential search methods, the content-based information retrieval system, consistency of retrieved information, accuracy, and precision of retrieved information.

UNIT III INTERNET BASED INFORMATION RETRIEVAL METHODS

Vector space retrieval, relevance feedback and query expansion, xml retrieval probabilistic information retrieval, language model for information retrieval, text classification and naïve bayes, web search basics, web crawling and indexes, evaluating information retrieval methods, concept of precision and recall.

UNIT IV AGENT BASED INFORMATION RETRIEVAL

Ontology based web agents, search for information in unstructured knowledge domains, intelligent adaptive information agents, designing of agent for information retrieval, incorporation of ai concepts for design of intelligent agent. Document and term clustering, document categorization, ir systems and the www, pagerank and hyperlink analysis.

UNIT V INFORMATION RETRIEVAL TECHNIQUES

Search personalization ir systems and the www, heterogeneous information sources, intelligent web agents, web mining, and its applications, intelligent systems for finding genes in dna, using information content to evaluate semantic similarity in information taxonomy.

TEXTBOOK:

1. D. Grossman and o. Frieder,"information retrieval: algorithms and heuristics", kluwer academic press.

2. Richard k. Belew, "finding out about: a cognitive perspective on search engine technology and the www", cambridge university press, 2001.

3. C. J. Van rijsbergen , "information retrieval".

PYTHON PROGRAMMING			
Course Code:	**MDS207**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**P**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**2P**
No. of Lectures + Tutorials (Hrs/Week):	**03 +0**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. Master the fundamentals of writing Python scripts.
2. Learn core Python scripting elements such as variables and flow control structures.
3. Discover how to work with lists and sequence data.
4. Write Python functions to facilitate code reuse.
5. Use Python to read and write files.

COURSE OUTCOMES
At the end of the course the students should be able to:
1. Problem solving and programming capability.
2. Explain basic principles of Python programming language
3. Implement database and GUI applications.
4. Implement object oriented concepts
5. Define and demonstrate the use of built-in data structures “lists” and “dictionary”

UNIT I PYTHON BASICS, CONDITIONAL &LOOPS

Installation of Python and python Notebook, Python Objects, Number & Booleans, Strings, Operators - Arithmetic, Bitwise, comparison and Assignment operators, Operators Precedence and associativity. Conditions (If else, if-elif-else), Loops (While ,for), Break and Continue statements, Range Functions

UNIT II STRING OBJECTS AND LIST OBJECTS

String object basics, String methods, Splitting and Joining Strings, String format functions, list object basics, list methods, List comprehensions.

UNIT III TUPLES, SET, DICTIONARIES & FUNCTIONS

Tuples, Sets, Dictionary Object basics, Dictionary Object methods, Dictionary View Objects. Functions basics, Parameter passing, Iterators

UNIT IV OOPS CONCEPTS & WORKING WITH FILES

OOPS basic concepts, creating classes and Objects, Inheritance, Multiple Inheritance, working with files, Reading and writing files, Buffered read and write, Other File methods

UNIT V MODULES, EXCEPTION HANDLING & DATABASE PROGRAMMING

Using Standard Module, Creating new modules, Exceptions Handling with Try-except, Creating, inserting and retrieving Table, Updating and deleting the data.

Text Books:

1. Head First Python 2e: A Brain-Friendly Guide Paperback – Illustrated, 16 by PaulBarry, Oreilly.
2. Python: The Complete Reference Paperback – 20 March 2018 by Martin C. Brown (Author), TMHPublication
3. Let Us Python by YashavantKanetkar , 1 January 2019, BPB publication
4. Python Programming, A modular approach , First Edition, By Pearson Publication by Taneja Sheetal and Kumar Naveen , 26 September2017.

Numerical Algorithms for Machine Learning			
Course Code:	**MA033**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**P**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**2P**
No. of Lectures + Tutorials (Hrs/Week):	**03 +0**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. To understand and learn regression models, interpret estimates and diagnostic statistics.
2. To understand and learn different classification models and its algorithms
3. To understand and learn clustering methods
4. To generate an ability to build neural networks for solving real life problems
5. To acquire knowledge of Convolution Artificial Neural Networks

COURSE OUTCOMES
At the end of the course the students should be able to:
1. Apply, build and fit regression models for real time problems..
2. Apply and build classification models using SVM and random forest classifiers.
3. Apply and build clustering models using clustering methods and its corresponding algorithms
4. Design and development of certain scientific and commercial application using computational neural network models.
5. Apply text classification and topic modelling methods to solve given problem.

Unit 1 INTRODUCTION

Learning, Types of Learning, Well defined learning problems, Designing a Learning System, History of ML, Introduction of Machine Learning Approaches – (Artificial Neural Network, Clustering, Reinforcement Learning, Decision Tree Learning, Bayesian networks, Support Vector Machine, Genetic Algorithm), Issues in Machine Learning and Data Science Vs Machine Learning.

UNIT 2 REGRESSION: LINEAR REGRESSION AND LOGISTIC REGRESSION

BAYESIAN LEARNING - Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm. SUPPORT VECTOR MACHINE: Introduction, Types of support vector kernel – (Linear kernel, polynomial kernel,and Gaussiankernel), Hyperplane – (Decision surface), Properties of SVM, and Issues in SVM.

Unit 3 DECISION TREE LEARNING

Decision tree learning algorithm, Inductive bias, Inductive inference with decision trees, Entropy and information theory, Information gain, ID-3 Algorithm, Issues in Decision tree learning.

INSTANCE-BASED LEARNING – k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning.

Unit 4 ARTIFICIAL NEURAL NETWORKS

Perceptron's, Multilayer perceptron, Gradient descent and the Delta rule, Multilayer networks, Derivation of Backpropagation Algorithm, Generalization, Unsupervised Learning – SOM Algorithm and its variant; DEEP LEARNING - Introduction,concept of convolutional neural network , Types of layers – (Convolutional Layers , Activation function , pooling , fully connected) , Concept of Convolution (1D and 2D) layers, Training of network, Case study of CNN for eg on Diabetic Retinopathy, Building a smart speaker, Self-deriving car etc.

Unit 5 REINFORCEMENT LEARNING

Introduction to Reinforcement Learning , Learning Task,Example of Reinforcement Learning in Practice, Learning Models for Reinforcement – (Markov Decision process , Q Learning - Q Learning function, Q Learning Algorithm), Application of Reinforcement Learning,Introduction to Deep Q Learning. GENETIC ALGORITHMS: Introduction, Components, GA cycle of reproduction, Crossover, Mutation, Genetic Programming, Models of Evolution and Learning, Applications.

Text books:

1. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Ethem Alpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
3. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
4. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer-Verlag

ANALYSIS & DESIGN OF ALGORITHMS LAB			
Course Code:	**MDS281**	**Course Credits:**	**2**
Course Category:	**CC-P**	**Course (U / P)**	**U**
Course Year (U / P):U	**3P**	**Course Semester (U / P):**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**02(3 hrs)**		
Total No. of Labs:	**10**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1.Write sorting programs using Divide-and-Conquer techniques.
2. Implement to find the minimum cost spanning tree and shortest path using different Greedy techniques
3. Construct DFS, BFS programs and topological ordering using Decrease-and-Conquertechnique
4. Implement knapsack, travelling salesperson
5.Design different searching & sorting techniques and finding the complexities.
COURSE OUTCOMES
At the end of the course the students should be able to:
1.Demonstrate Quick sort and Merge sort and calculate the time required to sort the elements.
2.Implement the topological ordering of vertices, travelling salesman problem and Knapsack problem
3.Construct programs to check graph is connected or not using BFS and DFS methods
4.Implement programs on divide and conquer, decrease and conquer
5.ExperimentfindingtheminimumcostofspanningtreeusingPrim'salgorithmsandshortestpath using Dijkstra' algorithm

PRACTICALS (NOTE: USE ANY PROGRAMMING TOOLS LIKE C/JAVA/PYTHON TO EXECUTE.)

1. sort a given set of elements :

(A). Using the quick sort method an also analyse its runing time compleity for different inputs.

(B). Using merge sort method an also analyse its runtime complexity for different inputs.

2. Write a program to obtain the topological ordering of vertices in a given digraph.
3. Implement travelling salesman problem.
4. Implement the knapsack problem(0/1).
5. Print all the nodes reachable from a given starting node in a digraph using BFS method.
6. Check whether a given graph is connected or not using DFS method.

7. Write a program to implement binary search using divide and conquer technique
8. Write a program to implement insertion sort using decrease and conquer technique
9 . Find minimum cost spanning tree of a given undirected path using a prim's algorithm.
10. from given vertex in a weighted connected graph, find shortest paths to other vertices using
dijkstra's algorithm.

PYTHON PROGRAMMING LAB			
Course Code:	**MDS283**	**Course Credits:**	**1**
Course Category:	**CC-P**	**Course (U / P)**	**P**
Course Year (U / P):	**1U**	**Course Semester (U / P):**	**2P**
No. of Labs (Hrs/Week):	**3 hrs)**	**Mid Sem. Exam Hours:**	**1**
Total No. of Labs:	**10**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. To introduce students to use of Python programming to solve data analytics problems			
2. To elaborate students to statistical analysis using Python programming			
3. To describe various libraries required for data analytics			
4. To elaborate statistical analysis using Python			
5. To study special libraries in Python such as Numpy and Scipy			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Improve problem solving and programming capability			
2. Learn data analytics through python programming			
3. Underline the use of package			
4. Write simple Python programs for solving problems.			
5. Decompose a Python program into functions, lists etc.			

List of experiments:
Write a program in python:

1. To print the largest/smallest of twonumbers
2. To read two numbers x and n and print xn (first write with the use of operator andthen write with the help of inbuiltfunction
3. To input the value of x and n and print the sum of theseries: a.
1+x+x2+x3+x4+…….xn
4. Write a program to compute distance between two points taking input from the user (Pythagorean Theorem).
5. Write a program to count the numbers of characters in the string and store them in a dictionary data structure.

6. To print factorial of a number with and without using recursion.
7. To tell the frequency of the most common word in a file or a given string.
8. Write a function to find all duplicates in the list.
9. Write a program to perform addition and multiplication of two square matrices.
10. To read from a text file and print each word separated by # symbol, example #xyz#xyz.

ELECTIVES

Data Science Life Cycle			
Course Code:	**MDS112**	**Course Credits:**	**3**
Course Category:	**CC E1**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**2P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Learn concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration			
2. Understand the basic types of data and basic statistics			
3. Identify the importance of data reduction and data visualization techniques			
4. Understand and implement vectors			
5. Understand different data reduction technique			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Understand basic terms what Statistical Inference means			
2. Identify probability distributions commonly used as foundations for statistical modelling. Fit a model to data			
3. Describe the data using various statistical measures			
4. Utilize R elements for data handling			
5. Perform data reduction and apply visualization techniques.			

UNIT I INTRODUCTION

Definition of Data Science- Big Data and Data Science hype – and getting past the hype - Datafication - Current landscape of perspectives - Statistical Inference - Populations and samples

- Statistical modeling, probability distributions, fitting a model – Over fitting. Basics of R: Introduction, R Environment Setup, Programming with R, Basic Data Types.

UNIT II DATA TYPES & STATISTICAL DESCRIPTION TYPES OF DATA

Attributes and Measurement, What is an Attribute? The Type of an Attribute, The Different Types of Attributes, Describing Attributes by the Number of Values, Asymmetric Attributes, Binary Attribute, Nominal Attributes, Ordinal Attributes, Numeric Attributes, Discrete versus Continuous Attributes. Basic Statistical Descriptions of Data: Measuring the Central Tendency: Mean, Median, and Mode, Measuring the Dispersion of Data: Range, Quartiles, Variance, Standard Deviation, and Interquartile Range, Graphic Displays of Basic Statistical Descriptions of Data.

UNIT III VECTORS

Creating and Naming Vectors, Vector Arithmetic, Vector sub setting, Matrices: Creating and Naming Matrices, Matrix Sub setting, Arrays, Class. Factors and Data Frames: Introductionto Factors: Factor Levels, Summarizing a Factor, Ordered Factors, Comparing Ordered Factors, Introduction to Data Frame, subsetting of Data Frames, Extending Data Frames, Sorting Data Frames. Lists: Introduction, creating a List: Creating a Named List, Accessing List Elements, Manipulating List Elements, Merging Lists, Converting Lists to Vectors

UNIT IV CONDITIONALS AND CONTROL FLOW

Relational Operators, Relational Operators and Vectors, Logical Operators, Logical Operators and Vectors, Conditional Statements. Iterative Programming in R:Introduction, While Loop, For Loop, Looping Over List. Functions in R: Introduction, writing a Function in R, Nested Functions, Function Scoping, Recursion, Loading an R Package, Mathematical Functions in R.

UNIT V DATA REDUCTION

Overview of Data Reduction Strategies, Wavelet Transforms, Principal Components Analysis, Attribute Subset Selection, Regression and Log-Linear Models: Parametric Data Reduction, Histograms, Clustering, Sampling, Data Cube Aggregation. Data Visualization: Pixel-Oriented Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations.

TEXTBOOKS:

1. Doing Data Science, Straight Talk from The Frontline. Cathy O'Neil and Rachel Schutt, O'Reilly 2.Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, 3rded. The Morgan Kaufmann Series in Data Management Systems.
3. K G Srinivas, G M Siddesh, "Statistical programming in R", Oxford Publications.

REFERENCE BOOKS:

1.Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.
2.Brain S. Everitt, "A Handbook of Statistical Analysis Using R", Second Edition, 4 LLC, 2014.
3.Dalgaard, Peter, "Introductory statistics with R", Springer Science & Business Media, 2008. 4. Paul Teetor, "R Cookbook", O'Reilly, 2011.

Machine Learning Techniques			
Course Code:	**MDS116**	**Course Credits:**	**3**
Course Category:	**CC E1**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**2P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1.Understand how to correctly prepare input data for use, e.g. feature normalization.
2.Understand how to evaluate and interpret results from scikit-learn estimators.
3.Understand over- and under-fitting and how to detect and prevent these.
4.What data leakage is and how to detect it.
5.Use model selection methods such as cross-validation to tune the choice of model and key parameters.
COURSE OUTCOMES
At the end of the course the students should be able to:
1.Describe the most common types of machine learning problems,
2.Account for why it is important to have informative data and features for the success of machine learning systems
3.explain on a high level how different machine learning models generalize from training examples.
4.Apply a machine learning toolkit in an application relevant to the data science area
5.write the code to implement some machine learning algorithms

UNIT I: INTRODUCTION

Outline: Types of ML, ML Process Data exploration (review), ML Process Example K-NN and Accuracy, Feature Normalization, Supervised learning concepts. Regression versus

Classification k-NN Regression Linear regression, polynomial feature expansion, measuring error: RSS error, k-fold cross validation, Sci-kit learn datasets Overfitting and underfitting.

UNIT II: SUPERVISED LEARNING AND REGULARIZATION

Logistic regression, measuring accuracy: ROC, confusion matrix, dealing with categorical and missing data, Regularization: lasso, ridge. Robust regression, Hyper-parameter search, Support vector machines (linear and kernelized): RBF kernels, Multi-class classification, data imputation, data leakage, Decision trees for classification and regression, entropy Boosting, Random forests, gradient boosted decision trees, XGBboost, AdaBoost, feature importance, SVM paper on detecting fraudulent reviews, Naive Bayes,pipelines.

UNIT III: UNSUPERVISED LEARNING

Unsupervised learning: density estimation, Unsupervised learning: clustering. Agglomerative/tree-based clustering. K-means and variants, Gradient Descent and EM, dimensionality reduction (PCA, multi-dimensional scaling, t-SNE), Evaluation of unsupervised methods, Midterm Examination (tentative).

UNIT IV: DEEP LEARNING

Deep learning, Neural networks, Convolutional NN, Embeddings, Visualizing ConvNets, Sequence problems: Recurrent NN.

UNIT V: IMPLICATION OF PRIVACY:

Generative Adversarial networks (GANs), FAT-ML: bias in training and data collection, implications of privacy, Final project presentations (or catch-up), Incentives and Learning, adversarial ML.

Textbooks:

1. IntroductiontoMachineLearningwithPython.A.MuellerandS.Guido.O'Reilly.
2. Deep Learning with Python, by Francois CholletManning

Integrated Development Environment			
Course Code:	**MDS114**	**Course Credits:**	**3**
Course Category:	**CC E1**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**2P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. To explain the concept and issues behind sustainable development, how it evolved, why it is important, and how it affects people today and in the future
2. To discuss the UN 2030 Agenda and its Sustainable Development Goals as the present global framework for action.
3. To relate sustainability to the issues of economic development, wealth and poverty, social development, and the environment in an integrated systems perspective
4. To value the relevance of sustainability as a priority for communities, national governments, and the international system
5. Understand different IDE technique.
COURSE OUTCOMES
At the end of the course the students should be able to:
1To identify ways you can live more sustainably that are consistent with your own spiritual and ethical values, and to explain your choices to others
2. • To plan ways to educate others about the material and spiritual dimensions of sustainable development
3. Describe the data using various statistical measures• To demonstrate your understanding through postings in the course, weekly essays, and a final paper or project

4. Utilize of IDE
5. Perform IDE techniques.

UNIT I INTROUCTION

Software engineering/methodology: waterfall development, Prototyping, Incremental development, Spiral development, Rapid application development, Other practices, Integrated development environment, Modeling language, Programming paradigm, Software framework, Software development process.

UNIT II IDES IMPORTANCE:

Code editing automation, Syntax highlighting, Intelligent code completion, Refactoring support, Local build automation, Compilation, Testing, Debugging.

UNIT III TYPES OF IDES WITH LANGUAGES:

Introuction of languages: bash/shell, c#, c++, flutter, html & css, java, javascript, kotlin, php, python, r, ruby, sql, swift, Editing Source, Code, Syntax Highlighting, Autocomplete.

UNIT IV IDE TOOL:

Code Editor (and Compiler), Command Line Interface (CLI), Version Control System, Package Manager(Unity's Asset Store, NPM, CODA),

UNIT V IDE IMPLEMENT:

HjSoftware Development Life Cycle Models, Software Modeling, Software Requirements Gathering, Software Requirements Analysis, Software Design, Implementation, Software Testing, Project Management, Putting It Together: A Case Study.

REFERENCES:

1. https://learn.saylor.org/course/view.php?id=73&sectionid=692#section-2
2. HTTPS://AWS.AMAZON.COM/WHAT-IS/IDE/
3. HTTPS://LEARN.SAYLOR.ORG/MOD/BOOK/VIEW.PHP?ID=32962&CHAPTERID=12786
4. Https://eng.libretexts.org/bookshelves/computer_science/programming_and_computation_fundamentals/book%3a_programming_fundamentals_-_a_modular_structured_approach_using_c___(busbee)/06%3a_integrated_development_environment/6.01%3a_introduction_to_ides

INTERNET OF THINGS			
CourseCode:	**MDS118**	**CourseCredits:**	**3**
CourseCategory:CC	**CC E1**	**Course(U /P)**	**P**
No.ofLectures+Tutorials(Hrs/Week):	**2P**	**MidSem. ExamHours:**	**1.5**
TotalNo. ofLectures(L+T):30	**03 + 00**	**EndSem.ExamHours:**	**3**

COURSE OBJECTIVES
1. Explore to the interconnection and integration of the physical world in IoT.
2.Learning of networking concepts in IoT environment.
3.Understanding of various wireless network, topologies, IoT protocols.
4.Understad the importance of security issues in IoT.
5.Implementation of IoT in real life with learning of tools like MATLAB.
COURSE OUTCOMES
At the end of the course the students should be able to:
1 Figure out about all concepts of Internet of Things.
2 understand building blocks of Internet of Things and its characteristics.
3 learn application protocols for IoT.
4 Able to understand the application areas of IoT.
5 Realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.

UNIT I INTRODUCTION TO IOT

Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and OT, IoT Challenges, Drivers Behind New Network Architectures: Scale, Security, Constrained Devices and Networks, Data, Legacy Device Support

UNIT II IOT NETWORK ARCHITECTURE AND DESIGN

Comparing IoT Architectures : The one M2M IoT Standardized Architecture, The IoT World Forum (IoTWF) Standardized Architecture, Additional IoT Reference Models, A Simplified IoT Architecture, The Core IoT Functional Stack- Layer 1: Things: Sensors and Actuators Layer, Layer 2: Communications Network Layer, Layer 3: Applications and Analytics Layer, IoT Data Management and Compute Stack :Fog Computing , Edge Computing, The Hierarchy of Edge, Fog, and Cloud.

UNIT III NETWORK AND APPLICATION PROTOCOLS FOR IOT

Wireless Communication Technologies: ZigBee, ESP8266, Introduction to sensors and modules - concept, layout, working, applications, Introduction of IoT Development Boards-Node MCU, Arduino, IoT Access Technologies 107IEEE 802.15.4, IEEE 802.15.4g and 802.15.4e, IEEE 1901.2a, IEEE 802.11ah, LoRaWAN, Constrained Devices, Constrained-Node Networks, Optimizing IP for IoT :From 6LoWPAN to 6Lo, Header Compression, Fragmentation, Mesh Addressing, Mesh-Under Versus Mesh-Over Routing, Authentication and Encryption on Constrained Nodes , Application Protocols for IoT: CoAP, Message Queuing Telemetry Transport (MQTT)

UNIT IV DATA ANALYTICS AND SECURITY OF IOT

An Introduction to Data Analytics for IoT, Structured Versus Unstructured Data, Data in Motion Versus Data at Rest, IoT Data Analytics Overview, IoT Data Analytics Challenges, Machine Learning : Machine Learning Overview Supervised Learning, Unsupervised Learning, Neural Networks, Securing IoT : Common Challenges in IoT Security, Device Insecurity, Network Characteristics Impacting Security, Security Priorities: Integrity, Availability, and Confidentiality, Formal Risk Analysis Structures: IAS OCTAVE, Top Vulnerabilities of Iot.

UNIT V. IMPLEMENTING IoT IN REAL LIFE

Interfacing sensors with development boards, communication modules with sensors, communication modules with development boards, MATLAB and Arduino Interfacing, Hands-on in IoT - various real life projects involving different boards, sensors, modules and communication technologies

Text Books :

1. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things
by Rob Barton, Gonzalo Salgueiro, David Hanes
2. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1stEdition,
VPT, 2014.
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013

Advanced Java Programming (J2EE Technologies)			
Course Code:	**MDS120**	**Course Credits:**	**3**
Course Category:	**CC E1**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**2P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1.Teach principles of object-oriented programming paradigm including abstraction, encapsulation, inheritance, and polymorphism.			
2.Impart fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.			
3.Familiarize the concepts of packages and interfaces			
4.Facilitate students in handling exceptions.			
5.Demonstrate the concept of event handling used in GUI.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.Analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP like encapsulation, Inheritance and Polymorphism			
2.Design and develop java programs, analyze, and interpret object-oriented data and report results			

3.Design an object-oriented system, AWT components and multithreaded processes as per needs and specifications.
4.Participate and succeed in competitive examinations like GATE, Engineering services, recruitment interviews etc.
5.Plan their career in java-based technologies like HADOOP etc.

UNIT I OBJECT-ORIENTED PROGRAMMING

Concept of object-oriented programming (OOP), benefits of OOP, application of OOP, Java history, Java features, Java streaming, Java and Internet, Java contribution to Internet: Java applets, security, portability; Java environment, Java library, Java program structure, Java program, Java Virtual Machine (JVM) architecture, Just In Time compiler (JIT), data type, variables and arrays, operators, control statements, object-oriented paradigms; abstraction, encapsulation, inheritance, polymorphism, Java class and OOP implementation.

UNITII DATA TYPE, OPERATORS AND CONTROL STATEMENT

Data types, Java key words, identifiers, constants, variables, declaration and scope of the variable, symbolic constant, type casting, arithmetic operator, relational operator, logical operator, assignment operator, increment and decrement operator, conditional operator, bitwise operator, ?: operator, arithmetic expressions, expressions, type conversions in expressions, mathematical functions, more data types: arrays, strings, vectors, wrappers classes, program control statements: decision making and branching: if, if….else, else….if, else if ladder, switch, decision making and looping: while, do….while, for.

UNIT III CLASSES, OBJECTS AND METHODS

Java class libraries, class fundamentals, object, methods, adding variables, add methods, creating objects, accessing class members, constructors, methods overloading, static members, nesting of methods, inheritance: extending a class, overriding methods, final variables and methods, final classes, finalizer methods, abstract methods and classes, visibility control, exception handling fundamental.

UNIT IV INTERFACES AND PACKAGES

Interfaces, extending interfaces, implementing interfaces, interfaces references, accessing interface variable, creating queue interface, variable in interfaces, packages, finding a packages and classpath, package and member access, Java API package, system package, naming conventions, creating package, accessing a package, adding a class to a package, hiding classes.

UNIT V MULTITHREADING AND APPLET PROGRAMMING

Multithreading programming: creating threads, thread class and runnable interface extending the thread class, stopping and blocking a thread, life cycle of a thread, thread methods, thread exceptions, thread priority, synchronization, thread communication using notify(), wait(), and notify all(), applet programming : applet basic, applets architecture, a complete applet skeleton, building applets code, applets life cycle, creating a executable applet, designing a web page, applets tag, passing parameters to applets, applets and HTML.

Text Books:

1. Programming with JAVA, E. Balagurusawamy, Tata McGraw Hill, 1998.
2. JAVA Beginner‟s guide, Herbert Schildt, Tata McGraw Hill, 2007.
3. Java How to Program, Deitel & Deitel, Prentice-Hall, 1999.

Data Storage Technologies and Networking			
Course Code:	**MDS122**	**Course Credits:**	**3**
Course Category:	**CC E1**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**2P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Network-based storage allows more than one computer to access			
2. It through a network, making it better for data sharing and collaboration.			
3. Its off-site storage capability also makes			
4. it better suited for backups and data protection			
5. Data storage essentially means that files and documents are recorded digitally and saved in a storage system for future use			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
6. To explain the design of a data center and storage requirements			
7. To discuss the various types of storage and their properties			
8. To explain physical and virtualization of storage			

9. To explain the backup, archiving with regard to recovery and business continuity
10. To explain the design of a data center and storage requirements

UNIT I DATA CENTRE:
Introduction, site selection and environmental considerations, hierarchical or layered architecture, architect roles, goals and skills, architecture precursors

UNIT II STORAGE MANAGEMENT:
Introduction to storage technology, storage systems architecture, physical and logical components of a connectivity environment, major physical components of a disk drive and their functions, concept of raid and its components, different raid levels and their suitability for different application environments: raid 0, raid 1, raid 3, raid 4, raid 5, raid 0+1, raid 1+0, raid 6, integrated and modular storage systems, high-level architecture and working of an intelligent storage systems

UNIT III NETWORKED STORAGE:
Evolution of networked storage, architecture, components, and topologies of fc-san, nas, and ip-san, benefits of the different networked storage options, need for long-term archiving solutions and describe how cas fulfill the need, appropriateness of the different networked storage options for different application environments

UNIT IV STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION
Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration

UNIT V SECURING STORAGE AND STORAGE VIRTUALIZATION:
information security, critical security attributes for information systems, storage security domains, analyze the common threats in, each domain, storage virtualization: forms, configurations and challenges, types of storage virtualization: block-level and file-level.

Text books:

1. Mauricio arregoces, data center fundamentals, cisco press; 1st edition, 2003.
2. Robert spalding, storage networks: the complete reference, tata mcgraw hill, osborne, 2003.
3. Marc farley, building storage networks, tata mcgraw hill, osborne. 2001.
4. Meeta gupta, storage area network fundamentals, pearson education limited, 2002

Reference book:

1. G. Somasundaram, alok shrivastava, information storage and management, emc education series, wiley, publishing inc., 2011.

2. Gustavo santana, data center virtualization fundamentals: understanding techniques and designs for highly efficient data centers with cisco nexus, ucs, mds, and beyond, cisco press; 1 edition, 2013

Introduction to Statistical Learning			
Course Code:	**MDS124**	**Course Credits:**	**3**
Course Category:	**CC E1**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**2P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. To Input data using the CARDS/DATALINES statement.			
2. Use the LIBNAME statement to generate permanent datasets.			
3 Use the Import and Export functions in SAS			
4. Read-in data in various formats			
5. Understand techniques Create and redefine variables..			
COURSE OUTCOMES			
At the end of the course the students should be able to:			

1 Familiarize Program in SAS proficiently and capably in R.
2. Create and manage (small and large) datasets using computer software.
3. Generate appropriate and meaningful graphics and statistics.
4. Learn various Perform simulations using appropriate software
5. Learn various Create macros in SAS and functions in R..

UNIT I ACCESSING DATA

Use provides fundamentals of probability and statistics for data analysis in research. Topics include data collection, exploratory data analysis, random variables, common discrete and continuous distributions, sampling distributions, estimation, confidence intervals, hypoThesis tests, linear regression, analysis of variance, two (2)-way tables, and data analysis using statistical software.

UNIT II CREATING DATA STRUCTURES

Create temporary, permanent SAS data sets, Create and manipulate SAS date values, Export data create standard, comma-delimited raw data files, Control observations and variables in a SAS data set are processed and output.

UNIT III MANAGING DATA

Application Investigate SAS data libraries using base SAS utility procedures, Sort observations in a SAS data set, Conditionally execute SAS statements, Use assignment statements in the DATA step, Modify variable attributes, using options and statements, Accumulate sub-totals, totals using DATA step statements,Use SAS functions, to manipulate character data, numeric data, and SAS date values.

UNIT IV GENERATING REPORTS

Use SAS functions to convert character, data to numeric and vice versa, Process data using DO LOOPS, Process data using SAS arrays, Generate list reports, using the PRINT procedure, Generate summary reports, frequency tables using base SAS procedures, Enhance reports, user-defined formats, titles, footnotes and SAS System reporting, Generate reports using ODS statements.

UNIT V HANDLING ERRORS

Exploratory data analysis, random variables, common discrete and continuous distributions, sampling distributions, estimation, confidence in- tervals, hypothesis tests, elementary simulation and bootstrapping, distribution-free techniques, linear regression, analysis of variance, two-way tables, and data analysis using statistical software

Reference Book:

1. Tamhane, A. C. and Dunlop, D. D. (2000) Statistics and Data Analysis: From Elementary to Intermediate. Prentice Hall: Upper Saddle River, NJ. ISBN: 0-1374-4426-5 (Required) Hayter,
2. J. (2012) Probability and Statistics for Engineers and Scientists, 4th edition, ISBN: 1111827044. (Optional) Dalgaard, P. (2008) Introductory Statistics with R. Springer Science and Business Media. ISBN: 978-0-387-79053-4.

Research Tecniques for Data Science			
Course Code:	**MDS126**	**Course Credits:**	**3**
Course Category:	**CC E1**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**2P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Develop analytical problem solving and decision-making thinking			
2. Build operations research based models of management problems.			
3. Apply readily available software packages for solution of management problems.			
4. Understand the results of computer modeling.			
5. Select the appropriate analytical technique to real world problems			
COURSE OUTCOMES			
At the end of the course the students should be able to:			

1. understand the steps for translating a real world problem into a mathematical model and use optimization methods to evaluate engineering management alternatives.
2. judge the suitability of solutions and adapt mathematical models for typical problems arising in the manufacturing and service industries and other engineering management areas
3. produce final specifications and models to determine the best design solutions.
4. Identify variables that impact the model structure and analyze various alternatives
5. Solved engineering management decision problem

UNIT I INTRODUCTION AND LINEAR PROGRAMMING:
Definition and scope of operations research (OR), OR model, solving the OR model, art of modeling, phases of OR study,Two variable Linear Programming model and Graphical method of solution, Simplex method, Dual Simplex method, special cases of Linear Programming, duality, sensitivity analysis.

UNIT II TRANSPORTATION PROBLEMS AND ASSIGNMENT:
Types of transportation problems, mathematical models, transportation algorithms, Allocation and assignment problems and models, processing of job through machines.

UNIT III NETWORK TEACHNIQUES AND PROJECT MANAGEMENT:
Shortest path model, minimum spanning Tree Problem, Max-Flow problem and Min-cost problem. Phases of project management, guidelines for network construction, CPM and PERT.

UNIT IV THEORY OF GAMES AND QUALITY SYSTEMS:
Rectangular games, Minima theorem, graphical solution of 2 x n or m x 2 games, game with mixed strategies, reduction to linear programming model. Elements of Queuing model, generalized poisson queuing model, single server models.

UNIT V INVENTORY CONTROL
Models of inventory, operation of inventory system, quantity discount., Replacement, Replacement models: Equipments that deteriorate with time, equipments that fail with time.

Reference Books:
1.Wayne L. Winston,"Operations Research" Thomson Learning,2003.
2.Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education,2003.
3.R. Panneer Seevam, "Operations Research" PHI Learning, 2008.
4.V.K.Khanna,"Total Quality Management" New Age International, 2008.

HIGH PERFORMANCE COMPUTING			
Course Code:	**MDS209**	**Course Credits:**	**3**
Course Category:	**CC E3**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**2P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. To Study various computing technology architecture.			
2. To know Emerging trends in computing technology.			
3. To highlight the advantage of deploying computing technology.			
4. To understand high optimization techniques			
5. To study various emerging communication techniques related to performance criteria			
COURSE OUTCOMES			
At the end of the course the students should be able to:			

6. Cluster Computing and its Architecture
7. Cluster Setup and Administration
8. Introduction to Grid and its Evolution
9. Introduction to Cloud Computing
10. Nature of Cloud

UNIT I CLUSTER COMPUTING AND ITS ARCHITECTURE:
Ease of computing, scalable parallel computer architecture, towards low cost parallel,computing & motivation, windows opportunity ,a cluster computer and its architecture,cluster classification commodity components for clusters, network services/communication sw, cluster middleware and single systems image ,resource management & scheduling (rms).

UNIT II CLUSTER SETUP AND ADMINISTRATION:
Introduction, setting up the cluster, security,, system monitoring, system tuning

UNIT III INTRODUCTION TO GRID AND ITS EVOLUTION:
Introduction to grid and its evolution: beginning of the grid, building blocks of grid application and grid middleware, evolution of the grid: first, second & third generation.

UNIT IV INTRODUCTION TO CLOUD COMPUTING:
Defining clouds, cloud providers, consuming cloud services, cloud models – iaas, paas, saas, inside the cloud ,administering cloud services, technical interface, cloud resources.

UNIT V NATURE OF CLOUD:
Tradition data center,cost of cloud data center, scaling computer systems, cloud work loadmanaging data on clouds public, private and hybridclouds

TEXTBOOKS:
1. High performance cluster computing, volume 1, architecture and systems, rajkumar buyya, pearson education.
2. Berman, fox and hey, grid computing – making the global infrastructure a reality, wiley india.
3. Hurwitz, bllor, kaufman, halper, cloud computing for dummies, wiley india.

REFERENCE BOOKS:

1. Ronald krutz, cloud security, wiley india.
2. Cloud computing, a practical approach, anthony velte, toby velte, robert elsenpeter, mcgrawhill.

BIG DATA PLATFORM			
Course Code:	**MDS211**	**Course Credits:**	**3**
Course Category:	**CC E3**	**Course (U / P)**	**U**
Course Year (U / P):	**2P**	**Course Semester (U / P):**	**2P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Understand the Big Data Platform and its Use cases			
2. Provide an overview of Apache Hadoop			
3. Provide HDFS Concepts and Interfacing with HDFS			
4. Explain the Map Reduce Jobs			
5. Apply analytics on Structured, Unstructured Data. Exposure to Data Analytics with R.			
COURSE OUTCOMES			

At the end of the course the students should be able to:
1.Identify Big Data and its Business ImplicationsAccess and Process Data on Distributed File System
2.List the components of Hadoop and Hadoop Eco-System
3.Manage Job Execution in Hadoop Environment
4. Develop Big Data Solutions using Hadoop Eco System
5.Analyze Infosphere BigInsights Big Data Recommendations

UNIT I INTRODUCTION

Introduction to big data : Introduction to Big Data Platform, Challenges of Conventional Systems, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs Reporting.

UNIT II DATA STREAMS

Mining data streams : Introduction To Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream , Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis- Stock Market Predictions.

UNIT III HADOOP

Hadoop: History of Hadoop, the Hadoop Distributed File System, Components of Hadoop Analysing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics, Developing a Map Reduce Application-How Map Reduce Works, Anatomy of a Map Reduce Job run, Failures, Job Scheduling- Shuffle and Sort – Task execution, Map Reduce Types and Formats- Map Reduce FeaturesHadoop environment.

UNIT IV DATAPROCESSING

Frameworks: Applications on Big Data Using Pig and Hive, Data processing operators in Pig, Hive services, HiveQL, QueryingDatainHive, fundamentals of HBaseandZooKeeper, IBMInfoSphereBigInsightsandStreams.

UNIT V DATA ANALYTICS TECHNIQUE

Predictive Analytics- Simple linear regression, Multiple linear regression., Interpretation 5 of regression coefficients. Visualizations, Visual data analysis techniques, interaction techniques, Systems and applications.

Text Books:

1. MichaelBerthold,DavidJ.Hand,“IntelligentDataAnalysis”,Springer,2007.
2. TomWhite“Hadoop:TheDefinitiveGuide”ThirdEdition,O’reillyMedia,2012.
3. ChrisEaton,DirkDeRoos,TomDeutsch,GeorgeLapis,PaulZikopoulos,“UnderstandingBigData

INTRODUCTION TO BLOCK CHAIN TECHNOLOGY			
Course Code:	**MDS213**	**Course Credits:**	**3**
Course Category:	**E3**	**Course (U / P)**	**P**
Course Year (U / P):	**2P**	**Course Semester**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. To understand the technology behind blockchain			
2. Explain distributed Consensus, and Consensus in Bitcoin			

3. Discuss Permissioned Blockchain, and Hyperledger Fabric
4. To comprehend the issues related to blockchain
5. To study the real-world applications of blockchain
COURSE OUTCOMES
After completion of course, students would be able to:
1. Describe the basic concept of Blockchain, Crypto Primitives, Bitcoin Basics
2. Identify the area in which they can apply permission or permission less blockchain.
3. Apply Block chaining concept in various applications.
4. Design and implement new ways of using blockchain for applications other than cryptocurrency
5. Recognize the underlying technology of transactions, blocks, proof-of-work, and consensus building

UNIT I INTRODUCTION TO BLOCKCHAIN:

Introduction to blockchain, public ledgers, blockchain as public ledgers, bitcoin, blockchain 2.0, smart contracts, block in a blockchain, transactions, distributed consensus, the chain and the longest chain, cryptocurrency to blockchain 2.0, permissioned model of blockchain.

UNIT II BASIC CRYPTO PRIMITIVES:

Cryptographic hash function, properties of a hash function, hash pointer and merkle tree, digital signature, public key cryptography, a basic cryptocurrency.

Bitcoin basics: creation of coins, payments and double spending, forth – the precursor for bitcoin scripting, bitcoin scripts, bitcoin p2p network, transaction in bitcoin network, block mining, block propagation and block relay.

UNIT III DISTRIBUTED CONSENSUS:

why consensus, distributed consensus in open environments, consensus in a bitcoin network.

Consensus in bitcoin: bitcoin consensus, proof of work (pow) – basic introduction, hashcash pow, bitcoin pow, attacks on pow and the monopoly problem, proof of stake, proof of burn and proof of elapsed time. The life of a bitcoin miner, mining difficulty, mining pool.

UNIT IV PERMISSIONED BLOCKCHAIN:

permissioned model and use cases, design issues for permissioned blockchains, execute contracts, state machine replication, consensus models for permissioned blockchain, distributed consensus in closed environment, paxos, raft consensus, byzantine general problem.

Blockchain components and concepts: actors in a blockchain, components in blockchain design, ledger in blockchain.

UNIT V HYPERLEDGER FABRIC TRANSACTION FLOW:

fabric architecture, transaction flow in fabric, Hyperledger fabric details: ordering services, channels in fabric, fabric peer and certificate authority. Fabric – membership and identity management: organization and consortium network, membership service provide, transaction signing.

Books:

1. Nitin gaur, luc desrosiers, venkatraman ramakrishna, petr novotny, salman baset, anthony o'dowd.hands-on blockchain with hyperledger: building decentralized applications with hyperledger fabric and composer. Packt publishing ltd.
2. Bellaj badr, richard horrocks, xun (brian) wu. Blockchain by example: a developer's guide to creating decentralized applications using bitcoin, ethereum, and hyperledger. Packt publishing ltd, 2018.
3. Vikram dhillon, david metcalf, max hooper. Blockchain enabled applications: understand the blockchain ecosystem and how to make it work for you. Apress.
4. Mayukh mukhopadhyay ethereum smart contract development: build blockchain-based decentralized applications using solidity. Packt publishing ltd.

BUSINESS INTELLIGENCE			
Course Code:	**MDS215**	**Course Credits:**	**3**
Course Category:	**E3**	**Course (U / P)**	**P**
Course Year (U / P):	**2P**	**Course Semester**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES

1. To become familiar with the ethics and basics of Business Intelligence and Decision Support Systems

2. To define mathematical models, data mining and data preparation .
3. To describe classification problems and clustering methods
4. To study marketing models, Logistic and production models and Data envelopment analysiS
5.
COURSE OUTCOMES
After completion of course, students would be able to:
1. Discuss the basic concepts of Business Intelligence
2. Explain the basic concepts of Data warehouse, Pentaho Data Integration
3. Execute Pentaho Data Integration
4. Execute Pentaho Data Transformation

UNIT I INTRODUCTION BUSINESS INTELLIGENCE

Business intelligence-(business intelligence : need of The time, components, concept, existing solutions, existing challenges), pentaho- (pentaho, Mapping of pentaho stack to bi stack, pentaho in production), pentaho stack- (abstract component View, architecture view, data layer, server layer , clientlayer), pentahobaserver- (serverlayer), reporting-(pentahoreportesigner, etl), pentaho data integration- (pentaho Data integration), pentaho metadata editor- (pentaho metadata editor).

UNIT II DATAWAREHOUSE

Etlextract- (transfer and load, difference between oltp and olap-oltp, olap, pentaho data) integration(pdi): pdi- (pdi components, pdi architecture, pdi repository),spoon-(spoon layout, spoon components, understanding transformation), example-(create target database, create database, connections, Copy table, running the transformation, execution results, data verification).

UNIT III PENTAHO DATA INTEGRATION-TRANSFORMATION

Transformation, (Adding JNDI using wizard, CreatingMySQL table, Adding Text file input step, Setting up Text Input File step, Adding Table output step, Final Transformation), Problem statement-(Retrieving data from csv, Filter Records with Missing Zips, Load Data into RDBMS, Extracting Lookup Data, Resolve Missing ZIP with Lookup, Replace Missing ZIP with lookup, Execution of Intermediate Transformation, Correcting United states to USA, Tagging Deal size, Final Transformation, Running final Transformation)

UNIT IV PENTAHO DATAINTEGRATION-JOB AND MORE

Job, PDI job- Example-(Creating job and adding condition, Linking our transformation, Running first job) Pentaho Reporting: (Pentaho Report Designer), Pentaho Reporting: Components-(Pentaho Report Designer, Pentaho Report Engine, Reporting Software Development , Pentaho Report Designer? How to start?-(Pentaho Report Designer, Report Wizard, Adding Data Source, After importing spread sheet, Adding Chart element), Pentaho Report Designer-(Layout Types, Reporting Elements, Mapping Data, Alignment, Running

thereport(Basic Formatting), Conditional Formatting, Running the Report with Conditional Formatting, Data Source Connection(Native JDBC, Example).

UNIT V PENTAHO REPORTING

Pentaho Report Designer-(Adding Chart Element, chart Configuration, Resize the chart, Running chart, Chart in PDF),How and When is PRPT created?-(Understanding PRPT, Layout types, Reporting elements, Mapping data, Alignment, Running the report, Conditional formatting, Running the Report with conditional Formatting).

Text Book:

1. "Pentaho Data Integration Beginner's Guide", Packt Publishing, Maria Carina Roldan (2013)

References:

1. "Business Intelligence Master's Program", "Onlinecertification", https://learning.edureka.co/mycourses
2. "Kimball Dimensional Modeling Techniques",Ralph Kimball, Margy Ross2013, Kimball University
3. "Decision support and Business Intelligence systems" Edition: 1 Pearson.Efraim Turban, Ramesh Sharda and Dursun Delen (2014)

DATA VISUALIZATION USING TABLEAU			
Course Code:	**MDS217**	**Course Credits:**	**3**
Course Category:	**E3**	**Course (U / P)**	**P**
Course Year (U / P):	**2P**	**Course Semester**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**

Total No. of Lectures (L + T):	45 + 00	End Sem. Exam Hours:	3
COURSE OBJECTIVES			
1. Gaining a basic understanding of the subject (e.g., factual knowledge, methods, principles, generalizations, theories)			
2. Learning to analyze and critically evaluate ideas, arguments, and points of view.			
3. Learning appropriate methods for collecting, analyzing, and interpreting numerical information			
4. Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to this course			
5. Learning appropriate methods for collecting, analyzing, and interpreting numerical information			
COURSE OUTCOMES			
After completion of course, students would be able to:			
1. Understand and describe the main concepts of data visualization			
2. Understand the main chart types and their recommended usage			
3. Create ad-hoc reports, data visualizations, and dashboards using Tableau Desktop			
4. Publish the created visualizations to Tableau Server and/or Tableau Public			

UNIT I INTRODUCTION

Introduction to data visualization, Principles for data visualization, Data literacy, Identify and recognize types of data attributes, Recognize pre-attentive attributes: color, size, length, etc., plots: Bar charts, Scatter Plots, Maps, Bullet Graphs, Pie Charts, Donut Charts, Heat Maps, and Tables.

UNIT II VISUAL ANALYTICS

Scope of Visual analytics, aggregating and disaggregating data)- data granularity(data granularity, mark card In tableau, data granularity in tableau-shapes, data granularity in tableau-colors, data granularity in Tableau-size)- highlighting(highlighting-using legend, highlighting problem, highlighting solution, Highlighting power, bar graph, line graph, pie chart, dual axis graph, area graph with dual axis).

UNIT III VISUAL ANALYTICS IN DEPTH

Sorting (quick sort, sorting-measures, sorting-headers and legend, sorting-solution using pill)-filtering (interactive filter, grouping- data window, grouping group, grouping- calculated group (static), calculated group(dynamic))- graphical visualization(heat maps, circle plots, scatter plot, tree maps), sets(sets in tableau, sets- marks, sets- computation)-Forecasting(forecasting, forecasting-length, forecasting- source data, forecasting –model, Forecasting- summary box, forecasting – problem, forecasting – precision range)- clustering, trend Lines(clustering, trend lines- types, trend lines-benefit of color)- reference lines and Parameter(reference lines, reference lines- aggregating options, reference lines-labels, parameter in depth, parameter- filters).

UNIT IV DASHBOARD INTERACTIVITY

Dashboard interactivity(dashboard interactivity-actions, dashboard interactivity-filter action, dashboard interactivity- highlighting action, dashboard interactivity- url) introduction to mapping: mapping(mapping-coordinate points, mapping – plotting geographic data, mapping-symbol, mapping- layered view)- editing unrecognized location(ambiguous geographic data, editing locations)- polygon maps(polygon maps-filled map, polygon map-custom territory, polygon map- custom maps, polygon map-required data, building a polygon map)- background Images(background images, adding an image, background images-generating coordinates, background images- plotting points).

UNIT V CALCULATION

Introduction to calculation (creating a calculated field, number functions, numeric functions-calculation, numeric functions- solution, string functions, string functions-calculation, date functions, date functions-calculation, logical functions, logical functions-procedures, aggregate functions)- introduction to table calculation (table calculation, quick table calculation)- Introduction to lod expression (lod expression, lod expression-types) charts: charts (box and whisker's plot, gantt chart, water fall chart, pareto chart, control chart, funnel chart).

TEXT BOOK:

1."business intelligence master's program", "online certification", Https://learning.edureka.co/mycourses

REFERENCES:

1. "mastering tableau", packt publishing, david baldwin nore (2016)
2. "tableau questions & answers guide to tableau concepts & faqs", chandraish sinha, 2016.
3. "tableau 10.0 best practices" ,packt publishing, jenny zhang (2016)

WEB ANALYTICS			
Course Code:	**MDS219**	**Course Credits:**	**3**
Course Category:	**E3**	**Course (U / P)**	**P**
Course Year (U / P):	**2P**	**Course Semester**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
5. To Assess that how website visitors view and interact with a site's pages and features, demographics,			
6. and business intelligence, which would allow using data on customer purchasing patterns			
7. and demanding trends to make effective strategic decisions.			
8. Learn the fundamentals of analyzing and reporting from Google Analytics			
9.			
COURSE OUTCOMES			

After completion of course, students would be able to:
1. Identify problems with your site by defining a funnel for each of your goals
3. Implement Google Analytics tracking code to excellent report on your site
4. Navigate around Google Analytics to access your reports and dashboards
5. Implement tagging for your online marketing
6. Creating conversion funnels and analysis objectives

UNIT I INTROUCTION

Introduction: definition, process, key terms: site references, keywords and key phrases; building block terms: visit characterization terms, content characterization terms, conversion metrics; categories: offsite web, on site web; web analytics platform, web analytics evolution, need for web analytics, advantages, limitations.

UNIT II DATA COLLECTION

Data collection: clickstream data: web logs, web beacons, javascript tags, packet sniffing; outcomes data: e-commerce, lead generation, brand/advocacy and support; research data: mindset, organizational structure, timing; competitive data: panel-based measurement, isp-based measurement, search engine data.

UNIT III QUALITATIVE ANALYSIS

Qualitative analysis: heuristic evaluations: conducting a heuristic evaluation, benefits of heuristic evaluations; site visits: conducting a site visit, benefits of site visits; surveys: website surveys, post-visit surveys, creating and running a survey, benefits of surveys. Web analytic fundamentals: capturing data: web logs or javascripts tags, separate data serving and data capture, type and size of data, innovation, integration, selecting optimal web analytic tool, understanding clickstream data quality, identifying unique page definition, using cookies, link coding issues.

UNIT IV WEB METRICS

Web metrics: common metrics: hits, page views, visits, unique visitors, unique page views, bounce, bounce rate, page/visit, average time on site, new visits; optimization(e-commerce, non e-commerce sites): improving bounce rates, optimizing adwords campaigns; real time report, audience report, traffic source report, custom campaigns, content report, google analytics,

introduction to kpi, characteristics, need for kpi, perspective of kpi, uses of kpi. Web analytics 2.0: web analytics 1.0, limitations of web analytics 1.0.

UNITN V GOOGLE ANLYTICS

Google analytics: brief introduction and working, adwords, benchmarking, categories of traffic: organic traffic, paid traffic; google website optimizer, implementation technology, limitations, performance concerns, privacy issues. Relevant technologies:internet & tcp/ip, client / server computing, http (hypertext transfer protocol), server log files & cookies, web bugs**.**

Recommended books:

1. Clifton b., advanced web metrics with google analytics, wiley publishing, inc. (2010), 2nd ed.
2. Kaushik a., web analytics 2.0 the art of online accountability and science of customer centricity, wiley publishing, inc. (2010),1st ed.
3. Sterne j., web metrics:proven methods for measuring web site success, john wiley and sons (2002),1sted.

SOCIAL MEDIA ANALYTICS AND TECHNIQUES			
Course Code:	**MDS221**	**Course Credits:**	**3**
Course Category:	**E3**	**Course (U / P)**	**P**
Course Year (U / P):	**2P**	**Course Semester**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. Understand the role of social media data and analytics in helping organizations achieve their goals and understand their publics
2. Identify and select key performance indicators to accurately measure the success of social media efforts
3. Analyze social media data using native analytics (e.g. Facebook, Twitter, Instagram) and social media measurement tools
4. Draw meaningful insights and provide actionable and strategic recommendations based on thorough social media data analysis.

5. Examine the ethical and legal implications of leveraging social media data
COURSE OUTCOMES
After completion of course, students would be able to:
1. Describe the different types of data commonly found on social platforms
2. Understand the ethical sensitivities in obtaining and operating on social data
3. Use a social platform API to obtain data and understand the structure of those data
4. Load a large social media corpus
5. Produce summary statistics over a large social media corpus

UNIT 1: INTRODUCTION

Introduction to Social Media Social Media Data, Social Media Intelligence & Listening, Social Media Monitoring Metrics, Types of Social Media tools, Theories in Media Research, Long Tail, electronic word-of-mouth (eWOM), Power Law& Popularity Hands-on: Social Media Data Analysis using Excel.

UNIT 2: SOCIAL MEDIA ANALYTICS

Social Media Analytics Types of Social Media Analytics, Knowing your customers –Seven layer Approach, Location Analytics, Action Analytics, Mobile/App Analytics, Google Analytics Hands-on: Location Analytics & Social Media Traffic Analysis using Google Analytics

UNIT 3: SOCIAL MEDIA NETWORKS

Social Network Analysis Introduction to Networks, Common network terms, Network structure, Types of Networks, Egocentric Networks, Network analysis metrics, Strong and Weak Ties, Clustering and Grouping Hands-on: Social Network Analysis using NodeXL

UNIT 4: TEXT ANALYTICS IN SOCIAL MEDIA

Text Analytics in Social Media Text Analytics data types, Deployment models, Purpose of text analytics, Text analytics value creation cycle, Text Mining algorithms, Hands-on: Sentiment Analysis using R and Lexalytics.

UNIT 5: RECOMMENDER SYSTEMS IN SOCIAL MEDIA OVERVIEW

Association rule mining – Collaborative filtering – User-based similarity – Item-based similarity Hands-on: Recommender System.

REFERENCE BOOKS:

1. “networks, crowds, and markets: reasoning about a highly connected world”, david easley and jon kleinberg, cambridge university press, 3rd edition, 2017
2. “analysing social media networks with node xl”, derek hansen ben shneiderman marc smith itaihimelboim, morgan kaufmann, 2nd edition, 2019
3. "social media mining: an introduction", huan liu, mohammad ali abbasi, and reza zafarani, cambridge university press, 1st edition, 2014
4. “recommender systems the textbook”, charu c aggarwal, springer international publishing switzerland, 1st edition, 2016
5. "social data analytics: collaboration for the enterprise", krish krishnan & shawn p. Rogers, 8th edition, morgan kaufmann, 2014
6. Mastering social media mining with r , sharan kumar ravindran, vikram garg, packt publishing limited, 2015

TIME SERIES ANALYSIS			
Course Code:	**MDS223**	**Course Credits:**	**3**
Course Category:	**E3**	**Course (U / P)**	**P**
Course Year (U / P):	**2P**	**Course Semester**	**3P**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1.5**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. Learn the widely used time series models such as univariate ARMA/ARIMA modelling, (G)ARCH modeling, and VAR model.
2. Be given fundamental grounding in the use of some widely used tools, but much of the energy of the course is focus on individual investigation and learning.
3. To enhance the students understanding
4. the possibilities and limitation of different types of time series models through lectures
5. Through lectures and practical model application
COURSE OUTCOMES
After completion of course, students would be able to:
1. Demonstrate advanced understanding of the concepts of time series and their application to health, climate, finance and other areas.
2. Demonstrate familiarity with a range of examples for the different topics covered in the course.
3. Demonstrate an advanced understanding the underlying concepts in the time series and frequency domains.
4. Apply ideas to real time series data and interpret outcomes of analyses.
5. Demonstrate graduade-level skills in communicating mathematics and statistics, orally and in writing

UNIT 1 INTRODUCTION

Stochastic processes and time series, time series modeling, physical basis of time series modeling in hydrology, applicability, Characteristics of hydrologic series, Type of hydrologic series, general properties of hydrologic time series.

UNIT II STATISTICAL PRINCIPLES

Statistical principles and techniques for time series modeling,Probability function and distribution function, derived distributions, chebyshev's inequality, moment generating function, normal distribution, central limit theorem, estimation of the parameters of the distribution; methods of moments, method of maximum likelihood, selection of distribution

UNIT III AUTO-CORRELATION ANALYSIS

Classification of time series, components of time series, method of investigation, estimation of the auto-correlation coefficient, correlogram of an independent process.

UNIT IV TIME SERIES MODELS

Moving average process, auto regressive process, goodness of fit for annual ar models; test on the assumptions of the model, comparison of the historical and model correlograms, test of parsimony of parameters, generation and forecasting using annual ar models; thomas-fiering model; auto regressive moving average process, application in flood forecasting system, auto-regressive integrated moving average process.

UNIT V SEASONAL MODELS

Univariate seasonal models, daily flow model, spectral analysis; introduction, line spectrum,
Generation of random variates, Uniformly distributed random numbers; mid-square technique, mid-product technique, mixed congruential method, testing the random numbers sequence, generation of normal random numbers; the inverse transformation method, the central limit theorem method, box-muller method.

REFERENCES:

1. P. Jayarami reddy, 'stochastic hydrology', laxmi publications, new delhi
2. Salas, delleur, yevjwich and lane, "applied modelling of hydrologic time series', water resources publications, colorado, usa.