UNIVERSITY SCHOOL
OF
INFORMATION AND COMMUNICATION TECHNOLOGY

Department Of Computer Science & Engineering

COURSE STRUCTURE

B. TECH CSE
SPECIALIZATION: DATA SCIENCE

2022-2026

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

SEMESTER I

Sr.No	Course Code	Courses	L-T-P	Credits
1	CS101	Fundamentals of Computer Programming	3-1-0	4
2	CD101	Fundamentals of Data Science and MS-Excel	2-0-0	2
3	MA101	Engineering Mathematics-1	3-1-0	4
4	PH102	Engineering Physics	3-1-0	4
5	EC101	Basic Electronics Engineering	3-1-0	4
6	EN101	English Proficiency	2-0-0	2
7	CE103	Engineering Graphics Lab	1-0-2	2
8	PH104	Engineering Physics Lab	0-0-2	1
9	CS181	Computer Programming Lab	0-0-2	1
10	EC181	Basic Electronics Engineering lab	0-0-2	1
11	GP	General Proficiency	Non-Credit	
Total Credits			**25**	
Total Contact Hours			**17-4-8**	

SEMESTER II

Sr.No	Course Code	Courses	L-T-P	Credits
1	CD102	Introduction to Python	2-0-0	2
2	CD104	Computer Organization &Architecture	3-0-0	3
3	MA102	Engineering Mathematics-II	3-1-0	4
4	EE102	Basic Electrical Engineering	3-1-0	4
5	ME101	Engineering Mechanics	3-1-0	4
6	ES 101	Environmental Studies	3-1-0	4
7	CD182	Python Programming Lab	0-0-2	1
8	EE104	Basic Electrical Engineering Lab	0-0-2	1
9	ME102	Workshop Practice	1-0-2	2
10	GP	General Proficiency	Non Credit	
Total Credits			**26**	
Total Contact Hours			**18-4-8**	

SEMESTER III

Sr.No	Course Code	Courses	L-T-P	Credits
1	CD201	Internet Technology	3-0-0	3
2	CD203	Operating Systems	3-0-0	3
3	CD205	Data Structure & Algorithms	3-0-0	3
4	CD207	Optimization Problems for data Science	3-0-0	3
5	CD209	Introduction to R Programming	3-0-0	3
6	MA201	Engineering Mathematics-III	3-1-0	4
7	CD281	R Programming Lab	0-0-3	2
8	CD283	Data Structure &Algorithms Lab	0-0-3	2
9	CD285	Internet Technology Lab	0-0-3	2
10	GP	General Proficiency	Non Credit	
Total Credits			**25**	
Total Contact Hours			**18-1-9=28**	

SEMESTER IV

Sr.No	Course Code	Courses	L-T-P	Credits
1	CD202	Software Engineering	3-0-0	3
2	CD204	Database Management System	3-0-0	3
3	CD206	Java Programming	3-0-0	3
4	CD208	Artificial Intelligence	3-0-0	3
5	CD210	Theory of Automata	3-0-0	3
6	CD212	Data Handling and Visualization	3-1-0	4
7	CD282	Database Management System Lab	0-0-3	2
8	CD284	Java Programming Lab	0-0-3	2
9	CD286	Tableau Lab	0-0-3	2
10	GP	General Proficiency	Non Credit	
Total Credits			**25**	
Total ContactHours			**18-1-9=28**	

SEMESTER V

Sr.No	Course Code	Courses	L-T-P	Credits
1	CD301	Compiler Design	3-0-0	3
2	CD303	Soft Computing Techniques	3-0-0	3
3	CD305	Analysis and design of algorithms	3-0-0	3
4	CD307	SAS Programming	3-0-0	3
5	CD309	Machine Learning	3-1-0	4
6		Elective 1	3-0-0	3
7	CD381	Analysis and design of algorithms Lab	0-0-3	2
8	CD383	SAS Programming Lab	0-0-3	2
9	CD385	Machine Learning using Python	0-0-3	2
10	GP		Non Credit	
Total Credits			**25**	
Total Contact Hours			**18-1-9=28**	

SEMESTER–VI

Sr.No	CourseCode	Courses	L-T-P	Credits
1	CD302	Web Development using PHP	3-0-0	3
2	CD304	Introduction to Statistical Learning	3-0-0	3
3	CD306	Operation Research in Data Science	3-1-0	4
4	CD308	Quantum Computing	3-0-0	3
5	CD310	Data Privacy and Database Security	3-0-0	3
6		Elective 2	3-0-0	3
7	CD382	Web Development using PHP Lab	0-0-3	2
8	CD384	Statistical Learning Lab	0-0-3	2
9	CD386	Data Privacy and Database Security Lab	0-0-3	2
10	GP	General Proficiency	Non Credit	
Total Credits			**25**	
Total Contact Hours			**18-1-9=28**	

- Industrial Training will be done by candidate individually after third year during the summer break and it will be of minimum 4 weeks. It will be evaluated as per University Examination in VII semester

SEMESTERVII

Sr.No	Course Code	Courses	L-T-P	Credits
1	MA401	Modelling and Simulation	3-1-0	4
2	CD401	Cryptography and Network Security	3-0-0	3
3	CD403	Data Analytics using R	2-0-0	2
4		Elective 3	3-0-0	3
5		Elective 4	3-0-0	3
7	CD481	Data Analytics using R Lab	0-0-3	2
8	CD491	Minor Project	0-0-10	5
9	CD493	Industrial Training	0-0-6	3
10	GP	General Proficiency	Non Credit	
Total Credits			**25**	
Total Contact Hours			**14-1-19=28**	

SEMESTER–VIII

Sr.No	CourseCode	Courses	L-T-P	Credits
1	CD490	Seminar	0-0-3	2
2	CD492	Major project	0-0-16	8
3	CD494	Internship	0-0-30	15
4	GP	General Proficiency	Non Credit	
Total Credits			**25**	
Total Contact Hours			**0-0-49**	

GRAND TOTAL OF CREDITS = 200

- 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 8th semester and it will be for 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 industrial training, seminar, internship, minor and major projects.

ELECTIVES

S.No.	Course Code	CourseName	L	T	P	Credits	Types
1	CD311	Pattern Recognition	3	0	0	3	E1
2	CD313	Deep Learning	3	0	0	3	E1
3	CD315	Data Science Life Cycle	3	0	0	3	E1
4	CD317	Data Storage Technologies and Networking	3	0	0	3	E1
5	CD319	Internet of Things	3	0	0	3	E2
6	CD312	Big Data Platforms	3	0	0	3	E2
7	CD314	Research Techniques for Data Science	3	0	0	3	E2
8	CD316	High Performance Computing	3	0	0	3	E2
9	CD318	Data Mining	3	0	0	3	E2
10	CD320	Information Retrieval System	3	0	0	3	E3
11	CD405	Business Intelligence	3	0	0	3	E3
12	CD407	Computer Vision with Machine Learning	3	0	0	3	E3
13	CD409	Digital Image Processing	3	0	0	3	E3
14	CD411	Mobile and Wireless Network Security	3	0	0	3	E3
15	CD413	Cloud Computing	3	0	0	3	E4
16	CD415	Big Data Analytics	3	0	0	3	E4
17	CD417	Biomedical Image and Signal Processing	3	0	0	3	E4
18	CD419	AI Enabled Data Science	3	0	0	3	E4
19	CD421	Web Analytics	3	0	0	3	E4
20	CD423	Social Media Analytics and Techniques	3	0	0	3	E4

Semester I

FUNDAMENTALS OF COMPUTER PROGRAMMING			
Course Code:	**CS101**	**Course Credits:**	**4**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**1U**	**Course Semester (U / P):**	**2U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 01**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 15**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. To provide knowledge of primary and derived datatypes used in C
2. To make them understand basic conditional and break statements used in C
3. To provide a basic understanding of pointers and pointers arithmetic
4. To enable the students to explore how pre-defined functions are used and also created in a program
5. Learn difference between static and dynamic memory allocation method and also learn various dynamic memory allocation methods.

COURSE OUTCOMES
At the end of the course the students should be able to:
1. Understand the basic building blocks of C language like tokens, identifiers, constants and variables.
2. Acquire knowledge of various conditional and loop statements
3. Judge which data structure to use among arrays, struct and union depending on the application
4. Use pointers and tell the difference between call by value and call by reference.
5. Use dynamic memory allocation to create arrays, structures and union and also perform various operations on them.

UNIT I INTRODUCTION TO COMPUTER AND PROGRAMMING CONCEPTS

Definition, characteristic, generation of computers, basic components of a computer system, memory, input, output and storage units, high level language and low level language, Soft- ware: system software, application software, hardware, firmware, Operating System, compil- er, interpreter and assembler, linker, loader, debugger, IDE. Introduction to algorithm and flow chart; representation of algorithm using flow chart symbol, pseudo code, basic algorithm de- sign, characteristics of good algorithm, development of algorithm.

UNIT II INTRODUCTION TO C PROGRAMMING LANGUAGE

Introduction to C programming language , Declaring variables, preprocessor statements, arithmetic operators, programming style, keyboard input , relational operators, introduction, feature of C language, concepts, uses, basic program structure, simple data types, variables, constants, operators, comments, control flow statement

:if, while, for, do-while, switch.

UNIT III DATA TYPES AND STRUCTURES

bitwise operators, Pre defined and User defined data types, arrays, declaration and opera- tions on arrays, searching and sorting on arrays, types of sorting, 2D arrays, Passing 2D arrays to functions, structure, member accessing, structure and union, array of structures, func- tions, declaration and use of functions, parameter passing, recurssion .

UNIT IV FUNDAMENTALS OF POINTERS

Introduction to pointers, pointer notations in C, Declaration and usages of pointers, operations that can be performed on computers, use of pointers in programming exercises, parameter passing in pointers, call by value, call by references, array and characters using pointers, dynamic memory allocation

UNIT V FILE HANDLING IN C AND ENUM

Introduction to file handling, file operations in C , defining and opening in file, reading a file, closing a file, input output operations on file, counting: characters, tabs , spaces, file opening modes, error handling in input/output operations, Enumerated data types, use of Enum, declaration of Enum.

Text Books:

1. C Programming by Herbert Shield
2. C Programming Language 2nd Edition by Brian, W Kernighan Pearson Education.
3. Programming in ANSI C by E. Balagurusamy, Tata Mgraw Hill
4. C Puzzle Book: Puzzles For The C. Programming Language by Alan R Feuer Prentice HallGale
5. Expert C Programming: Deep C Secrets (s) by Peter Van Der Linden Dorling Kindersley India.

FUNDAMENTALS OF DATA SCIENCE AND MS EXCEL			
Course Code:	**CD101**	**Course Credits:**	**2**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**1U**	**Course Semester (U / P):**	**1U**
No. of Lectures + Tutorials (Hrs./Week):	**02 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**30 + 00**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
● To make students understand and make inferences based on relations found in the sample, to relations in the population.
● To Understand basic concepts in Excel
● Design effective data visualizations in order to provide new insights into a research question or communicate information to the viewer.
● Find and select appropriate data that can be used to create a visualization that answers a particular research question.
● For each individual statistical test students should be able to understand how it works, for what data and design it is appropriate and how results should be interpreted

COURSE OUTCOMES
At the end of the course the students should be able to:
● Understand the fundamentals of Data Science and Excel
● Key concepts in data science, including tools, approaches, and application scenarios
● State-of-the-art tools to build data-science applications for different types of data, including text and CSV data
● Work with frequency distribution, mean, covariance, serial correlation, multi-collinearity, conditional probability etc.
● Analyse data using Sampling Distribution, t-distribution, F-distribution, Chi-Square distribution etc.

UNIT I Introduction.

Introduction to Data Science , Evolution of Data Science, Data Science Roles, Stages in a Data Science Project, Applications of Data Science in various fields, Data Security Issues. A description of the purpose and application of Excel.

UNIT II Data Collection and Data Pre-Processing.

Data Collection Strategies, Data Pre-Processing Overview, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization, Techniques for sorting and filtering data, including controlling the order of precedence in a sort, advanced filters.

UNIT III Exploratory Data Analytics.

Math's basic addition, subtraction, multiplication, division, multi brackets, Powers, Rounding, data set. Totals and counts – SUM(), COUNT() and COUNTA(). Other statistics. Conditional totals and counts. Advanced conditional sums, SUMPRODUCT and array formulas, Change the date system, format, or two digit year interpretation, Descriptive Statistics Mean, Standard Deviation, Cell referencing and naming, Creating named ranges, managing named ranges, Calculations with named ranges, and

Automating processes with named ranges.

UNIT IV Model Development

Simple and Multiple Regression, Model Evaluation using Visualization, Residual Plot, Distribution Plot, Polynomial Regression and Pipelines, Measures for In-sample Evaluation, Prediction and Decision Making.

UNIT V Model Evaluation

Generalization Error, Out of Sample Evaluation Metrics, Cross Validation, Over fitting, Under Fitting and Model Selection, Prediction by using Ridge Regression, Testing Multiple Parameters by using Grid Search.

REFERENCE BOOKS:

1. Jojo Moolayil, "Smarter Decisions : The Intersection of IoT and Data Science", PACKT, 2016.
2. Cathy O'Neil and Rachel Schutt , "Doing Data Science", O'Reilly, 2015.
3. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big data Analytics", EMC 2013

COMPUTER PROGRAMMING LAB			
Course Code:	**CS181**	**Course Credits:**	**1**
Course Category:	**CC-P**	**Course (U / P)**	**U**
Course Year (U / P):	**1U**	**Course Semester (U / P):**	**2U**
No. of Labs (Hrs/Week):	**1(2 hrs)**	**Mid Sem. Exam Hours:**	
Total No. of Labs :	**10**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. To introduce students to the basic knowledge of programming fundamentals of C language.
2. To impart writing skill of C programming to the students and solving problems.
3. To impart the concepts like looping, array, functions, pointers, file, structure.
4. Write programs to print output on the screen as well as in the files..
5. Apply all the concepts that have been covered in the theory course.

COURSE OUTCOMES
At the end of the course the students should be able to:
1. Recognize and understand the syntax and construction of C programming code
2. Able to design and develop Computer programs, analyzes, and interprets the concept of pointers, declarations, initialization, operations on pointers and their usage.
3. Able to define data types and use them in simple data processing applications also he/she must be able to use the concept of array of structures.
4. Student must be able to define union and enumeration user defined data types.
1. Develop confidence for self-education and ability for life-long learning needed for Computer language. 5.

LIST OF EXPERIMENTS:

1. Write a program for the following:

   a) To find the reverse of a given number.

   b) Calculate factorial of a number using recursion.

2. Write a program to take marks of a student of 5 subjects as an input and print the grade. Also create the same program using switch.

marks<40 = FAIL
marks>=40 and <=59 =GOOD
marks>=59 and <80 =EXCELLENT
marks>=80 = OUTSTANDING

3. Write a program to compute the length of a string using While Loop.

4. Write a program to print the following pattern: -

a)
```
*
**
***
****
*****
```
b)
```
    *
   * *
  * * *
 * * * *
```
c)
```
 1  2
3  4  5
6  7  8  9
```

5. Write a program to compute and display the product of two matrices.

6. Write a program to illustrate the difference between call by value and call by reference.

7. Write a program to check whether a given string is palindrome or not.

8. Create a structure called STUDENT having name, reg no., class as its field.

Compute the size of structure STUDENT.

9. Write a program to compute the length of a string using pointers.

10. Write a program to create a file, input data and display its content.

Semester II

Introduction to PYTHON			
Course Code:	**CD102**	**Course Credits:**	**2**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**1U**	**Course Semester (U / P):**	**2U**
No. of Lectures + Tutorials (Hrs/Week):	**02 +0+0**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**30**	**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 Paul Barry,Oreilly

2. Python: The Complete Reference Paperback – 20 March 2018 by Martin C. Brown(Author), TMH Publication

3. Let Us Python by Yashavant Kanetkar , 1 January 2019, BPB publication

4. Python Programming, A modular approach , First Edition, By Pearson Publicationby Taneja Sheetal and Kumar Naveen , 26 September 2017

PYTHON PROGRAMMING LAB			
Course Code:	**CD182**	**Course Credits:**	**1**
Course Category:	**CC-P**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**2U**
No. of Labs (Hrs/Week):	**2(3 hrs)**	**Mid Sem. Exam Hours:**	
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 two numbers
2. To read two numbers x and n and print x^n (first write with the use of operator and then write with the help of inbuilt function
3. To input the value of x and n and print the sum of the series:
   a. $1+x+x^2+x^3+x^4+\ldots\ldots x^n$
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 #vipin # rai

COMPUTER ORGANIZATION AND ARCHITECTURE			
Course Code:	**CD104**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**1U**	**Course Semester (U / P):**	**2U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. Discuss the basic concepts and structure of computers.
2. Understand concepts of register transfer logic and arithmetic operations.
3. Explain different types of addressing modes and memory organization.
4. Learn the different types of serial communication techniques.
5. Summarize the Instruction execution stages.

COURSE OUTCOMES
At the end of the course the students should be able to:
1. Define different number systems, binary addition and subtraction, 2's complement representation and operations with this representation.
2. Understand the theory and architecture of central processing unit
3. Analyze some of the design issues in terms of speed, technology, cost, performance.
4. Use appropriate tools to design verify and test the CPU architecture
5. Learn the concepts of parallel processing, pipelining and interprocessor communication.

UNIT I COMPUTER ARITHMETIC AND NUMBER SYSTEM

Functional units of digital system and their interconnections, Logic gates, Boolean algebra, combinational circuits, flip flops, sequential circuits, Number representation; number system, fixed and floating point number representation, arithmetic algorithms (addition, subtraction, booth multiplication).

UNIT II REGISTER TRANSFER AND MICROOPERATION

Register transfer language, bus and memory transfers, bus architecture, bus arbitration, arithmetic logic, shift micro operation, arithmetic logic shift unit, design of fast address.

UNIT III PROCESSOR DESIGN

Processor organization: general register organization, stack organization, addressing mode, instruction format, data transfer & manipulations, program control, reduced instruction set computer.

UNIT IV INPUT-OUTPUT ORGANIZATION

I/O interface, synchronous and asynchronous data transfer, strobe, handshaking schemes, modes of transfer, interrupts & interrupt handling, direct memory access, I/O channels ,input-output processor.

UNIT V MEMORY ORGANIZATION

Memory hierarchy, main memory (RAM and ROM Chips), organization of 2d and 2 1/2 d, auxiliary memory, Cache memories: concept and design issues & performance, address mapping and replacement, virtual memory, memory management hardware.

Text Books:

1. Patterson, Computer Organisation and Design, Elsevier Pub. 2009
2. William Stalling, " Computer Organization", PHI
3. Vravice,Hamacher & Zaky, "Computer Organization", TMH
4. Mano," Computer System Architecture", PHI
5. John P Hays, " Computer Organization", McGraw Hill
6. Tannenbaum," Structured Computer Organization', PHI
7. P Pal chaudhry, ' Computer Organization & Design', PHI

Semester III

INTERNET TECHNOLOGY			
Course Code:	**CD201**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2U**	**Course Semester (U / P):**	**3U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1.Present the basic web technology concepts for developing web applications.
2.Helps in computational thinking.
3.Understand of networking fundamentals.
4.Recognize the process of technology planning.
5.Interpret the paradigms of web page coding.

COURSE OUTCOMES
At the end of the course the students should be able to:
1.Have basic knowledge and understanding of core Internet technologies.
2.Apply Internet technology techniques for Web page design.
3.Learn various Browsing systems.
4.Work in JavaScript to create web pages effectively.
5.Process page Coding & Planning

UNIT I OVERVIEW OF INTERNET AND WEB

Introduction to internet, history of Internet and web, Internet services and accessibility, uses of internet, Internet standards, Internet protocols- IP, TCP,UDP and host names, web server, proxy server, fast ready connections on the web, web browsers, Netscape communication suite, Microsoft Internet explorer, firewalls, data security.

UNIT II WEB DESIGN

Key issues in web site design, introduction to HTML, SGML- DTD, DTD elements, attributes, outline of an HTML document, body section- headers, paragraphs, text formatting, linking, internal linking, embedding images, lists, tables, frames, other special tags and characters, head section- prologue, link, base, meta, script, style, XML, XHTML, structuring data, XML schema documents, document object model, security and management issues for creating a website.

UNIT III BROWSING SYSTEMS

Searching and web casting technique, popular web servers, basic features, bookmarks, cookies, progress indicators, customization of browsers, browsing tricks, next generation web browsing, search engines, architecture of search engines, search tools, web crawlers, types of crawlers, scalable web crawler, incrementalcrawler, parallel crawler, focused crawler, agent based crawler, case study of IE, counters, Internet chat, hardware and software requirements for Internet and web based applications, Internet and web technologies.

UNIT IV JAVASCRIPT

Introduction, Language elements, objects of JavaScript, other objects like data, math, string, regular expressions, and arrays.

UNIT V ACTIVE SERVER PAGES

Creating interactive applications using active server pages : client and server side script in C#,variables and constants, creating modules, creating objects from classes, ASP's object model, arrays, collections, control structures, using request and response objects, Integration with database.

Reference Books:

1. Raj Kamal, Internet and Web Technologies, TMH, 2005.
2. Monica D'Souza, Web publishing, TMH, 2001.
3. David Crowder and Rhonda Crowder, Web Design, IDG Books India, 2001.
4. Musciano C., HTML and XHTML the Definitive Guide, 6th edition, OReilly, 2006.
5. Deitel H., Deitel P., Internet and World Wide Web: How to Program, 4 edition, PHI.

OPERATING SYSTEM			
Course Code:	**CD203**	**Course Credits:**	**3**
Course Category:CC	**CC**	**Course (U / P)**	**U**
Course Year (U / P):U	**2U**	**Course Semester (U / P):**	**3U**
No. of Lectures + Tutorials (Hrs/Week):	**03+ 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):30	**45+ 00**	**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.Learn different memory management techniques like paging, segmentation and demand paging etc.
5.Perform implementation of protection mechanisms in operating system

UNIT I INTRODUCTION TO OPERATING SYSTEM

Importance of operating systems, basic concepts and terminology about operating system, memory management, processor management, device management, information management functions.

UNIT II PROCESS MANAGEMENT

Elementary concept of process, job scheduler, process scheduling, operation on process, threads, overview, scheduling criteria, scheduling algorithms, algorithm ,deadlocks: system model, deadlock characterization, deadlocks prevention, deadlocks avoidance, deadlocks detection, recovery from deadlock.

UNIT III MEMORY &STORAGE MANAGEMENT

Basic Memory Management**:** Definition, Logical and Physical address map, Memory allocation: Contiguous Memory allocation, partition, Fragmentation, Compaction, Paging, Segmentation.

UNIT IV UNIX/LINUX OPERATING SYSTEM:

Development Of Unix/Linux, Role & Function Of Kernel, System Calls, Elementary Linux command & Shell Programming, Directory Structure, System Administration.

UNIT VSECURITY & PROTECTION:

Security Environment, Design Principles of Security, Userauthentication, Protection Mechanism: Protection Domain, Access Control List

Text Books:

[1]. Galvin, Wiley, Operating Systems Concepts, 8th edition, 2009

[2]. James L Peterson, Operating Systems Concept, John Wiley & Sons Inc, the 6Rev edition, 2007.

Reference Books:

[1]. Deitel H. M., An Introduction to Operating Systems, Addison-Wesley, 1990.

[4]. Stallings William, Operating Systems, PHI, New Delhi, 1997.

[2]. S. Tanenbaum Modern Operating Systems, Pearson Education, 3rd edition 2007.

[6]. Nutt, Operating System, Pearson Education, 2009.

[3]. S. Tanenbaum, Distributed Operating Systems, Prentice Hall, 2nd edition, 2007.

DATA STRUCTURE AND ALGORITHMS			
Course Code:	**CD205**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	U
Course Year (U / P):	**2U**	**Course Semester (U / P):**	3U
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**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.

OPTIMIZATION PROBLEM FOR DATA SCIENCE			
Course Code:	**CD-207**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2U**	**Course Semester (U / P):**	**3U**
No. of Lectures + Tutorials (Hrs/Week):	**03 +0+0**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1.To learn how to analyze and solve a linear system of equations in context of data science.
2.To understand important characteristics of matrices, such as its four fundamental subspaces, rank, determinant, Eigen values and Eigenvectors.
3.To Learn Concepts Of vector spaces such as independence, basis, dimensions, orthogonality
4.To enable the students to understand about collection, presentation and analysis of data.
5 to study optimization Algorithms With Single And multi-variables for large datasets.
COURSE OUTCOMES
At the end of the course the students should be able to:
1.Understand The basic concepts of inner product space, norm, angle, Orthogonality and projection and implementing the Gram-Schmidt process, to obtain Least square solution and SVD
2.Understand the basic concepts of vector space, subspace, basis and dimension.
3.Find the Eigen values and Eigen vectors of a matrix, enable to find maximum & minimum values of a function.
4.Use classical optimization techniques and numerical methods of optimization.

UNIT I: Linear Algebra and Optimization: Vector spaces, subspaces, bases and dimensions, systems of linear equations, Linear transformations, Isomorphism, Inner product, Orthogonality, Eigen values, and Eigen vectors, Matrix factorizations, Function optimization, Newton's method.

UNIT-II: Introduction to search: Conditions for local minimization - One dimensional Search methods - Golden search method, Fibonacci method, Newton's Method, Secant Method, Remarks on Line Search Gradient-based methods, the method of steepest descent, Analysis of gradient Methods, Convergence, Convergence Rate, Analysis of Newton's Method, Newton's Method for Non-linear Least-Squares Conjugate

direction method, Conjugate Direction Algorithm, Conjugate Gradient Algorithm for Non-Quadratic Quasi-Newton method.

UNIT III:Principles of Artificial Intelligence and Machine Learning: Intelligent Agents, Problem-solving and Uninformed search, Knowledge and reasoning, Probabilistic reasoning, Bayesian networks and decision theory, Neural networks, Issues in ANN training, Types of ANN architectures, SVM, SVD, Principal Component Analysis.

UNIT IV:Stochastic Models and Numerical Optimization: Random variables and events, distributions, inequalities and limits, Stochastic processes, Exponential distribution, Markov chains, Discrete-Time Markov chains, Continuous Time Markov chains, Mathematical models of optimization.

UNIT V:Exploration and Statistical Analysis for Data Science: Data Science process, Memorization methods, unsupervised models, Univariate data exploration, Data visualization, Prediction and filtering, Probability theory and Statistics.

Suggested Text Books

1. Howard Anton, Chris Rorres, Elementary Linear Algebra, Tenth edition, John Wiley & Sons,2010
2. EdwinK.P.Chong,Stanislaw.Zak,introduction Optimization, Second Edition, Wiley, 2013
3. Nabil Nassif, Jocelyne Erhel, Bernard Philippe, Introduction to Computational Linear Algebra, CRC press, 2015
4. Gilbert Strang, Linear Algebra and Its Applications, Fourth edition, Cengage,2006
5. Mohan C. Joshi and Kannan M. Moudgalya, Optimization: Theory and Practice, Narosa Publishing House, New Delhi, 2004 6. Hal DaumIII,A Courses Machine Learning, 2015

INTRODUCTION TO R PROGRAMMING			
Course Code:	**CD209**	**Course Credits:**	**3**
Course Year (U / P):	**1U**	**Course Semester (U / P):**	**1U**
No. of Lectures + Tutorials (Hrs./Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1.Master the use of the R and RStudio interactive environment.			
2.Expand R by installing R packages.			
3.Explore and understand how to use the R documentation.			
4.Understand the different data types in R.			
5.Understand the different data structures in R.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.The course would enable the ability to understand and critically assess available data using machine learning methods.			
2.Learn the basic concepts and techniques of Data Science and discover trends in both structured and unstructured data.			
3.Understand the concepts of supervised and unsupervised Learning.			
4.Analyse complex problems using advanced analytics tools.			
5.The course would also inform use of large volume data by extracting useful information and patterns and provide predictive insights.			

UNIT I INTRODUCTION TO R AND RSTUDIO

Background, Getting Started, History of R and S, installing R and RStudio, Basic data types in R, Functions for reading and writing data. Using R for calculations. Using R to calculate summary statistics on data. Using R to generate random numbers. Variable types in R. Numeric variables, strings and factors, Statistics with R Analysing Data: Summary Statistics, Correlation and Covariance, Principal Components Analysis, Factor Analysis, Bootstrap Resampling. Probability Distributions: Normal Distribution, Common Distribution-Type Arguments, Distribution Function Families. Statistical Tests for Continuous and Discrete Data, Power Tests: Experimental Design Example, t-Test Design, Proportion Test Design, ANOVA Test Design.

UNIT II DATA STRUCTURES: VECTORS, MATRICES, LISTS AND DATA FRAMES

Programming in R, Control structures- if-else, for loops, while, break, Repeat, next, Functions, Symbol binding, Scoping rules, Dates and times, the core data structures vectors, matrices, arrays, lists and data frames. sub-setting vectors, slicing arrays and drilling down on lists. lapply functions,

UNIT III READING DATA INTO R FROM VARIOUS DATA SOURCES

Loop functions- lapply, apply, mapply, tapply, split, Basic tools, Using the tools, reading from flat files (plain text), reading from database connections and reading from web sources, join command

UNIT IV STATISTICAL MODELING FUNCTIONS

Simulation and profiling, Simulation- Generating Random numbers, Simulating a Linear model, Random sampling, R profiler, Line

UNIT V WRITING YOUR OWN FUNCTIONS

R function syntax, passing of variables into the function, and argument handling, brute force approaches, function

evaluation s, notation that allows arguments to be passed on to other functions, functions that themselves take other functions as arguments.

Text Books:

1. Hands-On Programming with R: Write Your Own Functions and Simulations 1st Edition, KindleEdition
2. Reference Books 1.R for Everyone: Advanced Analytics and Graphics

R PROGRAMMING LAB			
Course Code:	**CD281**	**Course Credits:**	**2**
Course Category:	**CC-L**	**Course (U / P)**	**U**
Course Year (U / P):	**2U**	**Course Semester (U / P):**	**3U**
No. of Labs (Hrs./Week):	**2(3 hrs)**		
Total No. of Lectures (L + T):	**10**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. Install and set up R and RStudio.
2. Understand R data types
3. Understand R data structures
4. Understand R functions
5. Understand R Markdown
COURSE OUTCOMES
At the end of the course the students should be able to:
1.Access online resources for R and import new function packages into the R workspace
2.Import, review, manipulate and summarize datasets in R
3.learn the main R data structures – vector and data frame
4.Explore datasets to create testable hypotheses and identify appropriate statistical tests
5.Perform appropriate statistical tests using R

List of Experiments:

1. WAP to read data from various sources in a data frame.
2. Write a R program to create a sequence of numbers from 20 to 50 and find the mean of numbers from 20 to 60 and sum of numbers from 51 to 91.
3. Write a R program to find the factors of a given number.
4. Write a R program to find the maximum and the minimum value of a given vector.
5. Write a R program to create a 5 x 4 matrix , 3 x 3 matrix with labels and fill the matrix by rows and 2 × 2 5 matrix with labels and fill the matrix by columns.
6. Write a R program to get the statistical summary and nature of the data of a given data frame.
7. Write a R program to create inner, outer, left, right join(merge) from given two data frames.
8. Write a R program to save the information of a data frame in a file and display the information of the file.
9. Build a simple web app using Shiny.

9.Write a R program to create a list containing a vector, a matrix and a list and give names to the 10 elements in the list. Access the first and second element of the list.

10.Load the data set and create a dashboard using shiny.

11.Connect the R script to dummy database and retrieve data from it and save it in a data Frame.

DATA STRUCTURE AND ALGORITHMS LAB			
Course Code:	**CD283**	**Course Credits:**	**2**
Course Category:	**CC-L**	**Course (U / P)**	**U**
Course Year (U / P):	**2U**	**Course Semester (U / P):**	**3U**
No. of Labs (Hrs/Week):	**2(3 hrs)**		
Total No. of Labs:	**10**	**End Sem. Exam Hours:**	**3**
LAB 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.			
LAB 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

INTERNET TECHNOLOGY LAB			
Course Code:	**CD285**	**Course Credits:**	**2**
Course Category:	**CC-L**	**Course (U / P)**	**U**
Course Year (U / P):U	**2U**	**Course Semester (U / P):**	**3U**
No. of Labs	**2(3 hrs)**		
Total No. of Lab(L + T):10	**10+ 00**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1.To design interactive web pages using Scripting languages.
2.To learn server side programming using servlets and JSP.
3.To develop web pages using XML/XSLT
4.To develop dynamic web pages using different platforms
5.Learn how to use XAMP Server
COURSE OUTCOMES
At the end of the course the students should be able to:
1.Design simple web pages using markup languages like HTML and XHTML.
2.Create dynamic web pages using DHTML and java script that is easy to navigate and use.
3.Program server side web pages that have to process request from client side web pages.
4.Represent web data using XML and develop web pages using JSP.
5.Understand various web services and how these web services interact.

List of Programs

1. Create a web page with the following using HTML.
    0. To embed an image map in a web page.
    1. To fix the hot spots.
    2. Show all the related information when the hot spots are clicked
2. Create a web page with all types of Cascading style sheets.
3. Client Side Scripts for Validating Web Form Controls using DHTML.
4. Installation of Apache Tomcat web server.
5. Write programs in Java using Servlets:
    0. To invoke servlets from HTML forms.
    1. Session Tracking.
6. Write programs in Java to create three-tier applications using JSP and Databases
    0. For conducting on-line examination.
    1. For displaying student mark list. Assume that student information is available in a database which has been stored in a database server.
7. Programs Using Xml – Schema – Xslt/Xsl.
8. Programs using DOM and SAX parsers.
9. Programs using AJAX.
10. Consider a case where we have two web Services- an airline service and a travel agent and the travel agent is searching for an airline. Implement this scenario using Web Services and Data base.

Software Required:

- Dream Weaver or Equivalent, MySQL or Equivalent, Apache Server, WAMP/XAMPP

SEMESTER-IV

SOFTWARE ENGINEERING			
Course Code:	**CD202**	**Course Credits:**	**3**
Course Category:CC	**CC**	**Course (U / P)**	**U**
Course Year (U / P):U	**2U**	**Course Semester (U / P):**	**4 U**
No. of Lectures + Tutorials (Hrs/Week):3	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):45	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Help students to develop skills that will enable them to construct software of high quality software that is reliable, and that is reasonably easy to understand, modify and maintain.			
2. Foster an understanding of why these skills are important			
3.Provide an understanding of the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects			
4.Study process models, software requirements, software design, software testing			
5.Help to study Software process/product metrics, risk management, quality management and UML diagrams			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.Identify and apply appropriate software architectures and patterns to carry out high level design of a system and be able to critically compare alternative choices.			
2. Expertise and/or awareness of testing problems and will be able to develop a simple testing report			
3.Translate end-user requirements into system and software requirements, using e.g. UML, and structure the requirements in a Software Requirements Document (SRD).			
4. Analyse various software engineering models and apply methods for design and development of software projects			
5 .Proficiently apply standards, CASE tools and techniques for engineering software projects			

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, Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model

UNIT II 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, Decision Tables.

Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.

UNIT III 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 and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.

UNIT IV SOFTWARE TESTING

Testing Objectives, Unit Testing, Integration Testing, 8 Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards.

UNIT V SOFTWARE MAINTENANCE

Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management problem resolution, software maintenance from customers‟ perspective, maintenance standard: IEEE-1219, ISO-12207, Software Risk Analysis and Management.

Text 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.

DATABASE MANAGEMENT SYSTEM			
Course Code:	**CD204**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2U**	**Course Semester (U / P):**	**4U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**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 systemstructure, 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 largeenterprises.

UNIT II RELATIONAL 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 BASIC 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 SCHEMA REFINEMENT

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

UNIT V OVERVIEW OF 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.

JAVA PROGRAMMING			
Course Code:	**CD206**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2U**	**Course Semester (U / P):**	**4U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
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

UNIT II 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, creatingpackage, 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.

ARTIFICIAL INTELLIGENCE			
Course Code:	**CD208**	**Course Credits:**	**2**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2U**	**Course Semester (U / P):**	**4U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1.Provide a strong foundation of fundamental concepts in Artificial Intelligence			
2.Enable the student to apply these techniques in applications which involve perception, reasoning and learning			
3.Provide a basic exposition to the goals and methods of Artificial Intelligence			
4.Explain the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals.			
5.Learn the different machine learning techniques to design AI machine and enveloping applications for real world problems.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.Understand the various searching techniques, constraint satisfaction problem and example problems- game playing techniques.			
2. Apply these techniques in applications which involve perception, reasoning and learning			
3.Acquire the knowledge of real world Knowledge representation			
4.Analyze and design a real world problem for implementation and understand the dynamic behavior of a system.			
5.To enable the student to apply these techniques in applications which involve perception, reasoning and learning			

UNIT 1 INTRODUCTION

Introduction to AI, Components of AI, Goals of AI, Types of AI, History of AI, Turing Test in AI, Advantages and Disadvantages of AI, Intelligence, Intelligent System, Role of IS, Comparison of various IS, Weak AI and Strong AI, Mind Body Problem in AI, Chinese Room Experiment in AI, Parallel and Distributed AI.

UNIT 2 AGENTS IN AI

Intelligent Agents, Types of AI Agents, Simple Reflex Agent,Model-based reflex agent, Goal-based agents, Utility-based agent, Learning agent, Structure of an AI Agent, Agent Environment in AI, Examples of Agents, Knowledge Engineering, Knowledge Based System, Knowledge Engineering Techniques, Knowledge Engineering Principles, Knowledge Engineering Methodology.

UNIT 3 SEARCHING TECHNIQUES AND AI PROBLEMS

Searching in AI, Search Algorithm Terminologies, Properties of Search Algorithms, Breadth-first search, Depth-first search, Best First Search, Tic-Tac Toe Problem, Water Jug problem, Chess Problem, Tower of Hanoi problem, Travelling Salesman problem, Monkey and Banana Problem, Magic Square.

UNIT 4 KNOWLEDGE REPRESENTATION

Knowledge Representation Definition, Declarative Knowledge, Procedural knowledge, Meta Knowledge, Heuristic Knowledge, Structural Knowledge, Inheritable Knowledge, Inferential Knowledge, Relational Knowledge, Explicit Knowledge, Tacit Knowledge, Uncertain Knowledge, Knowledge Storage, Relation between Knowledge and Intelligence, AI knowledge cycle.

UNIT 5 AI TECHNIQUES AND APPLICATIONS

Introduction to Machine Learning, Introduction to Deep Learning, Introduction to Expert system, 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, surveillance, Ai in education, AI in health care, AI in E commerce.

Reference Books:

1. Artificial Intelligence, Elaine Reich: Tata Mcgraw Hill publishing house, 2008.
2. Artificial Intelligence, Ela Kumar, IK Publishing.
3. Artificial Intelligence, Peterson, TataMcGraw Hill, 2008.
4. Artificial Intelligence, Russel and Norvig, Pearson Printice Hall Publication, 2006.
5. Artificial Intelligence, Winston, PHI publication, 2006.
6. Artificial Intelligence- A modern approach (3rd Edition) By Stuart Russell & Peter Norvig.
7. Artificial Intelligence: The Basics By Kevin Warwick

THEORY OF AUTOMATA			
Course Code:	**CD210**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2U**	**Course Semester (U / P):**	**4U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**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: 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, Quotient Construction, Myhill-Nerode Theorem.

UNIT II

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

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 proper ties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping lemma for CFLs Cock-Younger-Kasami Algorithm, Application to Parsing.

UNIT IV

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 vs Looping, Introduction to Undecidability, Undecidable problems about TMs. Post correspondence problem (PCP), Modified PCP, Introduction to recursive function theory .

Text Books

1. Automata and Computability, Dexter C. Kozen, Springer Publishers, 2007.
2. Introduction to Automata Theory, Languages and Computation, Hopcroft, Motwani, and Ullman, Pearson Publishers, Third Edition, 2006.

Reference Books

1. Elements of the Theory of Computation, H. R. Lewis and C.H. Papadimitriou, Prentice Hall Publishers, 1981
2. Introduction to Languages and the Theory of Computation, John. C. Martin, Tata McGraw-Hill, 2003.
3. K.L.P. Mishra and N.Chandrasekaran, "Theory of Computer Science : Automata, Languages and Computation", PHI Learning Private Limited, Delhi India

DATA HANDLING AND VISUALIZATION			
Course Code:	**CD212**	**Course Credits:**	**4**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**2U**	**Course Semester (U / P):**	**4U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 01**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**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 Designing for Color-Vision Deficiency

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

DATABASE MANAGEMENT SYSTEM LAB			
Course Code:	**CD282**	**COURSE CREDITS:**	**2**
Course Category:	**CC-P**	**Course (U / P)**	**U**
Course Year (U / P):	**2U**	**Course Semester (U / P):**	**4U**
No. of Labs(Hrs/Week):	**2(3 hrs)**		
Total No. of Labs	**10**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Explain basic database concepts, applications, data models, schemas and instances.			
2.Demonstrate the use of constraints and relational algebra operations.			
3.Emphasize the importance of normalization in databases.			
4.Facilitate students in Database design			
5.Familiarize issues of concurrency control and transaction management.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.Students get practical knowledge on designing and creating relational database systems.			
2.Understand various advanced queries execution such as relational constraints, joins, set operations, aggregate functions, trigger, views and embedded SQL.			
3.Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system			
4.Use the basics of SQL and construct queries using SQL in database creation and interaction.			
5.Analyze and Select storage and recovery techniques of database system.			

List of Experiments:

1. Introduction to MySQL, an exercise of data types in MySQL & Data Definition Language Commands
2. Exercise on Data Manipulation Language and Transaction Control Commands
3. Exercise on Types of Data Constraints
4. Exercise on JOINS (Single-Table) Using Normalization
5. Exercise on JOINS (Multiple-Table) Using Normalization
6. Exercise on GROUP BY/ORDER BY Clause and Date Arithmetic
7. Exercise on different Functions (Aggregate, Math and String)
8. Exercise on different types of sub queries

View Procedures

JAVA PROGRAMMING LAB			
Course Code:	**CD284**	**Course Credits:**	**2**
Course Category:	**CC-P**	**Course (U / P)**	**U**
Course Year (U / P):	**2U**	**Course Semester (U / P):**	**4U**
No. of Labs (Hrs/Week):	**02(3 hrs)**		
Total No. of Labs:	**10**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. Prepare students to excel in Object Oriented programming and to succeed as a Java Developer through global rigorous education
2. Students learn an object-oriented way of solving problems using java.
3. Make the students to write programs using multithreading concepts and handle exceptions.
4.Demonstrate the students to write programs that connects to a database and be able to perform various operations.
5.Make the students to create the Graphical User Interface using Applets, AWT Components & Swing Components.
COURSE OUTCOMES
At the end of the course the students should be able to:
1.To Understand OOP concepts and basics of Java programming.
2.Design and develop java programs, analyze, and interpret object-oriented data and report results.
3.Demonstrate an ability to design an object-oriented system, AWT components or multithreaded process as per needs and specifications.
4.To build files and establish database connection.
5.To visualize and work on laboratory and multidisciplinary tasks like console and windows applications both for standalone and Applets programs

1. Write a separate Java Code to implement each of the following:
   Class, Command Line Argument, how to enter value through keyboard
2. Write a separate Java Code to implement each of the following data types: Variable, Constant, Arrays, Strings, Vectors, Wrappers Classes, Type Casting
3. Write a separate Java Code to implement each of the following operators:

   Arithmetic operator, Relational operator, Logical operator, Assignment operator, Increment & Decrement operator, Conditional operator, Bitwise operator, ?: operator
4. Write a separate Java Code to implement each of the following control statements: Decision statement, Loops statement and Branch statements
5. Write a separate Java Code to implement each of the following sorting: Bubble Sort, Selection Sort, Insertion Sort, Merge Sort
6. Write a separate Java Code to implement each of the following:
   Class, Object, Constructors, Method, Method Overloading and Method Overriding
7. Write a separate Java Code to implement each of the following : Final variable, final class, final method, abstract class, abstract method and concrete method

8. Write a separate Java Code to implement each of the following OOPs concepts: Abstraction, Polymorphism, Encapsulation, Inheritance

9. Write a separate Java Code to implement each of the following: Exception handling with Try, Catch, Throw, Throws, Finally Multiple catch statement with the following exceptions : Arithmetic Exception, Array Out Of Bounds Exception and Array Store Exception

10. Write a separate Java Code to implement the following:

a) Interface

b) Packages and how to import them.

TABLEAU LAB			
Course Code:	**CD286**	**Course Credits:**	**2**
Course Category: CC	**CC**	**Course(U/P)**	**U**
Course Year(U/P):U	**2U**	**Course Semester(U/P):**	**4U**
No. of Labs (Hrs/Week):	**02(3 hrs)**		
Total No. of Lectures(L+T):30	**10**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. Understand the main concepts of visual analytics with a hands-on tutorial using Tableau, a leading self-service data visualization tool
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 Tableau Desktop
5. Publish the created visualizations to Tableau Server and/orTableau Public

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 using Tableau, a leading self-service data visualization tool.
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 using Tableau Desktop.
5. To create Data story in Tableau.

Program List:

1. Installation of Tableau Desktop/Public .
2. Interface of Tableau (Layout, Toolbars, Data pane, Analytics pane etc).
3. Get started with Tableau Desktop.
4. Create common visualizations (bar charts, line charts etc.) in Tableau.
5. Filtering and sorting data in Tableau.
6. Adding Titles, Labels, and descriptions and Publish your work to Tableau Cloud.
7. Reorder and Remove Visualization Fields.
8. Create simple calculations in Tableau.
9. Use table calculations in Tableau.
10. Create a dashboard in Tableau.
11. Create a data story in Tableau.

SEMESTER-V

COMPILER DESIGN			
Course Code:	**CD301**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**5U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1.Understand the basic principles of compiler design, its various constituent parts, algorithms and data structures required to be used in the compiler.			
2.Find Out the relations between computer architecture and how its understanding is useful in design of a compiler.			
3. Construct efficient algorithms for compilers.			
4.Provide an understanding of the fundamental principles in compiler design.			
5.Learn the process of translating a modern high-level-language to executable code required for compiler construction.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.Acquire knowledge of different phases and passes of the compiler and also able to use the compiler tools like LEX, YACC, etc. Students will also be able to design different types of compiler tools to meet the requirements of the realistic constraints of compilers.			
2.Understand the parser and its types i.e. Top-Down and Bottom-up parsers and construction of LL, SLR, CLR, and LALR parsing table.			
3.Implement the compiler using syntax-directed translation method and get knowledge about the synthesized and inherited attributes.			
4.Acquire knowledge about run time data structure like symbol table organization and different techniques used in that.			
5.Analyse the target machine's run time environment, its instruction set for code generation and techniques used for code optimization.			

UNIT I INTRODUCTION TO COMPILER

Introduction to compiler, phases and passes, bootstrapping, finite state machines and regular expressions and their applications to lexical analysis, optimization of DFA-based pattern matchers implementation of lexical analyzers, lexical-analyzer generator, LEX-compiler, formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC, syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG. **UNIT II PARSING TECHNIQUE**

Parsers, shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers Automatic construction of efficient parsers: LR parsers, the canonical collection of LR(0) items, constructing SLR parsing tables, constructing canonical LR parsing tables, constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables.

UNIT III SYNTAX-DIRECTED TRANSLATION

Syntax-directed translation schemes, implementation of syntax directed translators, intermediate code, postfix notation, parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, boolean expressions, statements that alter the flow of control, postfix

translation, translation with a top down parser, more about translation: array references in arithmetic expressions, procedures call, declarations and case statements.

UNIT IV SYMBOL TABLES

Data structure for symbols tables, representing scope information, run-time administration: implementation of simple stack allocation scheme, storage allocation in block structured language, Error detection & recovery: lexical phase errors, syntactic phase errors, semantic errors.

UNIT V CODE GENERATION

Design issues, the target language. addresses in the target code, basic blocks and flow graphs, optimization of basic blocks, code generator. code optimization: machine-independent optimizations, loop optimization, DAG representation of basic blocks, value numbers and algebraic laws, global data-flow analysis

Text Books:

1. Aho, Sethi & Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education

2. V Raghvan, " Principles of Compiler Design", TMH

3. Kenneth Louden," Compiler Construction", Cengage Learning.

SOFT COMPUTING TECHNIQUES			
Course Code:	**CD303**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**5U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1.Primary objective of this course is to provide an introduction to the basic principles, techniques, and applications of soft computing.			
2. Understanding of the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms.			
3.Provide the mathematical background for carrying out the optimization associated with neural network learning.			
4.Aim of this course is to develop some familiarity with current research problems and research methods in Soft Computing by working on a research or design project.			
5. Genetic algorithms, its applications and advances.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.Apply basics of Fuzzy logic and neural networks..			
2.Discuss the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human			
3. Describe with genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations			
4. Develop some familiarity with current research problems and research methods in Soft Computing Techniques			
5. experience Relate with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems			

UNIT I INTRODUCTION

Introduction to Soft Computing; Definition, requirement, necessity and adequacy; various dialects of soft computing – Evolutionary Algorithms, Fuzzy Sets and Fuzzy Logic, Artificial Neural Networks - their suitability in Searching, optimization, decision matching and pattern related problems; potential areas of applications.

UNIT II FUZZY SETS AND FUZZY LOGIC

Introduction to fuzzy sets and fuzzy logic; difference between classical and fuzzy sets; chance vs fuzziness; limitations of fuzzy systems; typical shapes of membership functions and their usage; operations on fuzzy sets: compliment, intersection, union; combinations on operations, aggregation operation.

UNIT III FUZZY RELATIONS AND FUZZY SYSTEMS

Cartesian Product; Classical Relations and Fuzzy Relations; Cardinality, operations and properties of crisp and fuzzy relations; Composition of operations, Fuzzy cartesian product; The linguistic variables, Reasoning in fuzzy logic, Fuzzification and defuzzification; Mamdani and Sugano Fuzzy Inference Systems.

UNIT IV NEURAL NETWORK

Overview of biological neurons; McCulloch-Pitts model, Rosenblatt's Perceptron model, difference, capabilities and limitations; Model of generic computational neuron; Basic activation functions; Basic Learning laws of neurons; Single layer and multilayer architectures; Feedforward and feedback networks.

UNIT V LEARNING FUNDAMENTALS

Learning paradigms, supervised and unsupervised learning, reinforced learning; back propagation algorithm; Radial basis neurons, Generalized Regression Neural network, Probabilistic Neural Networks; Competitive learning; Self Organizing Features Map, Hopfield networks, associative memories, applications of artificial neural networks. Elasticity vs plasticity dilemma, preprocessing, post processing, early stopping.

UNIT VI EVOLUTIONARY ALGORITHMS

Problems suitable and not suitable for applying evolutionary algorithms; Various dialects of evolutionary Algorithms; Terminology of Genetic Algorithms; Canonical Genetic Algorithm; Common representations and related reproduction operators; premature convergence, schema theorem, minimal deceptive problem and Royal Road function; fitness function, Roulette wheel selection, Rank selection, Tournament Selection; termination criteria, survivor selection, population models; parallel implementations.

Text Books:

1. Artificial Neural Networks: An introduction to ANN Theory and Practice, Peteus J. Braspenning,

   PHI publication, 2005.
2. Fuzzy Logic: A spectrum of Theoretical and Practical issues, Paul P. Wang, pearson publication 2004.
3. An Introduction to Genetic Algorithms, Milanie Mitchell, MIT Press 1998.
4. A Genetic Algorithm Tutorial, Darrell Whitley.
5. Fuzzy Sets, Fuzzy logic, and Fuzzy Systems: Selected Papers- Lotfi Asker Zadeh, George J. Kilr, Bo yuan, 2005.
6. Foundations of Fuzzy logic and Soft Computing: 12th International Fuzzy conference proceeding, 2005.
7. Neural Networks Theory, Particia Melin, Oxford University press, 2003
8. Neural Networks Theory and Application, Oscar Castillo, Wiley Eastern publication
9. Genetic Algorithms in Search, Optimization and Machine Learning, David E Goldberg, Eddison-Wesley, 1988.

ANALYSIS & DESIGN OF ALGORITHMS			
Course Code:	**CD305**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**5U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 15**	**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 MATHEMATICAL 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 first 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",

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

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

SAS Programmimg			
Course Code:	**CD307**	**Course Credits:**	**3**
Course Category:CC	**CC**	**Course (U / P)**	**U**
Course Year (U / P):U	**3U**	**Course Semester (U / P):**	**5U**
No. of Lectures + Tutorials (Hrs/Week):	**03+ 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):30	**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

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.

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

Text Book

1. 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. A. 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

Reference Book:

1. Tamhane, A. C. and Dunlop,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.

MACHINE LEARNING			
Course Code:	**CD309**	**Course Credits:**	**4**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**5U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 01**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 15**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Explain Machine Learning concepts, classifications of Machine Learning and write simple programs using python.			
2.Describe Supervised Learning concepts.			
3.Describe unsupervised learning concepts and dimensionality reduction techniques			
4.Discuss simple Machine Learning applications in a range of real-world applications using Python programming			
5.To develop skills of using recent machine learning software for solving practical problems.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.Recognize the characteristics of machine learning that make it useful to real-world problems.			
2.Characterize machine learning algorithms as supervised, semi-supervised, and unsupervised.			
3.Effectively use machine learning toolboxes.			
4.Understand the concept behind neural networks for learning non-linear functions.			
5.Figure out the algorithms for learning Bayesian networks			

UNIT 1: INTRODUCTION

Well defined learning problems, Designing a Learning System, Issues in Machine Learning; THE CONCEPT LEARNING TASK - General-to-specific ordering of hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias

UNIT 2: DECISION TREE LEARNING

Decision tree learning algorithm-Inductive bias- Issues in Decision tree learning; ARTIFICIAL NEURAL NETWORKS – Perceptrons, Gradient descentand the Delta rule, Adaline,Multilayer networks, Derivation of backpropagation rule Backpropagation Algorithm Convergence, Generalization

UNIT 3: EVALUATING HYPOTHESES:

Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms;

Bayesian Learning: Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm;

UNIT 4: COMPUTATIONAL LEARNING THEORY

Sample Complexity for Finite Hypothesis spaces,Sample Complexity for Infinite Hypothesis spaces, The Mistake Bound Model of Learning;INSTANCE-BASED LEARNING – k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning

UNIT 5: GENETIC ALGORITHMS:

Hypothesis space search, Genetic Programming, Models of Evolution and Learning; Learning first order rules-sequential covering algorithms- General to specific beam search-FOIL; REINFORCEMENT LEARNING - The Learning Task, QLearning.

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.Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer-Verlag.

ANALYSIS & DESIGN OF ALGORITHMS LAB			
Course Code:	**CD381**	**Course Credits:**	**2**
Course Category:	**CC-P**	**Course (U / P)**	**U**
Course Year (U / P):U	**3U**	**Course Semester (U / P):**	**5U**
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-Conquer technique			
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.Experiment finding the minimum cost of spanning tree using Prim's algorithms and shortest path 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 and also analyse it's runtime complexity for different inputs. (b)using merge sort method and also analyse it's 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 a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm

SAS Programming Lab			
Course Code:	**CD383**	**Course Credits:**	**2**
Course Category:CC	**CC-P**	**Course (U / P)**	**U**
Course Year (U / P):U	**3U**	**Course Semester (U / P):**	**5U**
No. of Labs (Hrs/Week):	2(3 hrs)		
Total No. of Labs:	10	**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..			

List of Experiments.

1. Generate descriptive statistics and explore data with graphs.
2. Perform analysis of variance and apply multiple comparison techniques.
3. Perform linear regression and assess the assumptions.
4. Use regression model selection techniques to aid in the choice of predictor variables in multiple regression.
5. Use diagnostic statistics to assess statistical assumptions and identify potential outliers in multiple regression.
6. Use chi-square statistics to detect associations among categorical variables.
7. Fit a multiple logistic regression model.
8. Score new data using developed models.
9. Fit a multiple linear regression model.
10. Time series forecasting

MACHINE LEARNING LAB USING PYTHON			
Course Code:	CD385	**Course Credits:**	2
Course Category:	CC-P	**Course (U / P)**	U
Course Year (U / P):	3U	**Course Semester (U / P):**	5U
No. of Labs (Hrs/Week):	2(3 hrs)		
Total No. of Labs:	10	**End Sem. Exam Hours:**	3
COURSE OBJECTIVES			
1.To understand the basic concepts and techniques of Machine Learning through python programming.			
2.To develop skills of using recent machine learning packages for solving practical problems.			
3.To gain experience of doing independent study and research			
4.To understand the methods using in machine learning			
5. To demonstrate real time applications using python			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.Familiarize Python			
2.Able to generate, analyze and interpret data using Python.			
3. Use Python to design and implement classifiers for machine learning applications.			
4.Implement an end to end Machine Learning System			
5. Design new programs related to machine learning methods			

List of Experiments:

1. Write a python program to compute Central tendency Measures: Mean, Median, Mode Measure of Dispersion: Variance, Standard Deviation
2. Study of Python Basic Libraries such as Statistics, Math, Numpy and Scipy
3. Study of Python Libraries for ML application such as Pandas and Matplotlib
4. Write a Python program to implement Simple Linear Regression
5. Implementation of Multiple Linear Regression for House Price Prediction using sklearn
6. Implementation of Decision tree using sklearn and its parameter tuning
7. Implementation of KNN using sklearn
8. Implementation of Logistic Regression using sklearn
9. Implementation of K-Means Clustering
10. Performance analysis of Classification Algorithms on a specific dataset (Mini Project)

PATTERN RECOGNITION			
Course Code:	**CD311**	**Course Credits:**	**3**
Course Category:	**E1**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**5U**
No. of Lectures + Tutorials (Hrs/Week):	**03 +00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. To understand different pattern and mathematical foundation			
2. Understand statistic approach			
3. To understand estimation method			
4. Understand KNN, Nearest neighbor rule and other nonparametric technique			
5. Understand different clustering algorithm along with unsupervised learning			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Mathematically approach different pattern recognition			
2. Apply statistical approach of pattern recognition.			
3. Perform different estimation methods			
4. Apply nonparametric techniques like KNN fuzzy classification etc.			
5. Implement unsupervised learning and clustering			

UNIT I INTRODUCTION

Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches, Mathematical foundations – Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, multivariate normal densities, Chi squared test.

UNIT II STATISTICAL PATTEN RECOGNITION:

Bayesian Decision Theory, Classifiers, Normal density and discriminant functions.

UNIT III PARAMETER ESTIMATION METHODS

Maximum-Likelihood estimation, Bayesian Parameter Estimation, Dimension reduction methods – Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization (EM), Hidden Markov Models (HMM), Gaussian mixture models.

UNIT IV NONPARAMETRIC TECHNIQUES:

Density Estimation, Parzen Windows, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification.

UNIT V UNSUPERVISED LEARNING & CLUSTERING:

Criterion functions for clustering, Clustering Techniques: Iterative square - error partitional clustering – K means, agglomerative hierarchical clustering, Cluster validation.

REFERENCES:

1. Richard O. Duda, Peter E. Hart and David G. Stork, “Pattern Classification”, 2nd Edition, John Wiley, 2006.

2. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2009.

S. Theodoridis and K. Koutroumbas, “Pattern Recognition”, 4th Edition, Academic Press, 2009

DEEP LEARNING			
Course Code:	**CD313**	**Course Credits:**	**3**
Course Category:	**E1**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**5U**
No. of Lectures + Tutorials (Hrs/Week):	**03 +00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**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 system
2 Ability to apply software engineering principles and techniques
3 Ability to design, 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 INTRODUCTION

History, capabilities, the perceptron, Neural network learning: Back-Propagation, Practical network training, Auto encoders, Batch-normalization, Overfitting and generalization

UNIT II INTRODUCTION TO TENSORFLOW AND ACTIVATION FUNCTIONS

Computational Graph, Key highlights, Creating a Graph, Regression example, Gradient Descent, TensorBoard, Modularity, Sharing Variables, KerasPerceptrons: What is a Perceptron, XOR Gate, Sigmoid, ReLU, Hyperbolic Fns, Softmax Artificial Neural Networks: Introduction, Perceptron Training Rule, Gradient Descent Rule.

UNIT III GRADIENT DESCENT AND BACKPROPAGATION

Gradient Descent, Stochastic Gradient Descent, Backpropagation, Some problems in ANN Optimization and Regularization: Overfitting and Capacity, Cross-Validation, Feature Selection, Regularization, Hyperparameters.

UNIT IV INTRODUCTION TO CONVOLUTIONAL NEURAL NETWORKS

Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, CNN applications Introduction to Recurrent Neural Networks: Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, RNN applications.

UNIT V ADVANCED DEEP ARCHITECTURES

Recurrent Neural networks (RNNs), Advanced RNN: LSTM, GRU, Generative Adversarial Networks (GANs), Advanced GANs

Text Books:

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.

2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.

3. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013

DATA SCIENCE LIFE CYCLE			
Course Code:	**CD315**	**Course Credits:**	**3**
Course Category:	**E1**	**Course(U/P)**	**U**
Course Year(U/P):	**3U**	**Course Semester(U/P):**	**5U**
No. of Lectures +Tutorials(Hrs/Week):	**03+00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures(L+T):30	**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			
After completion of the course, the student 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: Introduction to 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.

DATA STORAGE TECHNOLOGIES AND NETWORKING			
Course Code:	**CD317**	**Course Credits:**	**3**
Course Category:	**E1**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**5U**
No. of Lectures + Tutorials (Hrs/Week):	**03+ 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):30	**45+ 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. To know the management of various storage technologies			
2. This course focuses on evolution of storage and implementation models, Storage devices principles.			
3. To know the Storage classes (SAN, NAS. CAS) and Backup			
4. To explore the techniques Need of virtualization.			
5. To Memory virtualization - Storage virtualization – Data virtualization – Network virtualization			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1 To explain the design of a data center and storage requirements			
2. To discuss the various types of storage and their properties			
3. To explain physical and virtualization of storage			
4. To explain the backup, archiving with regard to recovery and business continuity.			

UNIT I INTRODUCTION

Fundamentals of Storage, Storage hierarchy in a computer system, Storage Technology, Storage Device, Storage Arrays: Architectural principles, File Systems and I/O, RAID: Keeping your Data Safe, RAID Concepts, RAID Levels

UNIT II NETWORK ATTACHED STORAGE

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, Network File System (NFS), NFS Configuration, NAS Arrays, Samba SMB/CIFS), NAS vs. SAN, Fibre Channel SAN.

UNIT III STORAGE APPLICATIONS

Capacity Optimization Technologies: Thin Provisioning, Compression, Deduplication, Auto-tiering, Backup and Recovery: Backup Architecture, Backup methods, Backup types, Backup retention policies, Storage Management: Introduction & Challenges, SMI-S: Industry standard protocol for Management, Performance management, Management protocols and Interfaces.

UNIT IV CLOUD STORAGE

Cloud Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption.

Cloud deployment model: Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing

UNIT V REINFORCEMENT LEARNING AND ROBOTICS 9

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:

- Mauricio Arregoces, Data Center Fundamentals, Cisco Press; 1st edition, 2003.
- Robert Spalding, Storage Networks: The Complete Reference, Tata McGraw Hill, Osborne, 2003.
- Marc Farley, Building Storage Networks, Tata McGraw Hill, Osborne. 2001.
- 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

SEMESTER-VI

WEB DEVELOPMENT USING PHP			
Course Code:	**CD302**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**6U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Describe fundamentals of web			
2. Introduce the creation of static webpage using HTML			
3. Describe the function of JavaScript as a dynamic webpage creating tool			
4. Outline the principles behind using MySQL as a backend DBMS with PHP			
5.Describe the importance of CSS in web development			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.Learn and use DHTML and AJAX. Learn the basics of JQuery.			
2. Learn about the major vulnerabilities facing web sites and some simple ways to reduce their likelihood			
3.Use a MySQL database with PHP to create database applications			
4.Design HTML pages and use basic JavaScript code to enhance the pages			
5.Develop a complete market-ready database-driven website with PHP and JavaScript and go through the basic phases of the software life cycle			

UNIT I INTRODUCTION

Internet Standards, Introduction to WWW, WWW Architecture, client and server, web server, web application basic pieces, working of a website, Internet Protocols, Overview of HTTP, HTTP request – response, Generations of dynamic web pages, Front end and backend web development, web content management systems: Wordpress, Joomla, web development life cycle, Guidelines for Indian Government websites.

UNIT II BASICS OF HTML,CSS, JAVASCIPT

HTML and HTML5: Introduction, TML Tags, Formatting and Fonts, Commenting Code, Anchors, Backgrounds, Images, Hyperlinks, Lists, Tables, Frames, HTML Forms. Cascading Style Sheet (CSS): Introduction, Basics of CSS, style types. JavaScript: Introduction, variables, operators, conditionals, looping and validation. Introduction to Jquery, Ajax and XML.

UNIT III INTRODUCTION TO PHP

PHP structure: basic syntax, variables, operators, multiline commands. Expression and control flow in PHP, PHP dynamic linking. PHP functions and Objects, PHP arrays, Practical PHP: Date and time functions, file handling, system calls. Accessing and manipulating database using PHP, Error handling in PHP, generating images with PHP. Cookies, sessions and authentication.

UNIT IV INTRODUCTION TO FRAMEWORK

Introduction of MVC pattern models, MVC works, Configuration Codelgniter, setting up Codelgniter with apache, Environment eg. Enable mod_rewrite, Fetching data, saving and updating data, Deleting data, user defined function in model, Data Validation, controller function, interacting with views, controller variables and parameters, Redirection, Getting post data,

working with configuration layout, creating custom layout, Element and helpers, storing data in cake session, Reading a session data, Delete data from session

UNIT V MYSQL

Databases, Tables, Columns, MySQL Data Type, SELECT, UPDATE and DELETE Statements,PHP and MySQL: Connecting from PHP to MySQL Database, Executing SQL Queries from PHP.

Text Books:

1. Learning PHP, MySQL & JavaScript with JQUERY, CSS & HTML5: Robin Nixon (O'Reilly)
2. Learning Web Design: A Beginner's Guide to (X)HTML, Style Sheets and Web Graphics: Jennifer Niederst Robbins (O'Reilly).

INTRODUCTION TO STATISTICAL LEARNING			
Course Code:	**CD304**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**6U**
No. of Lectures + Tutorials (Hrs/Week):	**03 +00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45+00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Overview of predictive modeling and model evaluation			
2. High-dimensional data and variable selection			
3. An introduction to the principles of statistical learning and standard learning techniques for regression, classification, clustering, dimensionality reduction, and feature extraction			
4. Model selection and validation			
5. Nearest neighbor methods			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Recognize the types of learning problems and understand their statistical formulations.			
2. Understand the foundational principles of statistical learning including statistical modeling, computation and evaluation.			
3. Comprehend the rationale and algorithms behind statistical learning techniques and know their relative merits and limitations.			
4. Evaluate and compare different learning techniques numerically in terms of generalization error.			
5. Use statistical learning methods for data analysis and interpret the results in the context of the data problem.			

UNIT I INTRODUCTION TO STATISTICAL LEARNING

What Is Statistical Learning ,Why Estimate f?, How Do We Estimate f? The Trade-Off Between Prediction Accuracy and Model Interpretability, Supervised Versus Unsupervised Learning, Regression Versus Classification Problems , Assessing Model Accuracy, Measuring the Quality of Fit , The Bias-Variance Trade-Off .

UNIT II REGRESSION

Simple Linear Regression - Estimating the Coefficients , Assessing the Accuracy of the Coefficient Estimates , Assessing the Accuracy of the Model

Multiple Linear Regression - Estimating the Regression Coefficients, Qualitative Predictors

UNIT III CLASSIFICATION

Classification ,Why Not Linear Regression? ,Logistic Regression, The Logistic Model , Estimating the Regression Coefficients , Making Predictions , Multiple Logistic Regression , Multinomial Logistic Regression, Generative Models for Classification, Linear Discriminant Analysis for p = 1 , Linear Discriminant Analysis for p >1, Quadratic Discriminant Analysis, Naive Bayes , K-Nearest Neighbors , Poisson Regression

UNIT IV TREE BASED METHODS

The Basics of Decision Trees , Regression Trees , Classification Trees , Trees Versus Linear Models.....338 Advantages and Disadvantages of Trees ,

Bagging Random Forests, Boosting, and Bayesian Additive -Regression Trees .Bagging ,Random Forests, Boosting , Bayesian Additive Regression Trees

UNIT V SUPPORT V ECTOR MACHINE

Maximal Margin Classifier, What Is a Hyperplane?, Classification Using a Separating Hyperplane The Maximal Margin Classifier , Construction of the Maximal Margin Classifier, The Non-separable Case. Support Vector Classifiers , Support Vector Classifier ,Details of the Support Vector Classifier, Support Vector Machines , Classification with Non-Linear Decision Boundaries , SVMs with More than Two Classes . One-Versus-One Classification ,One-Versus-All Classification

Reference Books

1. **An Introduction to Statistical Learning: with Applications in R** by Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Paperback | Barnes & Noble

2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Geron Aurelien

Operation Research in Data Science			
Course Code:	**CD306**	**Course Credits:**	**4**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**6U**
No. of Lectures + Tutorials (Hrs/Week):	**03 +01**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45+15**	**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.

Text / 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.

QUANTUM COMPUTING			
Course Code:	**CD308**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**6U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Become familiar with basic principles of Quantum Computing and its goals			
2. Develop the skills to gain a basic understanding of the mathematics and physics behind Quantum Computing.			
3. To familiarize the concepts of Quantum Computing Circuits Design			
4. Understand the concepts of Cryptography involved in Quantum Computing			
5. Implementation of Algorithm in Quantum Computing.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Understand various phenomenon behind Quantum Computing			
2. Understand mathematics and physics involved in Quantum Computing			
3. Understand the concept of quantum circuit design			
4.Understand algorithm involved in Quantum Cryptography			
5. Able to implement various algorithms in Quantum Computers			

UNIT 1

Introduction to Quantum Computation Basics of Quantum theory, Mathematical Model of Quantum Computing, Introduction to quantum computers, Linear operators, and spectral decomposition.

UNIT 2

Background Mathematics and Physics Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis.

UNIT 3

Quantum Circuits Quantum bits, Bloch sphere representation of a qubit, multiple qubits Bits, Classical gates versus quantum gates, single qubit gates, multiple qubit gates, design of quantum circuits, Quantum error correcting codes, Quantum fault tolerance.

UNIT 4

Quantum Information and Cryptography Classical Cryptography, RSA algorithm, Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem. Mathematical models of quantum computation, their relationships to each other, and to physical systems, Quantum Cryptography – BB 84 protocol.

UNIT 5

Quantum Algorithms Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Groversearch. Noise error correction: Graph states and codes, Quantum error correction, fault-tolerant computation, Quantum algorithms, Simon's algorithm, The prime factorization algorithm.

Reference Books:

1. Nielsen, Michael A., and Isaac L. Chuang. Quantum Computation and Quantum Information. Cambridge, UK: Cambridge University Press, September 2000. ISBN: 9780521635035.

2. Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, Inc. Publication 2008

3. Peres, Asher. Quantum Theory: Concepts and Methods. New York, NY: Springer, 1993. ISBN: 9780792325499.

4. Pittenger A. O., An Introduction to Quantum Computing Algorithms

5. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific.

DATA PRIVACY & DATABASE SECURITY			
Course Code:	**CD310**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**6U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1.To understand the fundamentals of security, and how it relates to information systems.
2To identify risks and vulnerabilities in operating systems from a database perspective.
3.To learn good password policies, and techniques to secure passwords in an organization
4. To learn and implement administration policies for users.
5.To understand the various database security models and their advantages or disadvantages.
COURSE OUTCOMES
At the end of the course the students should be able to:
1.Identify between authorized & unauthorized data observation.
2.Examine unauthorized data modification.
3.Ensure the data confidentiality.
4.Identify security threats in database systems.
5.Design and Implement secure database systems.

UNIT I

Introduction: Introduction to Databases Security Problems in Databases Security Controls Conclusions ,Security Models -l:Introduction Access Matrix Model Take-Grant Model Acten Model PN Model Hartson and Hsiao's Model Fernandez's Model Bussolati and Martella's Model for Distributed databases

UNIT II

Security Models -2:Bell and LaPadula's Model Biba's Model Dion's Model Sea View Model Jajodia and Sandhu's Model The Lattice Model for the Flow Control conclusion

UNIT III

Security Mechanisms:Introduction User ldcntification fit authentication Memory Protection Resource Protection Control Flow Mechanisms Isolation Security Functionalities in some Operating Systems Trusted Computer System Evaluation Criteria

UNIT IV

Security Software Design:Introduction A Methodological Approach to Security Software Design Secure Operating System Design Secure DBMS Design Security Packages Database Security Design

UNIT V

Statistical Database Protection & Intrusion Detection Systems: lntroduction Statistics Concepts and Definitions Types of Attacks Inference Controls evaluation Criteria for Control Comparison Introduction IDES System RETISS System ASES System Discovery

Text Books:

1. Database Security and Auditing, Hassan A. Afyouni, India Edition, CENGAGE Learning, 2009.

2. Database Security, Castano, Second edition, Pearson Education.

Reference Books:

1. Database security by alfred basta, melissa zgola, CENGAGE learning.

2. Data and Applications Security and Privacy by Pierangela Samarati,22 June 2015

3.Protecting Privacy in Data Release: 57 (Advances in Information Security)by Giovanni Livraga 9 October 2016

WEB DEVELOPMENT USING PHP LAB			
Course Code:	**CD382**	**Course Credits:**	**2**
Course Category:	**CC-P**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**6U**
No. of Labs (Hrs/Week):	**02(3 hrs)**		
Total No. of Labs:	**10**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. Understand best technologies for solving web client/server problems using PHP
2. Analyse & design real time web applications
3. Use PHP for dynamic effects and to validate form input entry
4.Analyze & Develop to Use appropriate client-side or Server-side applications
5. To develop and deploy real time web applications in web servers and in the cloud
COURSE OUTCOMES
At the end of the course the students should be able to:
1. Develop a dynamic webpage by the use of java script and DHTML.
2. Write a well formed / valid XML document using PHP
3. Connect a java program to a DBMS and perform insert, update and delete operations on DBMS table using PHP.
4. Draft a server side application called Servlet to catch form data sent from client, process it and store it on database using PHP
5. Create a server side application to catch form data sent from client and store it on database using PHP

List of Experiments:

1. Basic HTML Tags,Table Tags,List Tags,Image Tags, Forms .
2. Implement forms using HTML,FRAMES,CSS.
3. Install the following on local machine
   - Apache web server
   - Tomcat application server locally,
   - Install MySQL
   - PHP and configure it to work with Apache web server and MySQL

4. To create an email id for receive and send pictures, documents .
5. To create a simple web file to demonstrate the use of different tags.
6. To create an html web with different types of frames such as floating frame, navigation frame & mixed frame.
7. Write a PHP program to store current date-time in a COOKIE and display the 'Last visited on' date- time on the web page upon reopening of the same page.
8. Write a PHP program to store page views count in SESSION, to increment the count on each refresh, and to show the count on web page.
9. Create a XHTML form with Name, Address Line 1, Address Line 2, and E-mail text fields. On submitting, store the values in MySQL table.Retrieve and display the data based on Name.
10. Using PHP and MySQL, develop a program to accept book information viz. Accession number, title, authors, edition and publisher from a web page and store the information in a database and to search for a book with the title specified by the user and to display the search results with proper headings.

STATISTICAL LEARNING LAB			
Course Code:	**CD384**	**Course Credits:**	**2**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**6U**
No. of Lab (Hrs/Week):	**02(03 hrs)**		
Total No. of Lectures (L + T):	**10 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. The principles of statistical learning and standard learning techniques for regression, classification, clustering, dimensionality reduction, and feature extraction.			
2. Evaluate and compare different learning techniques numerically in terms of generalization error.			
3. Understanding and solving complex problem.			
4.Comprehend the rationale and algorithms behind statistical learning techniques and know their relative merits and limitations.			
5. Logical understanding of learning algorithm.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Understand the implementation procedures for the learning algorithms			
2. Design Java/Python programs for various Learning algorithms.			
3. Identify and apply Learning algorithms to solve real world problems			
4. Understand the foundational principles of statistical learning including statistical modeling, computation and evaluation			
5. Recognize the types of learning problems and understand their statistical formulations.			

List of Experiments:

1. The probability that it is Friday and that a student is absent is 3 %. Since there are 5 school days in a week, the probability that it is Friday is 20 %. What is the probability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result.

2. Implement linear regression using python.

3. Study and write k-fold cross validation.

4. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

5. Study and write architecture of convolution neural network.

6. Study and write survival analysis and censored data

7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can useJava/Python ML library classes/API.

8. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

9. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

10. Study and write k-means clustering.

DATA PRIVACY & DATABASE SECURITY LAB			
Course Code:	**CD386**	**Course Credits:**	**2**
Course Category:	**CC-P**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**6U**
No. of Labs (Hrs/Week):	**2(3 hrs)**	**Mid Sem. Exam Hours:**	
Total No. of Labs:	**10**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1.To provide a good foundation in mathematics, sciences and engineering fundamentals required to solve engineering problems			
2. To provide analytical and problem solving skills to design algorithms, other hardware / software systems			
3.To facilitate graduates to get familiarized with the art software / hardware tools, imbibing creativity and innovation			
4. To inculcate professional ethics, inter-personal skills to work in a multi-cultural team.			
5. To facilitate & learn employment skills in industry and / or to pursue postgraduate studies with an appreciation for lifelong learning			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.An ability to apply knowledge of mathematics, science and engineering to develop and analyze computing systems			
2.An ability to apply knowledge of mathematics, science and engineering to develop and analyze computing systems			
3.An ability to perform experiments to analyze and interpret data for different applications.			
4. An ability to design, implement and evaluate computer-based systems, processes, components or programs to meet desired needs within realistic constraints of time and space.			
5. An ability to use current techniques, skills and modern engineering tools necessary to practice as an IT professional.			

List of Experiments:

1. Introduction of Cryptool Software
2. To understand steps and concepts to generate digital signatures.
3. To understand the concepts of hash value and steps to generate hash value.
4. To generate HMAC values using CrypTool.
5. Write a program for Diffie Hellman Key Exchange.
6. Write a program for the RSA algorithm by inputting the value of two prime numbers.
7. To understand the data discovery and classification for security with a single program.
8. To work with intrusion prevention and detection systems.
9. To understand the concept of data loss prevention.
10. To implement some new method with which data can be secured using previous study

INTERNET OF THINGS			
Course Code:	**CD319**	**Course Credits:**	**3**
Course Category:	**E1**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**5U**
No. of Lectures + Tutorials (Hrs/Week):	**03 +00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Students will be explored 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. Understanding of 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. Understand 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. Able to 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.
3. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013

BIG DATA PLATFORMS			
Course Code:	**CD312**	**Course Credits:**	**3**
Course Category:	**E2**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester**	**6U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
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. Provide hands on Hadoop Eco System.			
5. Apply analytics on Structured, Unstructured Data.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Identify Big Data and its Business Implications.			
2. List the components of Hadoop and Hadoop Eco-System			
3. Develop Big Data Solutions using Hadoop Eco System			
4. Manage Job Execution in Hadoop Environment.			
5. Apply Machine Learning Techniques to big data.			

UNIT I: INTRODUCTION TO BIG DATA AND HADOOP

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

UNIT II: HDFS (Hadoop Distributed File System)

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

UNIT III: Machine Learning in Big data platforms

Introduction and Concepts: Ridge Regression; Lasso Regression; and K Nearest Neighbours, Regression and Classification, Supervised Learning with Regression and Classification Techniques, Bias-Variance, Dichotomy, Linear and Quadratic Discriminant Analysis, Classification and Regression, Trees, Ensemble Methods: Random Forest, Neural Networks, Deep Learning.

UNIT IV: Classification and Partitioning Methods:

Decision Trees, Attribute Selection Measures and Tree Pruning, Bayesian and Rule-based Classification, Model Evaluation and Selection,Cross-Validation, Classification Accuracy, Classification by Backpropagation and Support Vector Machine, k-means Hierarchical Methods and

Hierarchical Clustering Using Feature Trees, Probabilistic Hierarchical Clustering, Evaluation ofClustering Methods.

UNIT V: Hadoop Eco System
Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt,Pig Latin, User Defined Functions, Data Processing operators.
Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases,HiveQL, Tables, **Querying Data and User Defined Functions.**
Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.
Big SQL : Introduction

Text Books
1. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.
3. Architecting Modern Data Platforms: A Guide to Enterprise Hadoop at Scale
Author: Ian Buss
4. Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning, Raj kamal, preetisaxena.

Reference Books
1. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
2. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle press.

RESEARCH TECHNIQUES FOR DATA SCIENCE			
Course Code:	**CD314**	**Course Credits:**	**3**
Course Category:CC	**E2**	**Course (U / P)**	**U**
Course Year (U / P):U	**3U**	**Course Semester (U / P):**	**6U**
No. of Lectures + Tutorials (Hrs/Week):	**03+ 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):30	**45+ 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Understand the data science basics			
2. Understand the basic mathematics for data science			
3. Understand the basic statistics for data science			
4. Understand the basic data processing techniques			
5. Understand the data visualization			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Understand what is data science			
2. Apply basic mathematics for data science			
3. Apply the basic data science techniques			
4. Apply the basic data processing techniques			
5. Create and apply data visualization			

UNIT 1 INTRODUCTION TO DATA SCIENCE

Definition and methodology of data science, venn diagram, flavorus of data, quantitative versus qualitative data, levels of data,
obtain, explore, model and visualize the data

UNIT II BASIC MATHEMATICS OF DATA SCIENCE

Vectors and matrices, graphs, logarithmic and exponents, basic linear algebra, probability, normal and poisson distribution, bayes theorem, random variables

UNIT III BASIC STATISTICS FOR DATA SCIENCE

Obtain and sample data, Measures of center, variation, and relative standings, the empirical rule, point estimates, samplings distributions, hypothesis test,

UNIT IV DATA PROCESSING TECHNIQUES

Understanding the data processing, numpy operations, data cleaning, slicing, indexing, manipulating, and cleaning dataframes, pandas and csv, pandas and json, python relational database

UNIT V DATA VISUALIZATION

Data visualization using matplotlib, style plots, line chart, bar plot, box plot, scatter plot, heatmap, 3-d plotting, time series plot or line plot with pandas, python geospatial data

Text Books:

[1]. Ozdemir Sinan ,Principles of Data Science

Reference Books:

[1]. Sanjiv Ranjan Das, Data Science: Theories, Models, Algorithms, and Analytics

HIGH PERFORMANCE COMPUTING			
Course Code:	**CD316**	**Course Credits:**	**3**
Course Category:	E2	**Course(U/P)**	U
Course Year(U/P):	3U	**Course Semester(U/P):**	**6U**
No. of Lectures +Tutorials(Hrs/Week):	**03+00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures(L+T):30	**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 different cloud computing techniques			
5. Understand different grids method			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.Cluster Computing and its Architecture			
2.Cluster Setup and Administration			
3.Introduction to Grid and its Evolution			
4.Introduction to Cloud Computing			
5.Nature of Cloud			
6.Cloud Elements			

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
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, Insidethe 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 workload Managing data on clouds Public, private and hybrid clouds

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.

DATA MINING			
Course Code:	**CD318**	**Course Credits:**	**3**
Course Category:CC	**E2**	**Course(U/P)**	**U**
CourseYear(U/P):U	**3U**	**Course Semester(U/P):**	**6U**
No.of Lectures+Tutorials(Hrs/Week):	**03+00**	**Mid Sem.Exam Hours:**	**1**
Total No.of Lectures(L+T):30	**45+00**	**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

Semester VII

CRYPTOGRAPHY AND NETWORK SECURITY			
Course Code:	**CD401**	**Course Credits:**	**3**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**4U**	**Course Semester (U / P):**	**7U**
No. of Lectures + Tutorials (Hrs/Week):	**03+ 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1 Explain the objectives of information security			
2 Explain the importance and application of each of confidentiality, integrity, authentication and availability			
3 Understand various cryptographic algorithms.			
4 Understand the basic categories of threats to computers and networks			
5 Understand Intrusions and intrusion detection			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1 Describe public-key cryptosystem.			
2 Understand the current legal issues towards information security.			
3 Understand basic cryptographic a algorithms, message and web authentication and security issues.			
4 Information system requirements for both of them such as client and server.			
5 Understand Web security and Firewalls			

Unit-I

Introduction to security attacks, services and mechanism, introduction to cryptography. Conventional Encryption: Conventional encryption model, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers. Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, fiestal structure, data encryption standard(DES), strength of DES, differential and linear crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, confidentiality using conventional encryption, traffic confidentiality, key distribution, random number generation.

Unit-II

Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms. Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption.

Unit-III

Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA). Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.

Unit-IV

Authentication Applications: Kerberos and X.509, directory authentication service, electronic mail security-pretty good privacy (PGP), S/MIME.

Unit-V

IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. Web Security: Secure socket layer and transport layer security, secure electronic transaction (SET). System Security: Intruders, Viruses and related threads, firewall design principals, trusted systems.

Books:

1. William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersy.

2. Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag.

3. Bruce Schiener, "Applied Cryptography".

Data Analytics using R			
Course Code:	**CD403**	**Course Credits:**	**2**
Course Category:	**CC**	**Course (U / P)**	**U**
Course Year (U / P):	**4U**	**Course Semester (U / P):**	**7U**
No. of Lectures + Tutorials (Hrs/Week):	**02+ 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**30 + 00**	**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 ANALYTICS USING R LAB			
Course Code:	**CD481**	**Course Credits:**	**2**
Course Category:CC	**CC**	**Course(U/P)**	**U**
Course Year(U/P):U	**4U**	**Course Semester(U/P):**	**7U**
No.of Labs(Hrs/Week):	**02(03hrs)**		
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

INFORMATION RETRIEVAL SYSTEMS			
Course Code:	**CD320**	**Course Credits:**	**3**
Course Category:	**E2**	**Course (U / P)**	**U**
Course Year (U / P):	**3U**	**Course Semester (U / P):**	**6U**
No. of Lectures + Tutorials (Hrs/Week):	**03 +00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**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 understand how techniques from natural language processing, artificial intelligence, human computer interaction, and visualization integrate with IR			
5.To be familiar with various algorithms and systems			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.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			
5.Open the door to the amazing job opportunities in Search Technology and E-commerce companies such as Google, Microsoft, Yahoo!, and Amazon.			

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 vssequential 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 theWWW", Cambridge University Press, 2001.

3. C. J. van Rijsbergen , "Information Retrieval".

BUSINESS INTELLIGENCE			
Course Code:	**CD405**	**Course Credits:**	**3**
Course Category:CC	**E3**	**Course (U / P)**	**U**
Course Year (U / P):U	**4U**	**Course Semester (U / P):**	**7U**
No. of Lectures + Tutorials (Hrs/Week):	**03+ 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):30	**45+ 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Introduce the concepts and components of Business Intelligence (BI)			
2. Evaluate the technologies that make up BI (data warehousing, OLAP)			
3. Define how BI will help an organization and whether it will help yours			
4.Identify the technological architecture that makes up BI systems			
5.Plan the implementation of a BI system			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1.Understand ethical frameworks to analyze problems and evaluate alternative solutions			
2.Create and manage technology policies and procedures for an organization with an understanding of the regulatory environment			
3. Interpret and manage IT governance policies.			
4. Develop appropriate data management technologies			
5. Create and deploy enterprise solutions in support of organizational goals			

UNIT I UNDERSTANDING BUSINESS INTELLIGENCE AND BUSINESS INTELLIGENCE TECHNOLOGY COUNTERPARTS

The Challenge of Decision Making, Business Intelligence, The Business Intelligence Value Proposition, The Combination of Business and Technology, Data Warehousing, Enterprise Resource Planning, Customer Relationship Management, Business Intelligence and Financial Information

UNIT II THE SPECTRUM OF BUSINESS INTELLIGENCE

Enterprise and Departmental Business Intelligence, Strategic and Tactical Business Intelligence, Power and Usability in Business Intelligence, Finding the Right Spot on the Continuum, Business Intelligence: Art or Science

UNIT III BUSINESS INTELLIGENCE USER INTERFACES

Querying and Reporting, Reporting and Querying Toolkits, Basic Approaches, Building Ad-Hoc Queries, Data Access, Dashboards, EIS Is the Engine, Briefing Books

UNIT IV ON-LINE ANALYTICAL PROCESSING (OLAP)

What Is OLAP, OLAP Applications and Functionality, Multi-Dimensions, OLAP Architecture, Data Mining, Visualization, Guided Analysis, Handling Unstructured Data

UNIT V BUSINESS INTELLIGENCE

Customizing Business Intelligence, The Business Intelligence Project Plan, Human Factors, “Could Be” as Opposed to “Should Be”, Choosing the Right Size, Shape, and Cost, Best Practice

Text Books:

1. Jörg Hartenauer, Introduction to Business Intelligence

Reference Books:

[2]. Jerzy Surma, An Introduction to Business Intelligence

[3]. Rimvydas Skyrius, Business Intelligence

COMPUTER VISION WITH MACHINE LEARNING			
Course Code:	**CD407**	**Course Credits:**	**3**
Course Category:	**E3**	**Course (U / P)**	**U**
Course Year (U / P):	**4U**	**Course Semester (U / P):**	**7U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1 Understand Camera model , Image formation in CV			
2 To understand different filter and features			
3 Understanding clustering , grouping and model fitting			
4 To understand register different objects			
5 Understand computer vision using machine learning			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1 How the camera model works and different color shading			
2 Apply different filter and features			
3 To do application of clustering , grouping and model fitting			
4 Apply registering rigid and deformable objects			
5 Apply Computer Vision in Machine learning			

UNIT I IMAGE FORMATION

Geometric Camera Model : Image formation - pinhole perspective ,Weak Perspective , Cameras with Lenses , Human eye , Intrinsic and Extrinsic Parameters , Geometric Camera calibration , Light and shading : Modelling pixel brightness , interference from shading , modelling Interreflection , Color : Human color perception , representing color , model of image color , inference from color

UNIT II FILTERS AND FEATURES

Linear filters and convolution , spatial frequency and fourier transformation , sampling and alias , Technique : Scale and Image pyramids , Computing the Image Gradient , Derivative of Gaussian Filters ,Representing the Image Gradient , Describing Neighborhoods with SIFT and HOG Features , Local Texture Representations Using Filters , Pooled Texture Representations by Discovering Textons

UNIT III CLUSTERING , GROUPING AND MODEL FITTING

Important application of clustering, Image segmentation by clustering pixels , segmentation clustering and graphs , The Hough Transform , Fitting lines and Planes , Robustness , Fitting using probabilistic models

UNIT IV REGISTRATION AND RANGE DATA

Registering rigid objects, registering deformable objects , active range sensors , range data segmentation , object recognition

UNIT V CLASSIFY USING MACHINE LEARNING

Building good image feature using ML, Image classification datasets using ML , Face detection , detecting human , detecting boundaries using ML , Visual Hulls in python

Text Book

1. Forsyth , Ponce ," Computer Vision using A Modern Approch"

Reference Book

1. George C. Stockman , " Computer Vision"
2. Simon J. D. Prince, " Computer Vision: Models, Learning, and Inference"

DIGITAL IMAGE PROCESSING			
Course Code:	**CD409**	**Course Credits:**	**3**
Course Category:	**E3**	**Course (U / P)**	**U**
Course Year (U / P):	**4U**	**Course Semester (U / P):**	**7U**
No. of Lectures + Tutorials (Hrs/Week):	**03 +00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1.To study the image fundamentals and mathematical transforms necessary for image processing			
2. To study the image enhancement techniques			
3. To study image restoration procedures			
4. To study the image compression procedures.			
5.To understand image segmentation and representation techniques.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Review the fundamental concepts of a digital image processing system.			
2. Analyze images in the frequency domain using various transforms.			
3. Evaluate the techniques for image enhancement and image restoration			
4. Categorize various compression techniques			
5. Interpret Image compression standards.			

UNIT I INTRODUCTION OF DIGITAL IMAGE PROCESSING

Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Sampling and Quantization, Representing Digital Images (Data structure), Some Basic Relationships Between Pixels- Neighbors and Connectivity of pixels in image, Applications of Image Processing: Medical imaging, Robot vision, Character recognition, Remote Sensing.

UNIT II IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN

Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods.

UNIT III IMAGE ENHANCEMENT IN FREQUENCY DOMAIN

Introduction, Fourier Transform, Discrete Fourier Transform (DFT), properties of DFT , Discrete Cosine Transform (DCT), Image filtering in frequency domain.

UNIT IV IMAGE SEGMENTATION

Introduction, Detection of isolated points, line detection, Edge detection, Edge linking, Region based segmentation- Region growing, split and merge technique, local processing, regional processing, Hough transform, Segmentation using Threshold.

UNIT V IMAGE COMPRESSION

Introduction, coding Redundancy , Inter-pixel redundancy, image compression model, Lossy and Lossless compression, Huffman Coding, Arithmetic Coding, LZW coding, Transform Coding, Sub-image size selection, blocking, DCT implementation using FFT, Run length coding.

TextBooks:

1. Rafael C G., Woods R E. and Eddins S L, Digital Image Processing, Prentice Hall, 3rd edition, 2008

2. Milan Sonka,"Image Processing, analysis and Machine Vision", Thomson Press India Ltd, Fourth Edition

3. Fundamentals of Digital Image Processing- Anil K. Jain, 2nd Edition, Prentice Hall of India

MOBILE AND WIRELESS NETWORK SECURITY			
Course Code:	**CD411**	**Course Credits:**	**3**
Course Category:	**E3**	**Course (U / P)**	**U**
Course Year (U / P):	**4U**	**Course Semester (U / P):**	**7U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Understand how Mobile and Wireless Network is Important for Computer System.			
2. Make aware of different types of Security and their features			
3. This skill-oriented course equips the system Administrators with the skills required to protect			
4. Perform implementation of protection mechanisms in Wireless and Mobile Network			
5. Implement data security			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Familiarize with the issues and technologies involved in designing a wireless and mobile system that is robust against various attacks.			
2. Gain knowledge and understanding of the various ways in which wireless networks can be attacked and tradeoffs in protecting networks.			
3. Have a broad knowledge of the state-of-the-art and open problems in wireless and mobile security			
4. Learn various security issues involved in cloud computing.			
5. Learn various security issues related to GPRS and 3G.			

UNIT I INTRODUCTION:

Security Issues in Mobile Communication: Mobile Communication History, Security – Wired Vs Wireless, Security Issues in Wireless and Mobile Communications, Security Requirements in Wireless and Mobile Communications, Security for Mobile Applications, Advantages and Disadvantages of Application – level Security.

UNIT II SECURITY ISSUES & LEVELS:

Security of Device, Network, and Server Levels: Mobile Devices Security Requirements, Mobile Wireless network level Security, Server Level Security. Application Level Security in Wireless Networks: Application of WLANs, Wireless Threats, Some Vulnerabilities and Attach Methods over WLANs, Security for 1G Wi-Fi Applications, Security for 2G Wi-Fi Applications, Recent Security Schemes for Wi-Fi Applications.

UNIT III APPLICATIONS:

Application Level Security in Cellular Networks: Generations of Cellular Networks, Security Issues and attacks in cellular networks, GSM Security for applications, GPRS Security for applications, UMTS security for applications, 3G security for applications, Some of Security and authentication Solutions.

UNIT IV SCHEME AND SOLUTIONS:

Application Level Security in MANETs: MANETs, Some applications of MANETs, MANET Features, Security Challenges in MANETs, Security Attacks on MANETs, External Threats for MANET applications, Internal threats for MANET Applications, Some of the Security Solutions. Ubiquitous Computing, Need for Novel Security Schemes for UC, Security Challenges for UC, and Security Attacks on UC networks, Some of the security solutions for UC.

UNIT V DATA & SECURITY:

Data Center Operations - Security challenge, implement "Five Principal Characteristics of Cloud Computing, Data center Security Recommendations Encryption for Confidentiality and Integrity, Encrypting data at rest, Key Management Lifecycle, Cloud Encryption Standards.

Text Books:

[1]Pallapa Venkataram, Satish Babu: "Wireless and Mobile Network Security", 1st Edition, Tata McGraw Hill,2010.
[2] Frank Adelstein, K.S.Gupta : "Fundamentals of Mobile and Pervasive Computing", 1st Edition, Tata McGraw Hill 2005.

References books:

[1.] Randall k. Nichols, Panos C. Lekkas : "Wireless Security Models, Threats and Solutions", 1st Edition, Tata McGraw Hill, 2006.
[2.] Bruce Potter and Bob Fleck : "802.11 Security" , 1st Edition, SPD O'REILLY 2005.
[3.] James Kempf: "Guide to Wireless Network Security, Springer. Wireless Internet Security – Architecture and Protocols", 1st Edition, Cambridge University Press, 2008.

CLOUD COMPUTING			
Course Code:	**CD413**	**Course Credits:**	**3**
Course Category:	**E3**	**Course (U / P)**	**U**
Course Year (U / P):	**4U**	**Course Semester (U / P):**	**7U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. Comprehensive and in-depth knowledge of Cloud Computing concepts,			
2. Understand the technologies, architecture and applications			
3. Cloud Computing fundamental issues, technologies, applications and implementations			
4. Another objective is to expose the students to frontier areas of Cloud Computing and information systems,			
5. while providing sufficient foundations to enable further study and research.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Understand the fundamental principles of distributed computing			
2. . Understand the importance of virtualization in distributed computing and how this has enabled the development of Cloud Computing			
3. Analyze the performance of Cloud Computing			
4. . Understand the concept of Cloud Security			
5. Learn the Concept of Cloud Infrastructure Model			

UNIT 1 INTRODUCTION TO CLOUD COMPUTING

Definition, Characteristics, Components, Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering & Monitoring cloud services, benefits and limitations, Deploy application over cloud, Comparison among SAAS, PAAS, IAAS Cloud computing platforms: Infrastructure as service: Amazon EC2,Platform as Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing

UNIT 2 INTRODUCTION TO CLOUD TECHNOLOGIES

Study of Hypervisors Compare SOAP and REST Web Services, AJAX and mashups-Web services: SOAP and REST, SOAP versus REST, AJAX: asynchronous 'rich' interfaces, Mashups: user interface services Virtualization Technology: Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization Multi Tenant software: Multi-entity support, Multi-schema approach, Multi-tenancy using cloud data stores, Data access control for enterprise applications

UNIT 3 DATA IN THE CLOUD

Relational databases, Cloud file systems: GFS and HDFS, Big Table, HBase and Dynamo. Map-Reduce and extensions: Parallel computing, The map-Reduce model, Parallel efficiency of Map-Reduce, Relational operations using Map-Reduce, Enterprise batch processing using Map-Reduce, Introduction to cloud development, Example/Application of Mapreduce, Features and comparisons among GFS,HDFS etc,

Map-Reduce model Cloud security fundamentals, Vulnerability assessment tool for cloud, Privacy and Security in cloud Cloud computing security architecture:Architectural Considerations- General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro-architectures; Identity Management and Access control-Identity management, Access control, Autonomic Security.

Cloud computing security challenges: Virtualization security management- virtual threats, VM Security Recommendations, VM-Specific Security techniques, Secure Execution Environments and Communications in cloud

UNIT 4: ISSUES IN CLOUD COMPUTING

Issues in cloud computing ,Implementing real time application over cloud platform Issues in Intercloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service (QoS) monitoring in a Cloud computing environment. Cloud Middleware. Mobile Cloud Computing. Inter Cloud issues. A grid of clouds, Sky computing, load balancing, resource optimization, resource dynamic reconfiguration, Monitoring in Cloud

UNIT 5: CLOUD COMPUTING PLATFORMS

Cloud computing platforms, Installing cloud platforms and performance evaluation Features and functions of cloud platforms: Xen Cloud Platform, Eucalyptus, Open Nebula, Nimbus, T Platform, Apache Virtual Computing Lab (VCL), Anomaly Elastic Computing Platform

Text Books:

1. Judith Hurwitz, R. Bloor, M. Kanfman, F. Halper, Cloud Computing for Dummies

by(Wiley India Edition)

2. Gautam Shroff, Enterprise Cloud Computing by, Cambridge

3. Ronald Krutz and Russell Dean Vines, Cloud Security by, Wiley-India

BIG DATA ANALYTICS			
Course Code:	**CD415**	**Course Credits:**	**3**
Course Category:	**E4**	**Course (U / P)**	**U**
Course Year (U / P):	**4U**	**Course Semester (U / P):**	**7U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
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. Provide hands on Hadoop Eco System			
5. Apply analytics on Structured, Unstructured Data.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Identify Big Data and its Business Implications.			
2. List the components of Hadoop and Hadoop Eco-System			
3. Access and Process Data on Distributed File System			
4. Manage Job Execution in Hadoop Environment			
5. Develop Big Data Solutions using Hadoop Eco System			

UNIT I UNDERSTANDING BIG DATA

Introduction to big data, application of big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

UNIT II NOSQL DATA MANAGEMENT

Introduction to NoSQL, aggregate data models, aggregates, key value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, sharing, master slave replication, peer-peer replication, sharing and replication, consistency, relaxing consistency, version stamps, MapReduce, partitioning and combining, composing MapReduce calculations.

UNIT III BASICS OF HADOOP

Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro file-based data structures

UNIT IV MAP REDUCE APPLICATIONS

Map Reduce workflows, unit tests with MR Unit , test data and local tests – anatomy of Map Reduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats.

UNIT V HADOOP RELATED TOOLS

Hbase, data model and implementations, Hbase clients, Hbase examples – praxis. Cassandra, cassandra data model, cassandra examples, cassandra clients, Hadoop integration. Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation – HiveQL queries

Text Books:

[1] Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
[2] Big-Data Black Book, DT Editorial Services, Wily India Reference Books:
[3] P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World ofPolyglot Persistence", Addison-Wesley Professional, 2012.
[4] Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012. 5. Eric Sammer,"Hadoop Operations", O'Reilley, 2012.
[5] E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012. 7. LarsGeorge, "HBase: The Definitive Guide", O'Reilley, 2011.
[6] Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010. [7]. Alan Gates, "Programming Pig", O'Reilley, 2011

BIOMEDICAL IMAGE & SIGNAL PROCESSING			
Course Code:	**CD417**	**Course Credits:**	**3**
Course Category:	**E4**	**Course (U / P)**	**U**
Course Year (U / P):	**4U**	**Course Semester**	**7U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):	**45 + 00**	**End Sem. Exam Hours:**	**3**

COURSE OBJECTIVES
1. To study various computer aided devices for biomedical applications.
2. To study the use of physiological assist devices.
3. To introduce the main concepts of medical imaging
4. To gain hands-on experience in developing image processing algorithms for medical imaging.
5. To introduce the main concepts of medical image processing algorithms.
COURSE OUTCOMES
At the end of the course the students should be able to:
1. To determine which algorithm is suitable to solve a specific challenge in medical image processing
2. To develop algorithms to solve specific challenges in medical image processing.
3. To apply various segmentation techniques and algorithms in Medical Images
4. Understand the origin of bio-potentials and their physical significance.
5. Compare different techniques of measuring blood pressure, blood flow and volume.

UNIT I OBJECTIVES OF BIOMEDICAL IMAGE ANALYSIS

Computer aided diagnosis – Nature of medical images: X-ray imaging – Tomography – Nuclear medicine imaging – SPECT imaging – Positron imaging tomography – Ultrasonography – Magnetic resonance imaging. Removal of artifacts – Space domain filters – Frequency domain filters – Optimal filtering – Adaptive filters.

UNIT II IMAGE ENHANCEMENT

Gray level transforms – Histogram transformation – Convolution mask operators – Contrast enhancement. Detection of regions of interest – Thresholding and binarization – Detection of isolated lines and points – Edge detection – Region growing.

UNIT III ANALYSIS OF SHAPE AND TEXTURE

Representation of shapes and contours – Shape factors – Models for generation of texture – Statistical analysis of texture – Fractal analysis – Fourier domain analysis of texture – Segmentation and structural analysis of texture. Pattern classification and diagnostic decision – Measures of diagnostic accuracy – Applications: Contrast enhancement ofmammograms – Detection of calcifications by region growing – Shape and texture analysis of tumours.

UNIT IV INTRODUCTION TO BIOMEDICAL SIGNALS

Classification, Acquisition and Difficulties during Acquisition. Basics of Electrocardiography, Electroencephalography, Electromyography & electro-retinography Role of Computers in the Analysis, Processing, Monitoring & Control and image reconstruction in bio-medical field.

UNIT V DATA REDUCTION

Turning Point algorithm, AZTEC Algorithm, Fan Algorithm, Huffman andModified Huffman Coding, Run Length. Coding.

Text Books

1. Willis J. Tomkin, "Biomedical Digital Signal Processing", PHI.
2. D. C. Reddy, "Biomedical Signal Processing", McGraw Hill
3. KayvanNajarian, Robert Splinter, "Biomedical Signal and Image Processing", Second Edition, CRCPress, 2014.

Reference Books

1. Arnon Cohen, "Biomedical Signal Processing (volume-I)", Licrc Press
2. Deserno T M, "Biomedical Image Processing", Springer, 2011.

AI ENABLE DATA SCIENCE			
Course Code:	**CD419**	**Course Credits:**	**3**
Course Category: CC	**E4**	**Course (U / P)**	**U**
Course Year (U / P):U	**4U**	**Course Semester (U / P):**	**7U**
No. of Lectures + Tutorials (Hrs/Week):	**03+ 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):30	**45+ 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1. To know the underlying structure behind intelligence mathematically.			
2. To know the logical implications in probabilistic Reasoning.			
3. To know the automated learning techniques.			
4. To explore the techniques in Reinforcement Learning.			
5. To explore artificial intelligence techniques for Robotics.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Explain the probabilistic reasoning using Bayesian inference			
2. Apply appropriate Probabilistic reasoning techniques for solving uncertainty problems			
3. Explain use of game theory for decision making.			
4. Explain and apply probabilistic models for various use cases.			
5. Apply AI techniques for robotics			

UNIT I PROBABILISTIC REASONING

Acting under uncertainty – Bayesian inference – naïve bayes models, Probabilistic reasoning Bayesian networks, exact inference in BN, approximate inference in BN , causal networks

UNIT II PROBABILISTIC REASONING II

Probabilistic reasoning over time, time and uncertainty, inference in temporal models, Hidden Markov Models, Kalman filters, Dynamic Bayesian networks, Probabilistic programming.

UNIT III DECISIONS UNDER UNCERTAINTY

Basis of utility theory, utility functions, Multi attribute utility functions, decision networks, value of information, unknown preferences, Sequential decision problems, MDPs, Bandit problems, partially observable MDPs Multi agent environments, non-cooperative game theory, cooperative game theory, makingcollective decisions.

UNIT IV LEARNING PROBABILISTIC MODELS

generative and descriptive models, continuous models, Bayesian parameter learning, Bayesian linear regression, learning Bayesian net structures, density estimation EM Algorithm, unsupervised clustering, Gaussian mixture models, learning Bayes net parameters, learning HMM, learning Bayes net structures with hidden variables. Statistical learning theory , maximum-likelihood parameter learning, naïve bayes models,

UNIT V REINFORCEMENT LEARNING AND ROBOTICS 9

Learning from rewards, passive reinforcement learning, active reinforcement learning, generalization in reinforcement learning, policy search, inverse reinforcement learning, applications Robots, robotic perception, planning movements, reinforcement learning in robotics, robotic frameworks, applications of robotics, Philosophy, ethics, and safety of AI, the future of AI

Text Books:

1. Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Fourth Edition, Pearson Education, 2020.

REFERENCES

1. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006
4. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013
(http://nptel.ac.in/)

WEB ANALYTICS			
Course Code:	**CD421**	**Course Credits:**	**3**
Course Category: CC	**E4**	**Course (U / P)**	**U**
Course Year (U / P):U	**4U**	**Course Semester (U / P):**	**7U**
No. of Lectures + Tutorials (Hrs/Week):	**03+ 00**	**Mid Sem. Exam Hours:**	**1**
Total No. of Lectures (L + T):30	**45+ 00**	**End Sem. Exam Hours:**	**3**
COURSE OBJECTIVES			
1.Understand how web analytics is important for computer system.			
2.Make aware of different types of Web Analytics and their services			
3.Learn different Analysis, Metrics and Data Sources			
4.Know about different protection mechanisms in Web Analytics.			
5.Understanding of Privacy & Ethics			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Understand the different services provided by web analytics.			
2.Learn real life applications of web analytics.			
3.Understands the use of different process and metrics.			
4.Learn different types of terminology and fundamentals.			
5.Perform implementation of protection mechanisms in Web Analytics.			

UNIT I INTRODUCTION TO WEB ANALYTICS

What are Web Analytics, Importance of Web Analytics, Web Analytics Process, Google Analytics :What are Google Analytics ,Audience Analysis, Acquisition Analysis, Behavior Analysis, Conversion Analysis.

UNIT II DATA SOURCE

Optimizely, Kiss metrics, Crazy Egg, Key Metrics, Data Sources: Server Logs, Visitors' Data, Search Engine Statistics, Conversion Funnels, Segmentation: Data Segmentation, Analysis Using Segmentation.

UNIT III IMPLEMENTATION AND TERMINOLOGY

Dashboards: Dashboard Implementation, Types of Dashboards, Metrics for Every Dashboard, EMERGING ANALYTICS: Social Media Analytics , Ecommerce Analytics, Mobile Analytics, Web Analytics Terminology.

UNIT IV FUNDAMENTALS OF WEB ANALYTICS

Fundamentals of Web Analytics, Web Analytics Maturity Model, Why Maturity, Maturity Model& Framework, Web Analytics Maturity Model (WAMM),Using the Web Analytics Maturity Model: Accountable, Responsible, Informed, The Three Heads of Online Analytics, Qualities of a Web Analytics Leader.

UNIT V PRIVACY AND ETHICS

Introduction to Privacy and Ethics, When Consumers Takes Control of their Privacy, The Impact of Ad Blocker,10 Privacy Principles of PIPEDA, General Data Protection Regulation (GDPR) (EU).

Text Books

[1] Web Analytics: An Hour a Day 2007 by Avinash Kaushik(author)

[2]. Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity 1st Edison.

SOCIAL MEDIA ANALYTICS & TECHNIQUES			
Course Code:	**CD 423**	**Course Credits:**	**3**
Course Category:	**E4**	**Course (U / P)**	**U**
Course Year (U / P):	**4U**	**Course Semester**	**7U**
No. of Lectures + Tutorials (Hrs/Week):	**03 + 00**	**Mid Sem. Exam Hours:**	**1**
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. Develop social media measurement plans and analytics reports, and communicate findings and recommendations effectively.			
5. Examine the ethical and legal implications of leveraging social media data.			
COURSE OUTCOMES			
At the end of the course the students should be able to:			
1. Familiarize the learners with the concept of social media analytics and understand its significance.			
2. Familiarize the learners with the tools of social media analytics.			
3. Enable the learners to develop skills required for analyzing the effectiveness of social media for business purposes.			
4. Explain and discuss the importance of Social Media Analytics.			
5. Examine how different industries across the globe are using social media analytics.			

UNIT I INTRODUCTION TO SOCIAL MEDIA ANALYTICS (SMA)

Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas

Network fundamentals and models: The social networks perspective - nodes, ties and influencers, Social network and web data and methods. Graphs and Matrices- Basic measures for individuals and networks. Information visualization

UNIT II MAKING CONNECTIONS

Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity.

Web analytics tools: Clickstream analysis, A/B testing, online surveys, Web crawling and Indexing. Natural Language Processing Techniques for Micro-text Analysis

UNIT III FACEBOOK ANALYTICS

Introduction, parameters, demographics. Analyzing page audience. Reach and Engagement analysis. Post-performance on FB. Social campaigns. Measuring and Analyzing social campaigns, defining goals and evaluating outcomes, Network Analysis.

UNIT IV: PROCESSING AND VISUALIZING

Processing and Visualizing Data, Influence Maximization, Link Prediction, Collective Classification .Applications in Advertising and Game Analytics (Use of tools like Unity30

/ PyCharm).Introduction to Python Programming, Collecting and analyzing social media data; visualization and exploration.

UNIT V PRACTICAL

Students should analyze the social media of any ongoing campaigns and present the findings.

Text Books

1. Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media by Matthew Ganis, Avinash Kohirkar Pearson 2016.
2. Social Media Metrics: How to Measure and Optimize Your Marketing Investment by jim sterne, wiley publication.
3. Social Media Analytics by Marshall Sponderm mcgraw hill publication latest edition,

Reference Books

1. Creating Value With Social Media Analytics by Gohar F. Khan, CreateSpace Independent Publisher 2018.
2. Social Media Analytics Strategy by Alex Gonsalves, Apress 2017.