MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)

B.Tech. CSE(Data Science) V to VIII Semester
Scheme of Instruction and Examination
(Choice Based Credit System)
For the batches to be admitted with effect from the academic year **2021-22**

V Semester

S.No.	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P/D	CIE	SEE		
1	CS503PC	Design and Analysis of Algorithms	3	0	0	30	70	3	3
2	CS506PC	Introduction to Data Science	3	0	0	30	70	3	3
3	CS509PC	Data Mining	3	0	0	30	70	3	3
4	CS510PC	Computer Networks	3	0	0	30	70	3	3
5	-	Professional Elective - I	3	0	0	30	70	3	3
6	-	Professional Elective - II	3	0	0	30	70	3	3
7	MC501ES	Artificial Intelligence	3	0	0	30	70	3	0
8	CS554PC	Data Mining Lab	0	0	3	30	70	3	1.5
9	CS557PC	Computer Networks Lab	0	0	3	30	70	3	1.5
10	EN553HS	Finishing Schools-III (Advanced Communication Skills Lab)	0	0	2	30	70	3	1
11	MC501HS	Intellectual Property Rights	3	0	0	30	70	3	0
		Total Hours/Marks/Credits	24	0	8	330	770	33	22

VI Semester

S.No.	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P/D	CIE	SEE		
1	CS608PC	Machine Learning	3	1	0	30	70	3	4
2	CS610PC	Big Data Analytics	3	1	0	30	70	3	4
3	CS611PC	Language Processors	3	1	0	30	70	3	4
4	--	Professional Elective – III	3	0	0	30	70	3	3
5	--	Open Elective - I	2	0	0	30	70	3	2
6	MC602ES	Cyber Security	3	0	0	30	70	3	0
7	CS651PC	Machine Learning Lab	0	0	3	30	70	3	1.5
8	CS656PC	Big Data Analytics Lab	0	0	3	30	70	3	1.5
9	--	Professional Elective - III Lab	0	0	2	30	70	3	1
10	MA654BS	Finishing Schools-IV (Quantitative Aptitude & Analytical Ability)	0	0	2	30	70	3	1
		Total Hours/Marks/Credits	17	3	10	300	700	-	22
11	MC601ESC	Environmental Science (For Lateral Entry Students)	3	0	0	30	70	3	0

L: Lecture **T**: Tutorial **D**: Drawing **P**: Practical **CIE** - Continuous Internal Evaluation **SEE** - Semester End Examination

VII Semester

S.No.	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P/D	CIE	SEE		
1	CS702PC	Predictive Analytics	3	0	0	30	70	3	3
2	CS706PC	Web and Social Media Analytics	3	0	0	30	70	3	3
3	--	Professional Elective – IV	3	0	0	30	70	3	3
4	--	Professional Elective – V	3	0	0	30	70	3	3
5	--	Open Elective – II	2	0	0	30	70	3	2
6	CS754PC	Web and Social Media Analytics Lab	0	0	2	30	70	3	1
7	CS755PC	Industrial Oriented Mini Project/ Summer Internship	0	0	4	-	100	-	2
8	CS756PC	Seminar	0	0	2	100	-	-	1
9	CS758PC	Project Stage – I	0	0	6	30	70	-	3
		Total Hours/Marks/Credits	14	0	14	310	590	-	21

VIII Semester

S.No.	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P/D	CIE	SEE		
1	MS802HS	Organizational Behavior	3	0	0	30	70	3	3
2	---	Professional Elective -VI	3	0	0	30	70	3	3
3	---	Open Elective-III	2	0	0	30	70	3	2
4	CS852PC	Project Stage - II	0	0	16	30	70	-	8
		Total Hours/Marks/Credits	8		16	120	280	-	16

L: Lecture **T**: Tutorial **D**: Drawing **P**: Practical **CIE** - Continuous Internal Evaluation **SEE** - Semester End Examination

Grand Total of Credits

Semester	I	II	III	IV	V	VI	VII	VIII	Total Credits
Credits	19	18	21	21	22	22	21	16	160

*Note: Industrial Oriented Mini Project/ Summer Internship is to be carried out during the summer vacation between 6th and 7th semesters. Students should submit report of Industrial Oriented Mini Project/ Summer Internship for evaluation.

MC - Environmental Science – Should be Registered by Lateral Entry Students Only. MC – Satisfactory/Unsatisfactory

Professional Elective-I

CS517PE	Web Programming
CS518PE	Image Processing
CS519PE	Data Warehousing and Business Intelligence
CS520PE	Design Patterns

Professional Elective - II

CS523PE	Information Retrieval Systems
CS525PE	Computer Vision and Robotics
CS526PE	Spatial and Multimedia Databases
CS527PE	DevOps

Professional Elective - III

CS622PE	Mobile Application Development
CS624PE	Cryptography and Network Security
CS625PE	Data Visualization Techniques
CS626PE	Scripting Languages

Professional Elective- III LAB

CS666PE	Mobile Application Development
CS668PE	Cryptography and Network Security
CS669PE	Data Visualization Techniques
CS670PE	Scripting Languages

Courses in PE – III and PE – III Lab must be in 1-1 correspondence.

Professional Elective –IV

CS711PE	Natural Language Processing
CS715PE	Database Security
CS724PE	Information Storage Management
CS725PE	Internet of Things

Professional Elective - V

CS716PE	Cloud Computing
CS733PE	Privacy Preserving in Data Mining
CS734PE	Mining Massive Datasets
CS735PE	Exploratory Data Analysis

Professional Elective – VI

CS813PE	Data Stream Mining
CS827PE	Video Analytics
CS828PE	Block chain Technology
CS829PE	Parallel and Distributed Computing

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List of Open Electives offered: **Open Elective-I**	
CS521OE	Data Structures
CS522OE	Operating Systems
CS523OE	Database Management Systems
Open Elective-II	
CS621OE	Computer Networks
CS622OE	Software Engineering
CS623OE	Java Programming
Open Elective-III	
CS721OE	Python Programming
CS722OE	Internet of Things
CS723OE	Introduction to Machine Learning

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Computer Science & Engineering (Data Science)
Scheme of Instruction and Examination

V Semester

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			Hours Per Week			Max. Marks		Duration of SEE in Hours	
			L	T	P/D	CIE	SEE		
1	CS503PC	Design and Analysis of Algorithms	3	0	0	30	70	3	3
2	CS506PC	Introduction to Data Science	3	0	0	30	70	3	3
3	CS509PC	Data Mining	3	0	0	30	70	3	3
4	CS510PC	Computer Networks	3	0	0	30	70	3	3
5	--	Professional Elective - I	3	0	0	30	70	3	3
6	--	Professional Elective - II	3	0	0	30	70	3	3
7	MC501ES	Artificial Intelligence	3	0	0	30	70	3	0
8	CS554PC	Data Mining Lab	0	0	3	30	70	3	1.5
9	CS557PC	Computer Networks Lab	0	0	3	30	70	3	1.5
10	EN553HS	Finishing Schools-III (Advanced Communication Skills Lab)	0	0	2	30	70	3	1
11	MC501HS	Intellectual Property Rights	3	0	0	30	70	3	0
Total Hours/Marks/Credits			24	0	8	330	770	33	22

L	T	P	C
3	0	0	3

V Semester Syllabus
CS503PC: Design and Analysis of Algorithms
[Common to CSE, CSE (AI&ML), CSE (DS) & IT]

Prerequisites:
1. A course on "Computer Programming and Data Structures".
2. A course on "Advanced Data Structures".

Course Objectives

- Introduces the notations for analysis of the performance of algorithms.
- Introduces the data structure disjoint sets.
- Describes major algorithmic techniques (divide-and-conquer, backtracking, dynamic programming, greedy, branch and bound methods) and mention problems for which each technique is appropriate;
- Describes how to evaluate and compare different algorithms using worst-, average-, and best-case analysis.
- Explains the difference between tractable and intractable problems, and introduces the problems that are P, NP and NP complete knowledge on various string-matching algorithms and implement them.

Course Outcomes

Student will be able to:
- Acquire the knowledge of algorithm analysis and its notations that are applied on the problems solved by divide and conquer paradigm.
- Use greedy approach to solve an appropriate problem for optimal solution.
- Apply dynamic programming approach to solve suitable problems
- Apply the concept of back tracking, branch and bound paradigm for real time problems.
- Analyze the complexity of problems and differentiate that in terms of P and NP problems with examples.

Unit I :
Introduction: Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation- Big oh notation, Omega notation, Theta notation and Little oh notation.

Divide and conquer: General method, applications-Binary search, Quick sort, Merge sort, Strassen's matrix multiplication.

Unit II :
Sets and Disjoint Set Unions: Introduction, Union and Find Operations with algorithms.

Greedy method: General method, applications-Job sequencing with dead lines, knapsack problem, Minimum cost spanning trees-Prim's and kruskal's Algorithm, Single source shortest path problem.

Unit III :
Dynamic Programming: General method, applications- Multistage Graphs, Optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem, The Traveling sales person problem, Reliability design.

Unit IV :
Backtracking: General method, applications- The 8-Queens problem, sum of subsets problem, graph coloring, Hamiltonian cycles.

Branch and Bound: General method, applications - 0/1 knapsack problem- LC Branch and Bound solution, FIFO Branch and Bound solution, Travelling sales person problem,.

Unit V :

NP-Hard and NP-Complete problems: Basic concepts, Nondeterministic algorithms, The classes NP - Hard and NP-Complete, Cook's theorem, NP-Hard Graph Problems-Clique Decision Problem(CDP), Node cover decision problem.

Text Books:

1. Ellis Horowitz, Satraj Sahni and Sanguthevar Rajasekharam, Fundamentals of Computer Algorithms, Galgotia publications Pvt. Ltd, Second Edition, 2007.
2. Aho, Ullman and Hopcroft, Design and Analysis of algorithms, Pearson education, Reprint 2002.

Reference Books:

1. R.C.T.Lee, S.S.Tseng, R.C.Chang and T.T Sai, Introduction to Design and Analysis of Algorithms A strategic approach, Mc Graw Hill,2005.
2. Algorithm Design: Foundations, Analysis and Internet Examples, M.T. Goodrich and R.Tamassia, John Wiley and sons.
3. Introduction to Algorithms, 3rd Ed, T. H. Cormen, C.E. Leiserson, R. L. Rivest, and Clifford Stein, PHI Pvt. Ltd., Pearson Education.

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V Semester Syllabus
CS506PC: Introduction to Data Science

Course Objectives

- Learn concepts, techniques and tools they need to deal with various facets of data science practice, including data collection and integration
- Understand the basic types of data and basic statistics
- Identify the importance of data reduction and data visualization techniques.

Course Outcomes

- Students would be able to
- Understand basic terms what Statistical Inference means.
- Identify probability distributions commonly used as foundations for statistical modeling. Fit a model to data
- Describe the data using various statistical measures
- Utilize Elements for data handling
- 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, and 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 Inter- quartile 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, and Class. Factors and Data Frames: Introduction to Factors: Factor Levels, Summarizing a Factor, Ordered Factors, Comparing Ordered Factors, Introduction to Data Frame, sub setting of Data Frames, Extending Data Frames, and 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.

Suggested Reading:
1. Doing Data Science, Straight Talk from the Frontline. Cathy O'Neil and Rachel Schutt, O'Reilly, 2014
2. Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, 3rd ed. The Morgan Kaufmann Series in Data Management Systems.

Reference Books:

1. K G Srinivas, G M Siddesh, "Statistical programming in R", Oxford Publications.
2. Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Pearson Education.
3. Brain S. Everitt, "A Handbook of Statistical Analysis Using R", Second Edition, 4 LLC, 2014.
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V Semester Syllabus
CS509PC: Data Mining

Pre-Requisites:
- A course on "Database Management Systems"
- Knowledge of probability and statistics

Course Objectives

- It presents methods for mining frequent patterns, associations, and correlations.
- It then describes methods for data classification and prediction, and data–clustering approaches.
- It covers mining various types of data stores such as spatial, textual, multimedia, streams.

Course Outcomes

- Students would be able to
- Ability to understand the types of the data to be mined and present a general classification of tasks and primitives to integrate a data mining system.
- Apply preprocessing methods for any given raw data.
- Extract interesting patterns from large amounts of data.
- Discover the role played by data mining in various fields.
- Choose and employ suitable data mining algorithms to build analytical applications
- Evaluatetheaccuracyofsupervisedandunsupervisedmodelsandalgorithms.

Unit-I

Data Mining: Data–Types of Data–, Data Mining Functionalities–Interestingness Patterns–Classification of Data Mining systems–Data mining Task primitives–Integration of Data mining system with a Data warehouse–Major issues in Data Mining–Data Preprocessing.

Unit-II

Association Rule Mining: Mining Frequent Patterns–Associations and correlations – Mining Methods– Mining Various kinds of Association Rules– Correlation Analysis– Constraint based Association mining. Graph Pattern Mining, SPM.

Unit-III

Classification: Classification and Prediction– Basic concepts–Decision tree induction–Bayesian classification, Rule–based classification, Lazy learner.

Unit-IV

Clustering and Applications: Cluster analysis–Types of Data in Cluster Analysis–Categorization of Major Clustering Methods– Partitioning Methods, Hierarchical Methods– Density–Based Methods, Grid–Based Methods, Outlier Analysis.

Unit-V

Advanced Concepts: Basic concepts in mining data streams–Mining Time–series data––Mining sequence patterns in Transactional databases– Mining Object– Spatial– Multimedia–Text and Web data–Spatial Data mining–Multimedia Data mining–Text Mining–Mining the World Wide Web.

Suggested Reading:
1. Data Mining – Concepts and Techniques – Jiawei Han & Micheline Kamber, 3rd Edition Elsevier.
2. Data Mining Introductory and Advanced topics– Margaret H Dunham, PEA.

Reference Books:
1. Ian H. Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques (Second Edition),Morgan Kaufmann,2005.

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V Semester Syllabus
CS510PC: Computer Networks
[*Common to CSE, CSBS, CSE (AI&ML) & CSE (DS)*]

Prerequisites:
- A course on "Programming for problem solving".
- A course on "Data Structures".

Course Objectives

- The objective of the course is to equip the students with a general overview of the concepts and fundamentals of computer networks.
- Familiarize the students with the standard models for the layered approach to communication between machines in a network and the protocols of the various layers.

Course Outcomes

Students would be able to
- Gain the knowledge of the basic computer network technology.
- Gain the knowledge of the functions of each layer in the OSI and TCP/IP reference model.
- Identify and analyze various routing algorithms, congestion control algorithms.
- Outline the transport layer protocols like TCP and UDP.
- List and examine the applications of HTTP, WWW, DNS, Email, FTP and the underlying protocols.

UNIT - I
Network Hardware: Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Internetwork.
Network software: Protocol Hierarchies, Design Issues for the Layers, Connection-Oriented and Connectionless Services.
Reference Models: OSI, TCP/IP Reference models, Comparison of OSI and TCP/IP Models
Example Networks: ARPANET, Internet.
Physical Layer: Guided Transmission media: Magnetic Media, Twisted pairs, Coaxial Cable, Fiber Optics, Unguided Transmission Media: Radiowaves, Microwaves, Infrared.

UNIT - II
Data link layer: Design issues, **Framing**: Character Count, Character Stuffing, Bit Stuffing
Error Detection and Correction: Block Codes, Simple Parity Check, LRC, Hamming Distance, Checksum, Hamming Code, CRC
Elementary data link protocols: simplex protocol, A simplex stop and wait protocol for an error-free channel, A simplex stop and wait protocol for noisy channel.
Sliding Window protocols: Pipelining, Piggybacking, A one-bit sliding window protocol, A protocol using Go-Back-N, A protocol using Selective Repeat,
Example data link protocols: HDLC, PPP

Medium Access sub layer: The channel allocation problem, Multiple access protocols: ALOHA, Carrier sense multiple access protocols, collision free protocols.
Wireless LANs, Connecting devices at the data link layer.

UNIT - III

Network Layer: Design issues, **Routing algorithms**: shortest path routing, Flooding, Hierarchical routing, Broadcast, Multicast, distance vector routing, Link State Routing,

Congestion Control Algorithms: Approaches to Congestion Control, Traffic aware routing, Admission Control, Traffic throttling, Load shedding.

Quality of Service: Traffic Shaping, Packet scheduling, Admission Control, Integrated services, Differentiated Services, Internetworking,

Network layer in the Internet: IPv4 protocol, IP Addresses, IPv6 protocol, Internet Control Protocols: ICMP, ARP, RARP, BOOTP, DHCP,

Internetwork Routing: OSPF, BGP, Internet Multicasting.

UNIT - IV

Transport Layer: Transport Services: Services provided to Upper layer, Transport service primitives, Berkeley Sockets

Elements of Transport protocols: Addressing, Error and Flow Control, Multiplexing, Crash Recovery, Connection management.

Internet Transport Protocols: TCP: Service Model, TCP Protocol, Segment header, TCP Connection establishment and Release, TCP Connection management, TCP Sliding Window, Timer management, TCP Congestion Control.

UDP: Protocol, UDP Header

UNIT - V

Application Layer: Domain name system- DNS Name Space, Resource records, Name Servers. SNMP, Electronic Mail: Architecture and Services, User Agent, Message Formats, Message Transfer, Final Delivery.

World Wide Web: Architectural Overview, Static Web pages, Dynamic web pages and Web applications, HTTP, Mobile Web.

Streaming audio and video: Digital Audio, Digital Video, Streaming Stored media, Streaming Live media, Real Time Conferencing.

Suggested Reading:
1. Computer Networks -- Andrew S Tanenbaum, David. j. Wetherall, 5th Edition. Pearson Education/PHI,2011.
2. Data Communications and Networking – Behrouz A. Forouzan. Fifth Edition TMH, 2017.

Reference Books:
1. An Engineering Approach to Computer Networks-S. Keshav, 2nd Edition, Pearson Education
2. "Data and Computer Communications" by William Stallings 9 th Edition, Pearson Education 2010.
3. "TCP/IP Illustrated" by W. Richard Stevens,Addison-Wesley Professional;2 nd edition 2011.

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3	0	0	3

V Semester Syllabus
CS517PE: Web Programming (Professional Elective–I)
(*COMMON TO CSE (AI&ML), CSE (DS)*)

Course Objectives

- The student should be able to:
- Understand the technologies used in Web Programming.
- Know the importance of object-oriented aspects of Scripting.
- Understand creating database connectivity using JDBC.
- Learn the concepts of web-based application using sockets.

Course Outcomes

- Upon Completion of the course, the students will be able to
- Design web pages.
- Use technologies of Web Programming.
- Apply object-oriented aspects to Scripting.
- Create databases with connectivity using JDBC.
- Build web-based application using sockets.

Unit-I
SCRIPTING: Web page designing using HTML, Scripting basics-Client side and server-side scripting. Java Script-Object, names, literals, operators and expressions- statements and features- events -windows-documents-frames-data types-built-in functions-Browser object model -Verifyingforms-HTML5-CSS3-HTML 5canvas-Web site creation using tools.

Unit–II
JAVA: Introduction to object-oriented programming-Features of Java–Data types, variables and arrays
– Operators – Control statements – Classes and Methods – Inheritance. Packages and Interfaces –Exception Handling
– Multithreaded Programming – Input/ Output – Files – Utility Classes – String Handling.

Unit–III
JDBC: JDBC Overview – JDBC implementation – Connection class – Statements –Catching Database Results, handling database Queries. Networking–Inet Address class–URL class-TCP sockets–UDP sockets, Java Beans–RMI.

Unit–IV
APPLETS: Java applets- Life cycle of an applet – Adding images to an applet – Adding sound to an applet. Passing parameters to an applet. Event Handling. Introducing AWT: Working with Windows Graphics and Text. Using AWT Controls, Layout Managers and Menus. Servlet–lifecycle of a servlet. The Servlet API, Handling HTTP Request and Response, using Cookies, Session Tracking. Introduction to JSP.

Unit–V
XML AND WEB SERVICES: Xml –Introduction-Form Navigation-XML Documents-XSL–XSLT-Web services-UDDI-WSDL-Java web services–Web resources.

Suggested Reading:

1. Harvey Deitel, Abbey Deitel, Internet and World Wide Web: How To Program 5th Edition.
2. Herbert Schildt, Java-The Complete Reference, 7th Edition. Tata Mc Graw-Hill Edition.
3. Michael Morrison XMLUnleashed Techmedia SAMS.

Reference Books:

1. John Pollock, Javascript-A Beginners Guide, 3rd Edition–-Tata Mc Graw-Hill Edition.
2. Keyur Shah, Gateway to Java Programmer Sun Certification, Tata Mc Graw Hill, 2002

L	T	P	C
3	0	0	3

V Semester Syllabus
CS518PE: Image Processing (Professional Elective–I)
(COMMON TO CSE (AI&ML), CSE (DS))

Pre-requisites:
1. Students are expected to have knowledge in linear signals and systems, Fourier Transform, basic linear algebra, basic probability theory and basic programming techniques; knowledge of Digital Signal Processing is desirable.
2. A course on "Computational Mathematics"
3. A course on "Computer Oriented Statistical Methods"

Course Objectives

- Provide a theoretical and mathematical foundation of fundamental Digital Image Processing concepts.
- The topics include image acquisition; sampling and quantization; preprocessing; enhancement; restoration; segmentation; and compression.

Course Outcomes

Students would be able to
- Demonstrate the knowledge of the basic concepts of two-dimensional signal acquisition, sampling, and quantization.
- Demonstrate the knowledge of filtering techniques.
- Demonstrate the knowledge of 2D transformation techniques.
- Demonstrate the knowledge of image enhancement, segmentation, restoration and compression techniques.

Unit-I
Digital Image Fundamentals: Digital Image through Scanner, Digital Camera. Concept of Gray Levels. Gray Level to Binary Image Conversion. Sampling and Quantization. Relationship between Pixels. Imaging Geometry. 2D Transformations-DFT, DCT, KLT and SVD.

Unit-II
Image Enhancement in Spatial Domain Point Processing, Histogram Processing, Spatial Filtering, Enhancement in Frequency Domain, Image Smoothing, Image Sharpening.

Unit-III
Image Restoration Degradation Model, Algebraic Approach to Restoration, Inverse Filtering, Least Mean Square Filters, Constrained Least Squares Restoration, Interactive Restoration.

Unit-IV
Image Segmentation Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region Oriented Segmentation.

Unit-V
Image Compression Redundancies and their Removal Methods, Fidelity Criteria, Image Compression Models, Source Encoder and Decoder, Error Free Compression, Lossy Compression.

Suggested Reading:
1. Digital Image Processing: R.C. Gonzalez & R.E. Woods, Addison Wesley / Pearson Education, 2nd Ed, 2004.

Reference Books:
1. Fundamentals of Digital Image Processing: A.K. Jain, PHI.
2. Digital Image Processing using MATLAB: RafaelC. Gonzalez, Richard E. Woods, Steven L. Eddins: Pearson Education India, 2004.
3. Digital Image Processing: William K. Pratt, John Wilely, 3rd Edition, 2004.

L	T	P	C
3	0	0	3

V Semester Syllabus
CS519PE: Data Warehousing and Business Intelligence (Professional Elective–I)
(COMMON TO CSE (AI&ML) (PE-2)), CSE (DS))

- This course is concerned with extracting data from the information systems that deal with the day-to-day operations and transforming it into data that can be used by businesses to drive high-level decision making
- Students will learn how to design and create a data warehouse, and how to utilize the process of extracting, transforming, and loading (ETL) data into data warehouses.

Course Outcomes

Students would be able to

- Understand architecture of data warehouse and OLAP operations.
- Understand Fundamental concepts of BI and Analytics
- Application of BI Key Performance indicators
- Design of Dashboards, Implementation of Web Analytics
- Understand Utilization of Advanced BI Tools and their Implementation.
- Implementation of BI Techniques and BI Ethics.

Unit-I
DATA WAREHOUSE: Data Warehouse-Data Warehouse Architecture- Multidimensional Data Model-Data cube and OLAP Technology-Data Warehouse Implementation -DBMS schemas for Decision support-Efficient methods for Data cube computation.

Unit-II
Business Intelligence: Introduction–Definition, Leveraging Data and Knowledge for BI, BI Components, BI Dimensions, Information Hierarchy, Business Intelligence and Business Analytics. BI Life Cycle. Data for BI-Data Issues and Data Quality for BI.

Unit-III
BI Implementation – Key Drivers, Key Performance Indicators and Performance Metrics, BI Architecture / Framework, Best Practices, Business Decision Making, Styles of BI-vent-Driven alerts - Acyclic process of Intelligence Creation. The value of Business Intelligence-Value driven & Information use.

Unit-IV
Advanced BI – Big Data and BI, Social Networks, Mobile BI, emerging trends, Description of different BI-Tools (Pentaho, KNIME)

Unit-V
Business intelligence implementation-Business Intelligence and integration implementation-connectingin BI systems-Issues of legality-Privacy and ethics-Social networking and BI.

Suggested Reading:
1. Data Mining – Concepts and Techniques-JIAWEIHAN& MICHE LINEKAMBER, Elsevier.
2. Rajiv Sabherwal "Business Intelligence" Wiley Publications, 2012.

Reference Books:
1. Efraim Turban, Ramesh Sharda, Jay Aronson, David King, Decision Support and Business Intelligence Systems, 9th Edition, Pearson Education, 2009.
2. David Loshin, Business Intelligence-The Savy Manager's Guide Getting Onboard with Emerging IT, Morgan Kaufmann Publishers, 2009.
3. Philo Janus, Stacia Misner, Building Integrated Business Intelligence Solutions with SQL Server, 2008 R2 & Office 2010, TMH, 2011.
4. Business Intelligence Data Mining and Optimization for decision making [Author: Carlo-Verellis] [Publication: (Wiley)].

5. Data Warehousing, Data Mining & OLAP-Alex Bersonand Stephen J. Smith-Tata Mc Graw-Hill Edition,Tenth reprint 2007.
6. Building the Data Warehouse- W. H. Inmon, Wiley Dreamtech India Pvt. Ltd.
7. Data Mining Introductory and Advanced topics–MARGARETHDUNHAM, PEA.

L	T	P	C
3	0	0	3

V Semester Syllabus
Professional Elective-I
CS520PE: Design Patterns (Professional Elective–I)

Prerequisites: Software Engineering, Object Oriented Programming through Java
Course Objectives:

- The aim of the course is to appreciate the idea behind Design Patterns in handling common problems faced during building an application
- This course covers all pattern types from creational to structural, behavioral to concurrency and highlights the scenarios when one pattern must be chosen over others.

Course Outcomes:

- Ability to understand underlying principles of design patterns.
- To analyze the design and structure of a document editor and its supporting features.
- To differentiate between creational, structural and behavioral design patterns.

UNIT – I
Introduction: What is a design pattern? design patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.

UNIT – II
Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation, Summary

UNIT – III
Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns.

UNIT – IV
Structural Patterns: Adapter, Bridge, Composite, Decorator, Façade, Flyweight, Proxy

UNIT – V
Behavioral Patterns: Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, State, Strategy, Template Method, Visitor.

TEXT BOOKS:
1. Design Patterns, Erich Gamma, Pearson Education
2. Patterns in Java, Vol –I, Mark Grand, Wiley Dream Tech.

REFERENCE BOOKS:
1. Patterns in Java, Vol-II, Mark Grand, Wiley Dream Tech.
2. Java Enterprise Design Patterns Vol-III, Mark Grand, Wiley Dream Tech.
3. Head First Design Patterns, Eric Freeman, O'reily publications

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V Semester Syllabus
CS523PE: Information Retrieval Systems
[*Common to CSE (AI&ML) & CSE (DS)*]

Prerequisites:
- Data Structures.

Course Objectives

- To learn the important concepts and algorithms in IRS
- To understand the data / file structures that are necessary to design, and implement information retrieval (IR) systems.

Course Outcomes

Students would be able to
- Ability to apply IR principles to locate relevant information large collections of data
- Ability to design different document clustering algorithms
- Implement retrieval systems for web search tasks.
- Design an Information Retrieval System for web search tasks.

Unit-I
Introduction to Information Retrieval Systems: Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management Systems, Digital Libraries and Data Warehouses
Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities

Unit-II
Cataloging and Indexing: History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction
Data Structure: Introduction to Data Structure, Stemming Algorithms, Inverted File Structure, N-Gram Data Structures, PAT Data Structure, Signature File Structure, Hypertext and XML Data Structures, Hidden Markov Models

Unit-III
Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages. Document and Term Clustering: Introduction to Clustering, Thesaurus Generation, Item Clustering, Hierarchy of Clusters

Unit-IV
User Search Techniques: Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of Boolean Systems, Searching the INTERNET and Hypertext
Information Visualization: Introduction to Information Visualization, Cognition and Perception, Information Visualization Technologies

Unit-V
Text Search Algorithms: Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems
Multimedia Information Retrieval: Spoken Language Audio Retrieval, Non-Speech Audio Retrieval, Graph Retrieval, Imagery Retrieval, Video Retrieval

Suggested Reading:
1. Information.Tech Storage and Retrieval Systems–Theory and Implementation, Second Edition, Gerald J. Kowalski, Mark T. Maybury, Springer.

Reference Books:
1. Frakes, W.B., Ricardo Baeza-Yates: Information Retrieval Data Structures and Algorithms, Prentice Hall, 1992.
2. Information Storage & Retrieval by Robert Korfhage – John Wiley & Sons.
3. Modern Information Retrieval By Yates and Neto Pearson Education.

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V Semester Syllabus
CS525PE: Computer Vision and Robotics (Professional Elective-II)
(COMMON CSE (AI&ML), CSE (DS))

Pre-Requisites:
- UG level Course in Linear Algebra and Probability.

Course Objectives

1.	To understand the Fundamental Concepts related to sources, shadows and shading.
2.	To understand The Geometry of Multiple Views.

Course Outcomes

Students would be able to
1. Implement fundamental image processing techniques required for computer vision.
2. Implement boundary tracking techniques.
3. Apply chain codes and other region descriptors, Hough Transform for line, circle, and ellipse detections.
4. Apply 3D vision techniques and Implement motion related techniques.
5. Develop applications using computer vision techniques.

Unit-I
CAMERAS: Pinhole Cameras.
Radiometry–Measuring Light: Light in Space, Light Surfaces, Important Special Cases.
Sources, Shadows, And Shading: Qualitative Radiometry, Sources and Their Effects, Local Shading Models, Application: Photometric Stereo, Inter reflections: Global Shading Models.
Color: The Physics of Color, Human Color Perception, Representing Color, a Model for Image Color, Surface Color from Image Color.

Unit-II
Linear Filters: Linear Filters and Convolution, Shift Invariant Linear Systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates.
Edge Detection: Noise, Estimating Derivatives, Detecting Edges.
Texture: Representing Texture, Analysis (and Synthesis) Using Oriented Pyramids, Application: Synthesis by Sampling Local Models, Shape from Texture.

Unit-III
The Geometry of Multiple Views: Two Views.
Stereopsis: Reconstruction, Human Stereposis, Binocular Fusion, Using More Cameras. **Segmentation by Clustering:** What Is Segmentation? Human Vision: Grouping and Getstalt, Applications: Shot Boundary Detection and Background Subtraction, Image Segmentation by Clustering Pixels, Segmentation by Graph-Theoretic Clustering,

Unit-IV
Segmentation by Fitting a Model: The Hough Transform, Fitting Lines, Fitting Curves, Fitting as a Probabilistic Inference Problem, Robustness
Segmentation and Fitting Using Probabilistic Methods: Missing Data Problems, Fitting, and Segmentation, the EM Algorithm in Practice.
Tracking with Linear Dynamic Models: Tracking as an Abstract Inference Problem, Linear Dynamic Models, Kalman Filtering, Data Association, Applications and Examples

Unit-V
Geometric Camera Models: Elements of Analytical Euclidean Geometry, Camera Parameters and the Perspective Projection, Affine Cameras and Affine Projection Equations.
Geometric Camera Calibration: Least-Squares Parameter Estimation, a Linear Approach to Camera Calibration, Taking Radial Distortion into Account, Analytical Photogrammetry, an Application: Mobile Robot Localization.

Model-Based Vision: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses by pose Clustering, Obtaining Hypotheses Using Invariants, Verification, and Application: Registration in Medical Imaging Systems, Curved Surfaces and Alignment.

Suggested Reading:

1. David A. Forsyth and Jean Ponce: Computer Vision – A Modern Approach, PHI Learning (Indian Edition), 2009.

Reference Books:

1. E.R. Davies: Computer and Machine Vision–Theory, Algorithms and Practicalities, Elsevier (Academic Press), 4th edition, 2013.
2. R.C. Gonzalez and R.E. Woods "Digital Image Processing" Addison Wesley 2008.
3. Richard Szeliski "Computer Vision: Algorithms and Applications" Springer-Verlag London Limited 2011.

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V Semester Syllabus
CS526PE: Spatial and Multimedia Databases (Professional Elective-II)

Course Objectives

- Introduce the basic concepts, data models and indexing structures for spatial data, multimedia data.

Course Outcomes

- Students would be able to
- Understand data models, storage, indexing and design of spatial databases.
- Represent image database with R-tree.
- Store and retrieve multimedia data.

Unit-I

Introduction to Spatial Databases: Overview, beneficiaries, GIA and SDBMS, users, Space taxonomy, query language, query processing, query optimization. Spatial Concepts and Data Models: Models of Spatial information, three step database design, extending the ER model with spatial concept, object-oriented data modeling. Spatial Query Languages.

Unit-II

Spatial Storage and Indexing: Storage-disks and files, spatial indexing, TR*, spatial join index. Query processing and optimization – Evaluation of Spatial operations, query optimization, Analysis of Spatial index structures, distributed and parallel spatial database system. Multidimensional Data Structures: k-d Trees, Point Quad trees, The MX-Quad tree, R-Trees, comparison of Different Data Structures.

Unit-III

Image Databases: Raw Images, Compressed Image Representations, Image Processing: Segmentation, Similarity-Based Retrieval, Alternative Image DB Paradigms, Representing Image DBs with Relations, Representing Image DBs with R-Trees, Retrieving Images By Spatial Layout, Implementations. Text / Document Databases: Precision and Recall, Stop Lists, Word Stems, and Frequency Tables, Latent Semantic Indexing, TV-Trees, Other Retrieval Techniques.

Unit-IV

Video Databases : Organizing Content of a Single Video, Querying Content of Video Libraries, Video Segmentation, video Standards Audio Databases : A General Model of Audio Data, Capturing Audio Content through Discrete Transformation, Indexing Audio Data Multimedia Databases : Design and Architecture of a Multimedia Database, Organizing Multimedia Data Based on The Principle of Uniformity, Media Abstractions, Query Languages for Retrieving Multimedia Data, Indexing SMDSs with Enhanced Inverted Indices, Query Relaxation / Expansion.

Unit-V

Creating Distributed Multimedia Presentations: Objects in Multimedia Presentations, Specifying Multimedia Documents with Temporal Constraints, Efficient Solution of Temporal Presentation Constraints, Spatial Constraints. Distributed Media Servers: Distributed multimedia server architecture, distributed retrieval plans, optimal distributed retrieval plans.

Suggested Reading:
1. Shashi Shekhar, Sanjiv Chawla, Spatial Databases-A Tour, Pearson Education.
2. V.S. Subrahmanian, Principles of Multimedia Database Systems, Morgan Kauffman.

Reference Books:
1. Multimedia Databases: An object relational approach, Lynne Dunckley, Pearson Education.
2. Multimedia Database Systems, Prabhakaran, Springer.

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V Semester Syllabus
CS527PE: DevOps (Professional Elective-II)

Course Objectives

- The main objectives of this course are to
- Describe the agile relationship between development and IT operations.
- Understand the skillsets and high-functioning teams involved in DevOps and related methods to reach a continuous delivery capability
- Implement automated system update and DevOps lifecycle

Course Outcomes

- Students would be able to
- Identify components of Devops environment
- Describe Software development models and architectures of DevOps
- Apply different project management, integration, testing and code deployment tool
- Investigate different DevOps Software development models
- Assess various Devops practices
- Collaborate and adopt Devops in real-time projects

Unit-I
Introduction: Introduction, Agile development model, DevOps, and ITIL. DevOps process and Continuous Delivery, Release management, Scrum, Kanban, delivery pipeline, bottlenecks, examples

Unit-II
Software development models and DevOps: DevOps Lifecycle for Business Agility, DevOps, and Continuous Testing.
DevOps influence on Architecture: Introducing software architecture, The monolithic scenario, Architecture rules of thumb, These parathion of concerns, Handling data base migrations, Micro services, and the data tier, DevOps, architecture, and resilience.

Unit-III
Introduction to project management: The need for source code control, The history of source code management, Roles and code, source code management system and migrations, Shared authentication, Hosted Git servers, Different Git server implementations, Docker intermission, Gerrit, The pull request model, GitLab.

Unit-IV
Integrating the system: Build systems, Jenkins build server, Managing build dependencies, Jenkins plugins, and file system layout, The host server, Build slaves, Software on the host, Triggers, Job chaining and build pipelines, Build servers and infrastructure as code, Building by dependency order, Build phases, Alternative build servers, Collating quality measures.

Unit-V
Testing Tools and automation: Various types of testing, Automation of testing Pros and cons, Selenium - Introduction, Selenium features, JavaScript testing, Testing backend integration points, Test-driven development, REPL-driven development
Deployment of the system: Deployment systems, Virtualization stacks, code execution at the client,Puppetmasterandagents,Ansible,Deploymenttools:Chef,SaltStackandDocker

Suggested Reading:
1. JoakimVerona.PracticalDevops,SecondEdition.Ingramshorttitle;2ndedition(2018).ISBN-10:1788392574
2. DeepakGaikwad,ViralThakkar.DevOpsToolsfromPractitioner'sViewpoint.Wileypublications.ISBN:9788126579952
Reference Books:
1. LenBass,IngoWeber,LimingZhu.DevOps:ASoftwareArchitect'sPerspective.AddisonWesley;ISBN-10.

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V Semester Syllabus
MC501ES: ARTIFICIAL INTELLIGENCE
(Common to all Branches)

Course Objectives:
- To learn the distinction between optimal reasoning Vs. human like reasoning
- To understand the concepts of state space representation, exhaustive search, heuristic search together with the time and space complexities.
- To learn different knowledge representation techniques.
- To understand the applications of AI, namely game playing, theorem proving, and machine learning.

Course Outcomes:
- Ability to formulate an efficient problem space for a problem expressed in natural language.
- Select a search algorithm for a problem and estimate its time and space complexities.
- Possess the skill for representing knowledge using the appropriate technique for a given problem.
- Possess the ability to apply AI techniques to solve problems of game playing, and machine learning.

UNIT - I

Introduction: AI Definition, Agents and Environments, Structure of Agents, Types of Agents. Problem Solving Agents: Problem spaces, states, goals and operators.

Uninformed Search Strategies: Breadth First Search, Depth First Search, Depth Limited Search, Iterative Deepening depth first search, Bidirectional Search.

UNIT – II
Informed Search: Heuristic Search strategies, Hill Climbing, A*, Hill climbing search.
Game Playing: Adversarial Searches. Two player games. Min-max Search: Algorithm, Problems. Draw Back of Min-Max Algorithm. Alpha-beta pruning: Algorithm, Problems.

Constraint Satisfaction Problems: Definition, Crypt-Arithmetic Problems, Map Coloring, Backtracking.

UNIT - III

Basic Knowledge Representation and Reasoning: Propositional Logic: Basics of logic, truth tables and sentence conversions. First order logic: Difference between Proposition & First order logic. Conjunctive Normal form. Disjunctive Normal Form. Conversion of English sentences into First order logic. Resolution and theorem proving. Problems of Resolution. Forward Chaining: Definition, Example problems. Backward Chaining: Definition, Example problems.

UNIT – IV
Planning Classical Planning: Definition of Classical Planning, Algorithms for Planning with State-Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches. **Planning and Acting in the Real World:** Time, Schedules, and Resources, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Multi agent Planning.

UNIT – V

Uncertain knowledge and Learning Uncertainty: Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and Its Use,
Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First-Order Probability
Learning: Forms of Learning, Supervised Learning, Learning Decision Trees.
Knowledge in Learning: Logical Formulation of Learning, Knowledge in Learning, Explanation-Based Learning, Learning Using Relevance Information, Inductive Logic Programming.

Text Books:
1. Artificial Intelligence: A Modern Approach by S. Russell and P. Norvig, Prentice Hall. 2010, third edition.
2. Artificial Intelligence by Elaine Rich, Kevin Knight and Shivashankar B Nair, Tata McGraw Hill.

Reference Books:
1. Introduction to Artificial Intelligence and Expert Systems by Dan W. Patterson, Pearson Education.
2. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson
Education, 6th ed., 2009.
3. Artificial Intelligence – Patric Henry Winston – Third Edition, Pearson Education

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V Semester Syllabus
CS554PC: Data Mining Lab

Prerequisites:
- A course on "Database Management System".

Course Objectives

- The course is intended to obtain hands- on experience using data mining software.
- Intended to provide practical exposure of the concepts in data mining algorithms.

Course Outcomes

Students would be able to
- Apply preprocessing statistical methods for any given raw data.
- Implement various algorithms for data mining in order to discover interesting patterns from large amounts of data.

Experiments using Weka Tools/Python
1. Implement Data Pre-Processing Techniques:
2. Implementation of Attribute oriented induction algorithm
3. Implementation of apriori algorithm
4. Implementation of FP –Growth algorithm
5. Implementation of Decision Tree Induction
6. Calculating Information gain measures
7. Classification of data using Bayesian approach
8. Classification of data using K–Nearest Neighbour Approach
9. Implementation of K–means algorithm
10. Implementation of PAM (Partition Around Medoids) algorithm

Suggested Reading:
1. Data Mining–Concepts and Techniques - JIAWEIHAN & MICHELINE KAMBER, Elsevier.
2. Data Warehousing, DataMining & OLAP-AlexBerson and StephenJ.Smith-TataMc Graw-Hill Edition, Tenth reprint2007.

Reference Books:
1. Pang-NingTan, Michael Steinbach,VipinKumar,AnujKarpatne,Introduction to DataMining, Pearson Education.

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V Semester Syllabus

CS557PC: Computer Networks Lab
[*Common to CSE, CSBS, CSE (AI&ML) & CSE (DS)*]

Course Objectives

- To understand the working principle of various communication protocols.
- To understand the network simulator environment and visualize a network topology and observe its performance
- To analyze the traffic flow and the contents of protocol frames

Course Outcomes

Students would be able to
- Implement data link layer farming methods
- Analyze error detection and error correction codes.
- Implement and analyze routing and congestion issues in network design.
- Implement Encoding and Decoding techniques used in presentation layer.
- To be able to work with different network tools.

List of Experiments

1. Write a program to implement framing.
   i. Fixed framing, ii. Variable framings
2. Write a program to implement stuffing techniques.
   i. Bit-stuffing ii. Character stuffing
3. Write a program to implement checksum
4. Write a program to compute CRC code for the polynomial CRC-12
5. Develop a simple data link layer that performs the flow control using the sliding window protocol, and loss recovery using the Go-Back-N mechanism.
6. Write a program to implement classful addressing.
7. Write a program to implement classless addressing.
8. Write a program to implement Dijsktra's algorithm to compute the shortest path through a network
9. Write a program to divide a given network into n-sub networks.
10. Implement distance vector routing algorithm for obtaining routing tables at each node.
11. Write a program to implement Link state routing
12. Write a program for congestion control using Leaky bucket algorithm
13. Implement data encryption and data decryption.

Suggested Reading:

1. Computer Networks -- Andrew S Tanenbaum, David. j. Wetherall, 5th Edition. Pearson Education/PHI, 2011.
2. Data Communications and Networking – Behrouz A. Forouzan. Fifth Edition TMH, 2017..

Reference Books:

1. An Engineering Approach to Computer Networks-S. Keshav, 2nd Edition, Pearson Education
2. "Data and Computer Communications" by William Stallings 9 th Edition, Pearson Education 2010.
3. "TCP/IP Illustrated" by W. Richard Stevens,Addison-Wesley Professional; 2nd edition 2011..

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V Semester Syllabus

EN553HS: *Advanced Communication Skills Lab*
[Common to CSBS, CSE (AI&ML) & CSE (DS)]

Course Objectives:

This Lab focuses on using multi-media instruction for language development to meet the various needs of the students. The objectives of the course are as follows:
- To improve students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- To enable them to communicate their ideas relevantly and coherently in writing.
- To facilitate placement activities for the students.
- To make the students participate in both oral as well as written presentation skills.
- To equip the students to be efficient in Group Discussions, Presentation Skills and Interview Skills.

Course Outcomes:

Students will be able to:
- Acquire English language vocabulary and use it contextually
- Listen and speak effectively in English language
- Develop proficiency in academic reading and writing skills
- Increase possibilities of job prospects in their respective domain
- Communicate confidently in formal and informal contexts

INTRODUCTION:
Advanced English Communication Skills Lab is considered essential as the students need to prepare themselves for their careers which may require them to listen, speak, read and write in English both for their professional and interpersonal communication in the globalized context. This course would enable students to use English effectively and perform the following:
1. Gathering ideas and information to organize ideas relevantly and coherently.
2. Participating in group discussions.
3. Facing interviews.
4. Writing project/research reports/technical reports.
5. Making oral presentations.
6. Writing formal letters.
7. Transferring information from non-verbal to verbal texts and vice-versa.
8. Taking part in social and professional communication.

Unit – I
Inter-personal Communication – Building General, Technical and Business English Vocabulary – Formal meeting–planning and circulating agenda–opening the meeting–during the meeting–closing the meeting-responding appropriately and relevantly – using the right body   language-general-technical-business- vocabulary, analogy.

Unit – II
Reading Comprehension: Reading for facts-skimming-scanning-guessing meanings from context, inferring meaning, critical reading, effective online navigation, sample passages from TOEFL/GRE/IELTS.

Unit – III
Writing Skills: Planning for writing, structure and presentation of different types of writing - letter writing/resume writing, email netiquette, project report writing – feasible/business/ periodical/academic reports.

Unit – IV
Presentation Skills: Brief speeches-introduction to a structured talk– **o**ral presentations (individual and group) /PPTs, gambits of presentation skills – use of tag questions, summarising after a brief talk, opening/during/concluding a presentation.

Unit – V
Group Discussion and Interview Skills: Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation - concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and mock interviews.

Text Books:
1. Effective Technical Communication by M Ashraf Rizvi. McGraw Hill Education (India) Pvt. Ltd. 2nd Edition
2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5th Edition.

References:
1. Learn Correct English – A Book of Grammar, Usage and Composition by Shiv K. Kumar and
   Hemalatha Nagarajan. Pearson 2007
2. Professional Communication by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
3. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
4. Technical Communication by Paul V. Anderson. 2007. Cengage Learning Pvt. Ltd. New Delhi.
5. English Vocabulary in Use Series, Cambridge University Press 2008.
6. Handbook for Technical Communication by David A. Mc Murrey & Joanne Buckley, 2012,
    Cengage Learning.
7. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
8. Job Hunting by Colm Downes, Cambridge University Press 2008.
9. English for Technical Communication for Engineering Students, AyshaVishwamohan, Tata Mc Graw-Hill 2009.
10. How to Write and Speak Better, Reader's Digest, 2003
11. Cambridge IELTS 16 Academic student's book with answers, 2017
12. TOEFL Reading & Writing Workout, The Princeton Review.
13. GRE Reading Comprehension: Detailed Solutions to 325 questions. Vibrant Publishers, 2017
14. How to prepare for Group Discussions and Interviews by Harimohan Prasad and Rajneesh Prasad,
     TataMcgrawHill.
15. Keep Talking, Frederick Klippel, Cambridge University Press, South Asian edition (6 May 2010),
16. Objective English, Edgar Thorpe & Showick Thorpe, Pearson; 5th edition (1 August 2013).

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V Semester Syllabus

MC501HS: Intellectual Property Rights
[*Common to CSE, CSBS, CSE (AI&ML) & CSE (DS)*]

Course Objectives: The objectives of the course are:

- To enable the students to have an overview of Intellectual Property Rights
- To provide comprehensive knowledge to the students regarding Trademarks Registration process and law related to it.
- To disseminate knowledge on Copyrights, its related rights and recent developments.
- To make the studentsunderstand Patent Regime in India and abroad.
- To understand the framework of Trade secrets

Course Outcomes: After completion of the course students will be able to:

- Gain knowledge on Intellectual property rights and their importance.
- Understand Indian and international Trademark Law and procedure for registration of Trademarks.
- Acquire knowledge on Copyright Law, and the privileges awarded to the copyright owners.
- Familiarized with the process of acquiring the patent and relevant laws.
- Learn the importance of trade secrets for business sustainability.

UNIT – I

Introduction to Intellectual property

Introduction of IPR-Meaning of intellectual property, types of intellectual property-trademarks, copyrights, patents, trade secrets, importance of intellectual property rights, International organizations-WTO-WIPO-USPTO-INTA, International Conventions, agencies and treaties- Paris Convention-Berne Convention- Madrid Protocol-NAFTA-PCT-GATT-TRIPS.

UNIT – II

Trademarks

Trademarks: Purpose and functions of Trademarks-Categories of marks, acquisition of Trademark rights - Protectable matter - Selecting and evaluating Trademark- Trademarks registration process – Trademark Infringement - Remedies for infringement in Trademarks-New developments in Trademark Law- International Trademarks Law.

UNIT III

Copyright

Copyrights-Fundamental of Copyright Law -Requirements of Copyrightability- Originality of material, fixation of material, Authorship works, exclusions from copyright protection- Rights of Copyright Owner-Right of reproduction of copyrighted work, right to do derivative works ,right to distribute copies of the copyrighted work, right to perform the work publicly, right to display the copyrighted work, – Copyright Ownership issues – Joint Works, Works made for Hire, Specially commissioned works, Copyright Registration - Notice of Copyright – Copyright Infringement -

Remedies for infringement in Copyrights- New developments in Copyright Law- International Copyright Law.

UNIT IV:

Patents

Patents: Concept of Patent - Classification – Utility Patents – Design Patents and Plant Patents, Patent searching process-Types of Patent Applications-Patent Registration Process, Ownership, Transfer, Assignment and Licensing of Patent-Patent Infringement, Remedies for Infringement of Patents, New developments in Patent Law- International Patent Law.

UNIT – V:

Trade Secrets & Law of Unfair Competition

Trade Secrets: Trade secret law, determination of trade secrete status, measures for protecting trade secret status-Liability for misappropriations of trade secrets, protection for submissions, trade secret litigation. New developments in Trade secrets Law- International Trade Secrets.

Law of Unfair competition: Passing off, Misappropriation, right of publicity, dilution of trademarks, product disparagement, false advertising.

Text Books:

1. Deborah. E. Bouchoux, Intellectual property, 4 e,Cengage learning India Pvt.Ltd., 2013
2. Prabuddha Ganguli, Intellectual property right, 8e,Tata McGraw Hill Publishing company, 2016
3. Dr.B.L.Wadehra, Law Relating to Intellectual Property,5 e, Universal Law Publishing Co. 2011.

References
1. Richard Stim, Intellectual Property, 3e Cengage learning India Pvt.Ltd., 2017
2. Vinod.V.Sopele, Asoka K.Ghosh,Managing Intellectual Property, 2 e,2010
3. Ananth Padmanabhan, Intellectual Property Rights – Infringement and Remedies, Lexis Nexis Publishers, 2012

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Computer Science & Engineering (Data Science)
Scheme of Instruction and Examination
(Choice Based Credit System)

For the batches to be admitted with effect from the academic year 2021-22

VI Semester

S.No.	Course Code	Course Title	Instruction			Examination			Credits
			Hours Per Week			Max. Marks		Duration of SEE in Hours	
			L	T	P/D	CIE	SEE		
1	CS608PC	Machine Learning	3	1	0	30	70	3	4
2	CS610PC	Big Data Analytics	3	1	0	30	70	3	4
3	CS611PC	Language Processorꜱ	3	1	0	30	70	3	4
4	--	Professional Elective – III	3	0	0	30	70	3	3
5	--	Open Elective - I	2	0	0	30	70	3	2
6	MC602ES	Cyber Security	3	0	0	30	70	3	0
7	CS651PC	Machine Learning Lab	0	0	3	30	70	3	1.5
8	CS656PC	Big Data Analytics Lab	0	0	3	30	70	3	1.5
9	--	Professional Elective - III Lab	0	0	2	30	70	3	1
10	MA654BS	Finishing Schools-IV (Quantitative Aptitude & Analytical Ability)	0	0	2	30	70	3	1
	Total Hours/Marks/Credits		17	3	10	300	700	-	22
11	MC601ESC	Environmental Science (For Lateral Entry Students)	3	0	0	30	70	3	0

L: Lecture **T**: Tutorial **D**: Drawing **P**: Practical **CIE** - Continuous Internal Evaluation **SEE** - Semester End Examination

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VI Semester Syllabus
CS608PC: Machine Learning

Prerequisites
1. Data Structures.
2. Knowledge on statistical methods.

Course Objectives

- This course explains machine learning techniques such as decision tree learning, Bayesian learning etc.
- To understand computational learning theory.
- To study the pattern comparison techniques.

Course Outcomes

Students would be able to

- Understand the concepts of computational intelligence like machine learning.
- Ability to get the skill to apply machine learning techniques to address the real time problems in different areas.
- Understand the Neural Networks and its usage in machine learning application

UNIT - I
Introduction - Well-posed learning problems, designing a learning system, Perspectives and issues in machine learning.
Concept learning and the general to specific ordering – introduction, a concept learning task, concept learning as search, find-S: finding a maximally specific hypothesis, version spaces and the candidate elimination algorithm, remarks on version spaces and candidate elimination, inductive bias**.**
Decision Tree Learning – Introduction, decision tree representation, appropriate problems for decision tree learning, the basic decision tree learning algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning.

UNIT - II
Artificial Neural Networks-1– Introduction, neural network representation, appropriate problems for neural network learning, perceptions, multilayer networks and the back-propagation algorithm.
Artificial Neural Networks-2- Remarks on the Back-Propagation algorithm, An illustrative example: face recognition, advanced topics in artificial neural networks.
Evaluation Hypotheses – Motivation, estimation hypothesis accuracy, basics of sampling theory, a general approach for deriving confidence intervals, difference in error of two hypotheses, comparing learning algorithms.

UNIT - III
Bayesian learning – Introduction, Bayes theorem, Bayes theorem and concept learning, Maximum Likelihood and least squared error hypotheses, maximum likelihood hypotheses for predicting probabilities, minimum description length principle, Bayes optimal classifier, Gibs algorithm, Naïve Bayes classifier, an example: learning to classify text, Bayesian belief networks, the EM algorithm.
Computational learning theory – Introduction, probably learning an approximately correct hypothesis, sample complexity for finite hypothesis space, sample complexity for infinite hypothesis spaces, the mistake bound model of learning.
Instance-Based Learning- Introduction, *k*-nearest neighbour algorithm, locally weighted regression, radial basis functions, case-based reasoning, remarks on lazy and eager learning.

UNIT- IV
Genetic Algorithms – Motivation, Genetic algorithms, an illustrative example, hypothesis space search, genetic programming, models of evolution and learning, parallelizing genetic algorithms.

Learning Sets of Rules – Introduction, sequential covering algorithms, learning rule sets: summary, learning First-Order rules, learning sets of First-Order rules: FOIL, Induction as inverted deduction, inverting resolution.
Reinforcement Learning – Introduction, the learning task, Q–learning, non-deterministic, rewards and actions, temporal difference learning, generalizing from examples, relationship to dynamic programming.

UNIT - V
Analytical Learning-1- Introduction, learning with perfect domain theories: PROLOG-EBG, remarks on explanation-based learning, explanation-based learning of search control knowledge.
Analytical Learning-2-Using prior knowledge to alter the search objective, using prior knowledge to augment search operators.
Combining Inductive and Analytical Learning – Motivation, inductive-analytical approaches to learning, using prior knowledge to initialize the hypothesis.

TEXT BOOK:
- Machine Learning – Tom M. Mitchell, - MGH.

REFERENCE BOOK:
- Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis.

L	T	P	C
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VI Semester Syllabus
CS610PC: Big Data Analytics

Prerequisites

Course Objectives:

- The purpose of this course is to provide the students with the knowledge of Big data Analytics principles and techniques.
- This course is also designed to give an exposure of the frontiers of Big data Analytics

Course Outcomes

Students would be able to
- Ability to explain the foundations, definitions, and challenges of Big Data and various Analytical tools.
- Ability to program using HADOOP and Map reduce, NOSQL
- Ability to understand the importance of Big Data in Social Media and Mining.

UNIT - I
Introduction to Big Data: Big Data and its Importance – Four V's of Big Data – Drivers for Big Data – Introduction to Big Data Analytics – Big Data Analytics applications.

UNIT - II
Big Data Technologies: Hadoop's Parallel World – Data discovery – Open source technology for Big Data Analytics – cloud and Big Data –Predictive Analytics – Mobile Business Intelligence and Big Data

UNIT - III
Introduction Hadoop: Big Data – Apache Hadoop & Hadoop Eco System – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce - Data Serialization.

UNIT - IV
Hadoop Architecture: Hadoop: RDBMS Vs Hadoop, Hadoop Overview, Hadoop distributors, HDFS, HDFS Daemons, Anatomy of File Write and Read., Name Node, Secondary Name Node, and Data Node, HDFS Architecture, Hadoop Configuration, Map Reduce Framework, Role of HBase in Big Data processing, HIVE, PIG.

UNIT - V
Data Analytics with R Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering, Social Media Analytics, Mobile Analytics, Big Data Analytics with BigR.

TEXT BOOKS:
1. Big Data Analytics, Seema Acharya, Subhasini Chellappan, Wiley 2015.
2. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business, Michael Minelli, Michehe Chambers, 1st Edition, Ambiga Dhiraj, Wiely CIO Series, 2013.
3. Hadoop: The Definitive Guide, Tom White, 3rd Edition, O"Reilly Media, 2012.
4. Big Data Analytics: Disruptive Technologies for Changing the Game, Arvind Sathi, 1st Edition, IBM Corporation, 2012.

REFERENCE BOOKS:
1. Big Data and Business Analytics, Jay Liebowitz, Auerbach Publications, CRC press (2013)
2. Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop, Tom Plunkett, Mark Hornick, McGraw-Hill/Osborne Media (2013), Oracle press.
3. Professional Hadoop Solutions, Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, Wiley, ISBN: 9788126551071, 2015.
4. Understanding Big data, Chris Eaton, Dirk deroos et al. McGraw Hill, 2012.
5. Intelligent Data Analysis, Michael Berthold, David J. Hand, Springer, 2007.
6. Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, Bill Franks, 1st Edition, Wiley and SAS Business Series, 2012

L	T	P	C
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VI-Semester Syllabus
CS611PC: Language Processors

Course Objectives:

- To understand the various phases in the design of a compiler.
- To understand the design of top-down and bottom-up parsers.
- To understand syntax directed translation schemes.
- To introduce lex and yacc tools.
- To learn to develop algorithms to generate code for a target machine.

Course Outcomes:

- Ability to design, develop, and implement a compiler for any language.
- Able to use lex and yacc tools for developing a scanner and a parser.
- Able to design and implement LL and LR parsers.
- Able to design algorithms to perform code optimization in order to improve the performance of a program in terms of space and time complexity.
- Ability to design algorithms to generate machine code.

UNIT – I
Introduction: Language Processors, The Structure of a compiler, Phases of Compilation, Language Processing System, the Science of building a compiler, Applications of Compiler Technology, Programming language basics.

Lexical Analysis: The Role of the Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, The Lexical-Analyzer Generator Lex, Design of a Lexical-Analyzer Generator, Optimization of DFA-Based Pattern Matchers, Error Recovery in Lexical Analysis.

UNIT – II
Syntax Analysis: Introduction, writing a Grammar- Lexical Versus Syntactic Analysis, Eliminating Ambiguity, Elimination of Left Recursion, Left Factoring. Top-Down Parsing -Problems of Top-down Parsing, Recursive descent Parsing, FIRST and FOLLOW, LL(1) Grammar, Non-Recursive Predictive Parsing, Error Recovery in Predictive Parsing.

Bottom-Up Parsing: Introduction to LR Parsing: Shift Reduce Parsing, Operator Precedence Grammar, Simple LR, Canonical LR, Look Ahead LR, Construction of Parsing Table and Error Recovery in Bottom-up Parsers, Using Ambiguous Grammars, Parser Generators-YACC.

UNIT – III
Syntax-Directed Translation: Syntax-Directed Definitions, Evaluation Orders for SDD's, Applications of Syntax-Directed Translation, Syntax-Directed Translation Schemes, and Implementing L-Attributed SDD's.

Intermediate-Code Generation: Variants of Syntax Trees, Three-Address Code, Three-Address Code Representations – Triples, Quadruples, Indirect Triples. Conversion of Popular Programming Languages Constructs into Three-Address Code, Types and Declarations, Translation of Expressions, Type Checking, Control Flow, Back Patching.

UNIT – IV
Run-Time Environments: Storage organization, Stack Allocation of Space, Access to Nonlocal Data on the Stack, Heap Management, Introduction to Garbage Collection, Mark-and-sweep Garbage Collection Algorithm, Introduction to Trace-Based Collection.

Code Generation: Object Code Forms**,** Machine Dependent Code Optimization, DAG Representation of Basic Blocks, Optimization of Intermediate Code by DAG, Issues in the Design of a Simple Code Generator, The Target Language, addresses in the Target Code, Code Generation Algorithm, Code Generation by DAG, Peephole Optimization, Register Allocation and Assignment.

UNIT – V

Machine-Independent Optimizations: The Principal Sources of Optimization, Introduction to Data-Flow Analysis, Constant Folding, Copy Propagation, Dead Code Elimination, Algebraic Transformation,Strength reduction, Common Sub Expression Elimination. Loop Optimization Techniques – Loop Invariant Code Motion, Strength Reduction on induction variable, Loop Unrolling.

Basic Blocks and Flow Graphs: Local Optimization, Global Optimization, Data Flow Properties: Available Expressions, Reaching Definition, Live Variable Analysis.

TEXT BOOKS
1. Compilers: Principles, Techniques and Tools, Second Edition, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman, Pearson Education, 2011.
2. Principles of Compiler Design by V Raghavan Mcgraw Hill Education, 2017.

REFERENCE BOOKS
1. Compiler Construction-Principles and Practice, Kenneth C Louden, CengageLearning, 1970.
2. The Theory and Practice of Compiler writing, J.P. Tremblay and P.G.Sorenson, TMH, 1985.
3. Writing compilers and interpreters, R. Mak, 3rd edition, Wiley student edition.
4. lex & yacc – John R. Levine, Tony Mason, Doug Brown, O'reilly, 1992.

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VI Semester Syllabus

CS622PE: Mobile Application Development (Professional Elective–III)
(Common to CSBS, CSE (AI & ML) & CSE (Data Science))

Prerequisites:
1. Acquaintance with JAVA programming.
2. A Course on DBMS.

Course Objectives

- To demonstrate their understanding of the fundamentals of Android operating systems
- To improves their skills of using Android software development tools
- To demonstrate their ability to develop software with reasonable complexity on mobile platform
- To demonstrate their ability to deploy software to mobile devices
- To demonstrate their ability to debug programs running on mobile devices

Course Outcomes

Students would be able to

- Student understands the working of Android OS Practically.
- Student will be able to develop Android user interfaces
- Student will be able to develop, deploy and maintain the Android Applications.

UNIT - I
Introduction to Android Operating System: Android OS design and Features – Android development framework, SDK features, Installing and running applications on Android Studio, Creating AVDs, Types of Android applications, Best practices in Android programming, Android tools
Android application components – Android Manifest file, Externalizing resources like values, themes, layouts, Menus etc, Resources for different devices and languages, Runtime Configuration Changes Android Application Lifecycle – Activities, Activity lifecycle, activity states, monitoring state changes

UNIT - II
Android User Interface: Measurements – Device and pixel density independent measuring UNIT - s Layouts – Linear, Relative, Grid and Table Layouts
User Interface (UI) Components – Editable and non-editable Text-Views, Buttons, Radio and Toggle Buttons, Checkboxes, Spinners, Dialog and pickers
Event Handling – Handling clicks or changes of various UI components
Fragments – Creating fragments, Lifecycle of fragments, Fragment states, Adding fragments to Activity, adding, removing and replacing fragments with fragment transactions, interfacing between fragments and Activities, Multi-screen Activities

UNIT - III
Intents and Broadcasts: Intent – Using intents to launch Activities, Explicitly starting new Activity, Implicit Intents, Passing data to Intents, Getting results from Activities, Native Actions, using Intent to dial a number or to send SMS
Broadcast Receivers – Using Intent filters to service implicit Intents, Resolving Intent filters, finding and using Intents received within an Activity
Notifications – Creating and Displaying notifications, Displaying Toasts

UNIT - IV
Persistent Storage: Files – Using application specific folders and files, creating files, reading data from files, listing contents of a directory Shared Preferences – Creating shared preferences, saving and retrieving data using Shared Preference

UNIT - V
Database – Introduction to SQLite database, creating and opening a database, creating tables, inserting retrieving and etindelg data, Registering Content Providers, Using content Providers (insert, delete, retrieve and update)

TEXT BOOKS:
1. Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox), 2012.
2. Android Application Development for Java Programmers, James C Sheusi, Cengage Learning, 2013.

REFERENCE BOOK:
1. Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013.

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VI Semester Syllabus

CS624PE: Cryptography and Network Security (Professional Elective–III)
(Common to CSE (AI & ML) & CSE (Data Science))

Course Objectives

- Explain the objectives of information security.
- Explain the importance and application of each of confidentiality, integrity, authentication and availability.
- Understand various cryptographic algorithms.
- Understand the basic categories of threats to computers and networks.
- Describe public-key cryptosystem.
- Describe the enhancements made to IPv4 by IPSec.
- Understand Intrusions and intrusion detection.
- Discuss the fundamental ideas of public-key cryptography.
- Generate and distribute a PGP key pair and use the PGP package to send an encrypted e- mail message.
- Discuss Web security and Firewalls.

Course Outcomes

Students would be able to
- Student will be able to understand basic cryptographic algorithms, message and web authentication and security issues.
- Ability to identify information system requirements for both of them such as client and server.
- Ability to understand the current legal issues towards information security.

UNIT - I
Security Concepts: Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security.
Cryptography Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.

UNIT - II
Symmetric key Ciphers: Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4.
Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie-Hellman Key Exchange, Knapsack Algorithm.

UNIT - III
Cryptographic Hash Functions: Message Authentication, Secure Hash Algorithm (SHA-512), **Message authentication codes:** Authentication requirements, HMAC, CMAC, Digital signatures, Elgamal Digital Signature Scheme.
Key Management and Distribution: Symmetric Key Distribution Using Symmetric & Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure.

UNIT - IV
Transport-level Security: Web security considerations, Secure Socket Layer and Transport Layer Security, HTTPS, Secure Shell (SSH).
Wireless Network Security: Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN, IEEE 802.11i Wireless LAN Security.

UNIT - V
E-Mail Security: Pretty Good Privacy, S/MIME **IP Security:** IP Security overview, IP Security architecture, Authentication Header, Encapsulating security payload, Combining security associations, Internet Key Exchange.
Case Studies on Cryptography and security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability.

TEXT BOOKS:
1. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 6th Edition.
2. Cryptography and Network Security: Atul Kahate, Mc Graw Hill, 3rd Edition.

REFERENCE BOOKS:
1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, Mc Graw Hill, 3rd Edition.
3. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH.
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning.
6. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning.

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VI Semester Syllabus
CS625PE: Data Visualization Techniques (Professional Elective –III)

Prerequisites:

Course Objectives

- To understand various data visualization techniques.

Course Outcomes

- Students would be able to
- Visualize the objects in different dimensions.
- Design and process the data for Virtualization.
- Apply the visualization techniques in physical sciences, computer science, applied mathematics and medical science.
- Apply the virtualization techniques for research projects. (K1, K3).

UNIT - I
Introduction and Data Foundation: Basics - Relationship between Visualization and Other Fields - The Visualization Process - Pseudo code Conventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Preprocessing - Data Sets

UNIT - II
Foundations for Visualization: Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables - Historical Perspective - Taxonomies - Experimental Semiotics based on Perception Gibson's Affordance theory – A Model of Perceptual Processing.

UNIT - III
Visualization Techniques: Spatial Data: One-Dimensional Data - Two-Dimensional Data – Three- Dimensional Data - Dynamic Data - Combining Techniques. **Geospatial Data:** Visualizing Spatial Data
- Visualization of Point Data -Visualization of Line Data - Visualization of Area Data - Other Issues in Geospatial Data Visualization **Multivariate Data:** Point-Based Techniques - Line- Based Techniques - Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures – Graphics and Networks-Displaying Arbitrary Graphs/Networks.

UNIT - IV
Interaction Concepts and Techniques: Text and Document Visualization: Introduction - Levels of Text Representations - The Vector Space Model - Single Document Visualizations -Document Collection Visualizations - Extended Text Visualizations **Interaction Concepts**: Interaction Operators - Interaction Operands and Spaces - A Unified Framework. **Interaction Techniques**: Screen Space - Object-Space -Data Space -Attribute Space- Data Structure Space - Visualization Structure - Animating Transformations -Interaction Control

UNIT - V
Research Directions in Virtualizations: Steps in designing Visualizations – Problems in designing effective Visualizations- Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues of System Design Evaluation, Hardware and Applications.

TEXT BOOKS:
1. Matthew Ward, Georges Grinstein and Daniel Keim, "Interactive Data Visualization Foundations, Techniques, Applications", 2010.
2. Colin Ware, "Information Visualization Perception for Design", 2nd edition, Margon Kaufmann Publishers, 2004.

REFERENCE BOOKS:
1. Robert Spence "Information visualization – Design for interaction", Pearson Education, 2nd Edition, 2007.
2. Alexandru C. Telea, "Data Visualization: Principles and Practice," A. K. Peters Ltd, 2008.

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VI Semester Syllabus
CS626PE: Scripting Languages (Professional Elective–III)

Prerequisites:
- A course on "Computer Programming and Data Structures".
- A course on "Object Oriented Programming Concepts".

Course Objectives

- This course introduces the script programming paradigm.
- Introduces scripting languages such as Perl, Ruby and TCL.
- Learning TCL

Course Outcomes

Students would be able to
- Comprehend the differences between typical scripting languages and typical system and application programming languages.
- Gain knowledge of the strengths and weakness of Perl, TCL and Ruby; and select an appropriate language for solving a given problem.
- Acquire programming skills in scripting language.

UNIT - I
Introduction: Ruby, Rails, The structure and Execution of Ruby Programs, Package Management with RUBYGEMS, Ruby and web: Writing CGI scripts, cookies, Choice of Webservers, SOAP and web services
RubyTk – Simple Tk Application, widgets, Binding events, Canvas, scrolling

UNIT - II
Extending Ruby: Ruby Objects in C, the Jukebox extension, Memory allocation, Ruby Type System, Embedding Ruby to Other Languages, Embedding a Ruby Interpreter

UNIT - III
Introduction to PERL and Scripting
Scripts and Programs, Origin of Scripting, Scripting Today, Characteristics of Scripting Languages, Uses for Scripting Languages, Web Scripting, and the universe of Scripting Languages. PERL- Names and Values, Variables, Scalar Expressions, Control Structures, arrays, list, hashes, strings, pattern and regular expressions, subroutines.

UNIT - IV
Advanced PERL
Finer points of looping, pack and unpack, file system, eval, data structures, packages, modules, objects, interfacing to the operating system, Creating Internet ware applications, Dirty Hands Internet Programming, security Issues.

UNIT - V
TCL
TCL Structure, syntax, Variables and Data in TCL, Control Flow, Data Structures, input/output, procedures, strings, patterns, files, Advance TCL- eval, source, exec and up-level commands, Name spaces, trapping errors, event driven programs, making applications internet aware, Nuts and Bolts Internet Programming, Security Issues, C Interface.

Tk
Tk-Visual Tool Kits, Fundamental Concepts of Tk, Tk by example, Events and Binding, Perl-Tk.

TEXT BOOKS:
1. The World of Scripting Languages, David Barron, Wiley Publications.
2. Ruby Programming language by David Flanagan and Yukihiro Matsumoto O'Reilly
3. "Programming Ruby" The Pramatic Programmers guide by Dabve Thomas Second edition

REFERENCE BOOKS:
1. Open Source Web Development with LAMP using Linux Apache, MySQL, Perl and PHP, J. Lee and B. Ware (Addison Wesley) Pearson Education.
2. Perl by Example, E. Quigley, Pearson Education.
3. Programming Perl, Larry Wall, T. Christiansen and J. Orwant, O'Reilly, SPD.
4. Tcl and the Tk Tool kit, Ousterhout, Pearson Education.
5. Perl Power, J. P. Flynt, Cengage Learning

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VI-Semester
MC602ES: CYBER SECURITY
(Common to all Branches)

Prerequisites: NIL
Course objectives:
- To familiarize various types of cyber-attacks and cyber-crimes
- To give an overview of the cyber laws
- To study the defensive techniques against these attacks

Course Outcomes:

The students will be able

- To understand various cyber-attacks and cybercrimes.
- Knowledge about cyberlaws and cyber forensics.
- Summarize cyber crimes in mobile and wireless devices, how to protect them
- Knowledge about IPR issues in cyber space and cyber terrorism.

UNIT - I

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, IP spoofing, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Comprehensive Cyber Security Policy.

UNIT - II

Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

UNIT - III

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations.

UNIT- IV

Cyber Security: Organizational Implications: Introduction cost of cybercrimes and IPR issues, webthreats for organizations, security and privacy implications, social media marketing.

Cybercrime and Cyber terrorism: Introduction, intellectual property in the cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.

UNIT - V

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc.

TEXT BOOKS:

1. Nina God bole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley, India 2012.
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

REFERENCES:

1. Mark F. Grady, Fransesco Parisi, " The Law and Economics of Cyber security", Cambridge University Press,2006.
2. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press, 2016.
3. Introduction to Cyber Security, Chwan - Hwa (john) Wu, J. David Irwin, CRC Press T&F Group.

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VI Semester Syllabus
CS651PC: Machine Learning Lab
(Common to CSE, CSE (Data Science))

Course Objectives

- The objective of this lab is to get an overview of the various machine learning techniques and can able to demonstrate them using python.

Course Outcomes

- Students would be able to
- understand complexity of Machine Learning algorithms and their limitations;
- understand modern notions in data analysis-oriented computing;
- be capable of confidently applying common Machine Learning algorithms in practice and implementing their own;
- Be capable of performing experiments in Machine Learning using real-world data.

List of Experiments

1. Write a program to demonstrate the following in python Numpy: Indexing, Array, Slicing.
2. Write a program to demonstrate the following in python Pandas: Series, DataFrames,read .csv files, analyzing data
3. Write a program to demonstrate the following in python Matplotlib :pyplot, markers,line, labels, grid, subplots
4. 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
5. Implement Random forest classification in python.
6. Implement k-nearest neighbour classification using python.
7. Implement linear regression using python.
8. Implement Naïve Bayes theorem to classify the English text.
9. Implement an algorithm to demonstrate the significance of genetic algorithm.
10. Implement the finite words classification system using Back-propagation algorithm.

TEXT BOOKS

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson.

2. Python Machine Learning, Sebastian Raschka, PACKT publishing, 2015

REFERENCES

1. Machine Learning – Tom M. Mitchell, - MGH, 1997

2. Pattern recognition and Machine Learning, C. M. Bishop, Springer, 2007.
3. Introduction to Machine Learning, E. Alpaydin, MIT Press, 3rd Edition, 2014

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VI Semester Syllabus
CS656PC: Big Data Analytics Lab

Course Objectives

- The purpose of this course is to provide the students with the knowledge of Big data Analytics principles and techniques.
- This course is also designed to give an exposure of the frontiers of Big data Analytics

Course Outcomes

Students would be able to

- Use Excel as an Analytical tool and visualization tool.
- Ability to program using HADOOP and Map reduce.
- Ability to perform data analytics using ML in R.
- Use cassandra to perform social media analytics.

List of Experiments:

1. Implement a simple map-reduce job that builds an inverted index on the set of input documents (Hadoop)
2. Process big data in HBase
3. Store and retrieve data in Pig
4. Perform Social media analysis using cassandra
5. Buyer event analytics using Cassandra on suitable product sales data.
6. Using Power Pivot (Excel) Perform the following on any dataset
    a) Big Data Analytics
    b) Big Data Charting
7. Use R-Project to carry out statistical analysis of big data
8. Use R-Project for data visualization of social media data

TEXT BOOKS:

1. Big Data Analytics, Seema Acharya, Subhashini Chellappan, Wiley 2015.
2. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business, Michael Minelli, Michehe Chambers, 1st Edition, Ambiga Dhiraj, Wiely CIO Series, 2013.
3. Hadoop: The Definitive Guide, Tom White, 3rd Edition, O"Reilly Media, 2012.
4. Big Data Analytics: Disruptive Technologies for Changing the Game, Arvind Sathi, 1st Edition, IBM Corporation, 2012.

REFERENCE BOOKS:

1. Big Data and Business Analytics, Jay Liebowitz, Auerbach Publications, CRC press (2013).
2. Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop, Tom Plunkett, Mark Hornick, McGraw-Hill/Osborne Media (2013), Oracle press.
3. Professional Hadoop Solutions, Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, Wiley, ISBN: 9788126551071, 2015.
4. Understanding Big data, Chris Eaton, Dirk deroos et al., McGraw Hill, 2012.
5. Intelligent Data Analysis, Michael Berthold, David J. Hand, Springer, 2007.
6. Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, Bill Franks,   1st   Edition,   Wiley   and   SAS   Business   Series,   2012.

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VI Semester Syllabus
CS666PE: Mobile Application Development Lab (PE -III Lab)
(Common to CSE (AI&ML) & CSE (Data Science))

Course Objectives

- To learn how to develop Applications in android environment.
- To learn how to develop user interface applications.
- To learn how to develop URL related applications.

Course Outcomes

Students would be able to
- Students understand the working of Android OS Practically.
- Students will be able to develop user interfaces.
- Students will be able to develop, deploy and maintain the Android Applications.

List of Experiments:

1. Create an Android application that shows Hello + name of the user and run it on an emulator. (b) Create an application that takes the name from a text box and shows hello message along with the name entered in text box, when the user clicks the OK button.
2. Create a screen that has input boxes for User Name, Password, Address, Gender (radio buttons for male and female), Age (numeric), Date of Birth (Date Picket), State (Spinner) and a Submit button. On clicking the submit button, print all the data below the Submit Button. Use (a) Linear Layout (b) Relative Layout and (c) Grid Layout or Table Layout.
3. Develop an application that shows names as a list and on selecting a name it should show the details of the candidate on the next screen with a "Back" button. If the screen is rotated to landscape mode (width greater than height), then the screen should show list on left fragment and details on right fragment instead of second screen with back button. Use Fragment transactions and Rotation event listener.
4. Develop an application that uses a menu with 3 options for dialing a number, opening a website and to send an SMS. On selecting an option, the appropriate action should be invoked using intents.
5. Develop an application that inserts some notifications into Notification area and whenever a notification is inserted, it should show a toast with details of the notification.
6. Create an application that uses a text file to store usernames and passwords (tab separated fields and one record per line). When the user submits a login name and password through a screen, the details should be verified with the text file data and if they match, show a dialog saying that login is successful. Otherwise, show the dialog with a Login Failed message.
7. Create a user registration application that stores the user details in a database table.
8. Create a database and a user table where the details of login names and passwords are stored. Insert some names and passwords initially. Now the login details entered by the user should be verified with the database and an appropriate dialog should be shown to the user.
9. Create an admin application for the user table, which shows all records as a list and the admin can select any record for edit or modify. The results should be reflected in the table.
10. Develop an application that shows all contacts of the phone along with details like name, phone number, mobile number etc.
11. Create an application that saves user information like name, age, gender etc. in shared preference and retrieves them when the program restarts.
12. Create an alarm that rings every Sunday at 8:00 AM. Modify it to use a time picker to set alarm time.
13. Create an application that shows the given URL (from a text field) in a browser

TEXT BOOKS:
1.   Professional Android 4 Application Development, Reto Meier, Wiley India, (Wrox), 2012.
2.   Android Application Development for Java Programmers, James C Sheusi, Cengage Learning, 2013.

REFERENCE BOOK:
1.   Beginning Android 4 Application Development, Wei-Meng Lee, Wiley India (Wrox), 2013.

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VI Semester Syllabus

CS668PE: Cryptography and Network Security Lab (PE–III Lab)
(Common to CSE (AI&ML), CSE (Data Science))

Prerequisites:

Course Objectives

- Explain the objectives of information security.
- Explain the importance and application of each of confidentiality, integrity, authentication and availability.
- Understand various cryptographic algorithms.

Course Outcomes

Students would be able to

- Understand basic cryptographic algorithms, message and web authentication and security issues.
- Identify information system requirements for both of them such as client and server.
- Understand the current legal issues towards information security.

List of Experiments:
1. Write a C program that contains a string (char pointer) with a value 'Hello world'. The program should XOR each character in this string with 0 and displays the result.
2. Write a C program that contains a string (char pointer) with a value 'Hello world'. The program should AND or and XOR each character in this string with 127 and display the result.
3. Write a Java program to perform encryption and decryption using the following algorithms
   a.   Ceaser cipher b. Substitution cipher c. Hill Cipher
4. Write a C/JAVA program to implement the DES algorithm logic.
5. Write a C/JAVA program to implement the Blowfish algorithm logic.
6. Write a C/JAVA program to implement the Rijndael algorithm logic.
7. Write the RC4 logic in Java Using Java cryptography; encrypt the text "Hello world" using Blowfish. Create your own key using Java key tool.
8. Write a Java program to implement RSA algorithm.
9. Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript.
10. Calculate the message digest of a text using the SHA-1 algorithm in JAVA.
11. Calculate the message digest of a text using the MD5 algorithm in JAVA.

TEXT BOOKS:
1. Cryptography and Network Security - Principles and Practice: William Stallings, Pearson Education, 6th Edition.
2. Cryptography and Network Security: Atul Kahate, McGraw Hill, 3rd Edition.

REFERENCE BOOKS:
1. Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, 1st Edition.
2. Cryptography and Network Security: Forouzan Mukhopadhyay, McGraw Hill, 3rd Edition.
3. Information Security, Principles, and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: WM. Arthur Conklin, Greg White, TMH.
5. Introduction to Network Security: Neal Krawetz, CENGAGE Learning.
6. Network Security and Cryptography: Bernard Menezes, CENGAGE Learning.
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VI Semester Syllabus
CS669PE: Data Visualization Techniques Lab (PE–III Lab)

Course Objectives

- Understand the various types of data, apply and evaluate the principles of data visualization.
- Acquire skills to apply visualization techniques to a problem and its associated dataset.

Course Outcomes

- Students would be able to
- Identify the different data types, visualization types to bring out the insight.
- Relate the visualization towards the problem based on the dataset to analyze and bring out valuable insight on a large dataset.
- Demonstrate the analysis of a large dataset using various visualization techniques and tools.
- Identify the different attributes and showcasing them in plots. Identify and create various visualizations for geospatial and table data.
- Ability to create and interpret plots using R/Python.

List of Experiments:
1. Acquiring and plotting data.
2. Statistical Analysis – such as Multivariate Analysis, PCA, LDA, Correlation regression and analysis of variance.
3. Financial analysis using Clustering, Histogram and HeatMap.
4. Time-series analysis – stock market.
5. Visualization of various massive dataset - Finance - Healthcare - Census – Geospatial.
6. Visualization on Streaming dataset (Stock market dataset, weather forecasting).
7. Market-Basket Data analysis-visualization.
8. Text visualization using web analytics.

TEXT BOOKS:
1. Matthew Ward, Georges Grinstein and Daniel Keim, "Interactive Data Visualization Foundations, Techniques, Applications", 2010.
2. Colin Ware, "Information Visualization Perception for Design", 2nd edition, Margon Kaufmann Publishers, 2004.

REFERENCE BOOKS:
1. Robert Spence "Information visualization – Design for interaction", Pearson Education, 2nd Edition, 2007.
2. Alexandru C. Telea, "Data Visualization: Principles and Practice," A. K. Peters Ltd, 2008.

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VI Semester Syllabus
CS670PE: Scripting Languages Lab (PE–III Lab)

Prerequisites:
- Any High-level programming language (C, C++).

Course Objectives

- To Understand the concepts of scripting languages for developing web-based projects
- To understand the applications the of Ruby, TCL, Perl scripting languages

Course Outcomes

- Students would be able to
- Ability to understand the differences between Scripting languages and programming languages
- Able to gain some fluency programming in Ruby, Perl, TCL

List of Experiments:
1. Write a Ruby script to create a new string which is n copies of a given string where n is a non- negative integer
2. Write a Ruby script which accept the radius of a circle from the user and compute the parameter and area.
3. Write a Ruby script which accept the user's first and last name and print them in reverse order with a space between them
4. Write a Ruby script to accept a filename from the user print the extension of that
5. Write a Ruby script to find the greatest of three numbers
6. Write a Ruby script to print odd numbers from 10 to 1
7. Write a Ruby scirpt to check two integers and return true if one of them is 20 otherwise return their sum
8. Write a Ruby script to check two temperatures and return true if one is less than 0 and the other is greater than 100
9. Write a Ruby script to print the elements of a given array
10. Write a Ruby program to retrieve the total marks where subject name and marks of a student stored in a hash
11. Write a TCL script to find the factorial of a number
12. Write a TCL script that multiplies the numbers from 1 to 10
13. Write a TCL script for Sorting a list using a comparison function
14. Write a TCL script to (i)create a list (ii)append elements to the list (iii)Traverse the list (iv)Concatenate the list
15. Write a TCL script to comparing the file modified times.
16. Write a TCL script to Copy a file and translate to native format.
17. a) Write a Perl script to find the largest number among three numbers.
     b) Write a Perl script to print the multiplication tables from 1-10 using subroutines.
18. Write a Perl program to implement the following list of manipulating functions
    a)   Shift   b)Unshift   c)Push
19. a) Write a Perl script to substitute a word, with another word in a string.
     b) Write a Perl script to validate IP address and email address.
20. Write a Perl script to print the file in reverse order using command line arguments

TEXT BOOKS:
1. The World of Scripting Languages, David Barron,Wiley Publications.
2. Ruby Programming language by David Flanagan and Yukihiro Matsumoto O'Reilly
3. "Programming Ruby" The Pragmatic Programmer's guide by Dabve Thomas Second edition

REFERENCE BOOKS:
1. Open Source Web Development with LAMP using Linux Apache, MySQL, Perl and PHP, J.Lee and B. Ware (Addison Wesley) Pearson Education.
2. Perl by Example, E. Quigley, Pearson Education.
3. Programming Perl, Larry Wall, T. Christiansen and J. Orwant, O'Reilly, SPD.
4. Tcl and the Tk Tool kit, Ousterhout, Pearson Education.
5. Perl Power, J. P. Flynt, Cengage Learning.

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VI Semester
MA654BS: Finishing School-IV
(Quantitative Aptitude & Analytical Ability)
(Common to CSE, IT, CSBS, CSE (AI&ML),CSE(Data Science))

Course Objectives:

This is a foundation course and aims to enhance employability skills in students.

- Students will be introduced to higher order thinking skills and problem-solving on the following areas - Arithmetic ability, Numerical ability and General reasoning.
- Students will be trained to work systematically with speed and accuracy while solving problems.

Course Outcomes:

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

- Solve questions on the above-mentioned areas using shortcut and smart methods
- Understand the fundamental concepts of Aptitude skills
- Perform calculations with speed and accuracy

UNIT 1: QUANTITATIVE APTITUDE - NUMERICAL ABILITY
- Number system
  - Divisibility Rules
  - Square root
  - Cube root
  - Problems on numbers
  - LCM and HCF

UNIT 2: QUANTITATIVE APTITUDE- ARITHMETIC ABILITY-I
- Percentage
- Ratio proportions
- Averages
- Profit, loss and discounts
- Simple and Compound interest

UNIT3: QUANTITATIVE APTITUDE- ARITHMETIC ABILITY-II

- Pipes and Cisterns
- Ages
- Time- Work-Speed-Distance
- Clocks & Calendars
- Venn diagrams
- Tables and graphs

UNIT 4: REASONING ABILITY – GENERAL REASONING-I
- Coding decoding
- Directions
- Series completions - Letter, Number & Element Series
- Seating arrangements
- Symbols and Notations

UNIT 5: REASONING ABILITY- GENERAL REASONING -II

- Analogies
    - Alphabet Analogy
    - Numerical Analogy
- Classification
    - Alphabet Classification
    - Word Classification
    - Miscellaneous Classification
- Alphabet test
    - Arranging words in Alphabetical Order
    - Problems based on Letter-Word
    - Problems based on Alphabetical Quibble
- Blood Relations

REFERENCES:

1. R.S. Aggarwal - Quantitative Aptitude for Competitive Examinations.
2. Arun Sharma - Quantitative Aptitude for CAT.
3. Arihant Publications - Fast Track Objective Arithmetic.
4. Sarvesh K. Quantitative aptitude
5. A New Approach to Reasoning Verbal & Non-Verbal, Book by B.S. Sijwalii and Indu Sijwali
6. A Modern Approach to Logical Reasoning, Book by Agarwala Vikas and R.S. Aggarwal

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B.Tech. VI - Semester Syllabus

MC601ESC: Environmental Science

(Common to all branches)

Course Objectives:

- To understand the natural resources and their conservation.
- To understand the importance of ecosystem, biodiversity and ecological balance for sustainable development.
- To gain knowledge about environmental pollution, effects and controlling measures.
- To study about global environmental problems and global issues.
- To understand the environmental policies, regulations and sustainable development.

Course Outcomes:

After completing the course, the student will be able to:

- Learn about different types of natural resources and take up the measures to protect the resources.
- Get the information about ecosystem, biodiversity and their usage and conservation.
- Get the information about the types of pollution, understand their effects and controlling measures.
- Gain the knowledge about current global environmental issues and initiations to be taken to protect the environment.
- Gain the knowledge about environmental acts, EIA, sustainable development and follow the rules and regulations.

UNIT I : NATURAL RESOURCES (12 hours)

Classification - Renewable and Non-renewable resources.

Forest resources - Uses, deforestation- causes, effects and preventive measures.

Water Resources - Uses and over utilization of ground water, rain water harvesting, dams - benefits and problems. Causes, effects and management of floods and drought.

Mineral resources - Uses and Impacts of mining.

Energy resources - Growing energy needs, renewable and non-renewable energy resources, use of alternate energy resources.

UNIT II: ECOSYSTEM AND BIODIVERSITY (12 hours)

Ecosystem: Concept of ecosystem - Structure and functions of ecosystem. Food chain, food web and ecological pyramids - significance. Primary and Secondary production - Energy flow models: universal and single channel. Biogeochemical Cycles: Carbon cycle and Nitrogen cycle.

Biodiversity: Definition, Levels of Biodiversity, Values of biodiversity, Hotspots of biodiversity, Threats to biodiversity, Conservation of biodiversity: In-Situ and Ex-situ conservation methods.

UNIT III: ENVIRONMENTAL POLLUTION (12 hours)

Pollution - Definition and classification.

Air pollution: Definition, sources, causes, effects and control measures. Ambient air quality parameters, case Study.

Water pollution: Definition, sources, causes, effects and control measures. Waste water treatment. Case study (Namami Ganga Project)

Soil pollution: Sources, Land degradation - Soil erosion – effects and control measures. Impacts of modern agriculture on soil. Biomagnification and Bioaccumulation (Minamata disease).

Noise pollution: Sources, effects and control measures.

Solid Waste: E-Waste and Municipal solid waste management.

UNIT IV: GLOBAL ENVIRONMENTAL ISSUES AND GLOBAL EFFORTS (12 hours)

Global warming: Greenhouse effect - definition, sources and effects of greenhouse gases. Ozone layer depletion - Importance of ozone layer, Ozone depleting substances - sources and effects. Acid rain -causes and effects. Climate change - National Action Plan on Climate Change (NAPCC) – Government of India Initiatives. International conventions/protocols: The Earth summit, Kyoto Protocol and Montreal Protocol. Carbon credits - Emission trading, Green Chemistry Principles. Biodiesel-concept - transesterification and advantages.

UNIT V: ENVIRONMENTAL ACTS, EIA & SUSTAINABLE DEVOLOPMENT (12 hours)

Environmental Protection Act - **Legal aspects**: Air (Prevention and Control of pollution) Act 1981, Water (Prevention and control of pollution) Act -1974, Wildlife (Protection) Act – 1972, Biodiversity Act - 2002. Environmental Impact Assessment – Concept, structure and flow chart of EIA. Concept of sustainable development - Environmental education, Concept of green building, Ecological foot print, Low carbon life style, Life cycle assessment (LCA) and Clean development mechanisms.

Project Work: Related to Current environmental issues.

Text Books:

1. Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, University Grants Commission, Universities Press, 3rd Edition.
2. Kaushik A., Kaushik C.P., Text Book of Environmental Studies, New age International Publishers, 4th Edition.

Reference Books:

1. Anji Reddy M ., Textbook of Environmental Sciences and Technology, BS Publication.
2. Rajagopalan R., Environmental Studies, Oxford University Press, 3rd Edition
3. Raghavan Nambiar K., Text Book of Environmental Studies, SciTech Publications 2nd Edition.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Computer Science & Engineering (Data Science)
Scheme of Instruction and Examination

VII Semester

S.No.	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	**T**	**P/D**	**CIE**	**SEE**		
1	CS702PC	Predictive Analytics	3	0	0	30	70	3	3
2	CS706PC	Web and Social Media Analytics	3	0	0	30	70	3	3
3	--	Professional Elective – IV	3	0	0	30	70	3	3
4	--	Professional Elective – V	3	0	0	30	70	3	3
5	--	Open Elective – II	2	0	0	30	70	3	2
6	CS754PC	Web and Social Media Analytics Lab	0	0	2	30	70	3	1
7	CS755PC	Industrial Oriented Mini Project/ Summer Internship	0	0	4	-	100	-	2
8	CS756PC	Seminar	0	0	2	100	-	-	1
9	CS758PC	Project Stage – I	0	0	6	30	70	-	3
Total Hours/Marks/Credits			14	0	14	310	590	-	21

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VII Semester Syllabus
CS702PC: Predictive Analytics

Course Objectives

- The course serves to advance and refine expertise on theories, approaches and techniques related to prediction and forecasting.

Course Outcomes

Students would be able to
- Understand prediction-related principles, theories and approaches.
- Learn model assessment and validation.
- Understand the basics of predictive techniques and statistical approaches.
- Analyze supervised and unsupervised algorithms.

UNIT-I
Linear Methods for Regression and Classification: Overview of supervised learning, Linear regression models and least squares, Multiple regression, Multiple outputs, Subset selection, Ridge regression, Lasso regression, Linear Discriminant Analysis, Logistic regression, Perceptron learning algorithm.

UNIT-II
Model Assessment and Selection: Bias, Variance, and model complexity, Bias-variance trade off, Optimism of the training error rate, Estimate of In-sample prediction error, Effective number of parameters, Bayesian approach and BIC, Cross-validation, Bootstrap methods, conditional or expected test error.

UNIT-III
Additive Models, Trees, and Boosting: Generalized additive models, Regression and classification trees, Boosting methods-exponential loss and AdaBoost, Numerical Optimization via gradient boosting, Examples (Spam data, California housing, NewZea land fish, Demographic data).

UNIT-IV
Neural Networks (NN),Support Vector Machines (SVM),and K-nearest Neighbor: Fitting neural networks, Back propagation, Issues in training NN, SVM for classification, Reproducing Kernels, SVM for regression, K-nearest–Neighbour classifiers (Image Scene Classification).

UNIT-V
Unsupervised Learning and Random forests: Association rules, Cluster analysis, Principal Components, Random forests and analysis.

Suggested Reading:
1. Trevor Hastie, Robert Tibshi rani, Jerome Friedman, The Elements of Statistical Learning-Data Mining, Inference, and Prediction, Second Edition, Springer Verlag,2009.

Reference Books:
1. C.M.Bishop–Pattern Recognition and Machine Learning, Springer, 2006.
2. L.Wasserman-All of statistics.
3. Gareth James. Daniela Witten.TrevorHastieRobertTibshirani.AnIntroductiontoStatistical Learning with Applications in R.

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VII Semester Syllabus
CS706PC: Web and Social Media Analytics

Course Objectives

- Exposure to various web and social media analytic techniques.

Course Outcomes

Students would be able to
- Knowledge on decision support systems.
- Apply natural language processing concepts on text analytics.
- Understand sentiment analysis.
- Knowledge on search engine optimization and web analytics.

UNIT-I
An Overview of Business Intelligence, Analytics, and Decision Support: Analytics to Manage a Vaccine Supply Chain Effectively and Safely, Changing Business Environments and Computerized Decision Support, Information Systems Support for Decision Making, The Concept of Decision Support Systems(DSS), Business Analytics Overview, Brief Introduction to Big Data Analytics.

UNIT-II
Text Analytics and Text Mining: Machine Versus Men on Jeopardy!: The Story of Watson, Text Analytics and Text Mining Concepts and Definitions, Natural Language Processing, Text Mining Applications, Text Mining Process, Text Mining Tools.

UNIT-III
Sentiment Analysis: Sentiment Analysis Overview, Sentiment Analysis Applications, Sentiment Analysis Process, Sentiment Analysis and Speech Analytics.

UNIT-IV
Web Analytics, Web Mining: Security First Insurance Deepens Connection with Policy holders, Web Mining Overview, Web Content and Web Structure Mining, Search Engines, Search Engine Optimization, Web Usage Mining (Web Analytics), Web Analytics Maturity Model and Web Analytics Tools.

UNIT-V
Social Analytics and Social Network Analysis: Social Analytics and Social Network Analysis, Social Media Definitions and Concepts, Social Media Analytics.
Prescriptive Analytics – Optimization and Multi-Criteria Systems: Multiple Goals, Sensitivity Analysis, What-If Analysis, and Goal Seeking.

Suggested Reading:
1. Ramesh Sharda, Dursun Delen, Efraim Turban, BUSINESS INTELLIGENCE AND ANALYTICS: SYSTEMS FOR DECISION SUPPORT, Pearson Education.

Reference Books:
1. RajivSabherwal,IrmaBecerra-Fernandez,"BusinessIntelligence–Practice,TechnologiesandManagement",JohnWiley2011.
2. LarissT.Moss,ShakuAtre,"BusinessIntelligenceRoadmap",Addison-WesleyItService.
3. YuliVasiliev,"OracleBusinessIntelligence:TheCondensedGuidetoAnalysisandReporting",SPDShroff,2012.

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VII Semester Syllabus
CS711PE: Natural Language Processing (PE–IV)
(Common to CSE(PE-III), CSBS, CSE(Data Science))

Prerequisites:
- Data structures, finite automata and probability theory

Course Objectives
- Introduce to some of the problems and solutions of NLP and their relation to linguistics and statistics.

Course Outcomes

Students would be able to
- Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.
- Understand and carry out proper experimental methodology for training and evaluating empirical NLP systems
- Able to manipulate probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods.
- Able to design, implement, and analyze NLP algorithms
- Able to design different language modeling Techniques.

UNIT-I
Finding the Structure of Words: Words and Their Components, Issues and Challenges, Morphological Models,POS tagging,
Finding the Structure of Documents: Introduction, Methods, Complexity of the Approaches, Performances of the Approaches

UNIT-II
Syntax Analysis: Parsing Natural Language, Treebanks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure, Parsing Algorithms, Treebanks, Models for Ambiguity Resolution in Parsing, Multilingual Issues

UNIT-III
Semantic Parsing: Introduction, Semantic Interpretation, System Paradigms, Word Sense Systems, Software.

UNIT-IV
Predicate- Argument Structure, Meaning Representation Systems, Software.

UNIT-V
Discourse Processing: Cohension, Reference Resolution, Discourse Cohension and Structure **Language Modeling:** Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modeling Problems, Multilingual and Cross lingual Language Modeling

Suggested Reading:
1. Multilingual natural Language Processing Applications: From Theory to Practice–Daniel M.Bikeland ImedZitouni, Pearson Publication.
2. Natural Language Processing and Information Retrieval: Tanvier Siddiqui, U.S.Tiwary.

Reference Books:
1.Speech and Natural Language Processing- Daniel Jurafsky & James HMartin, Pearson Publications.

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VII Semester Syllabus
CS715PE: Database Security (PE–IV)
(Common to CSE, CSE (DS))

Course Objectives

- To learn the security of databases
- To learn the design techniques of database security
- To learn the secure software design.

Course Outcomes

Students would be able to
- Ability to carry out a risk analysis for large databases
- Ability to setup and maintain the accounts with privileges and roles.

UNIT-I
Introduction: Introduction to Databases Security Problems in Data bases Security Controls Conclusions.
Security Models -1: Introduction Access Matrix Model Take-Grant Model Acten Model PN Model Hartson and Hsiao's Model Fernandez'sModel 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.
Security Mechanisms: Introduction User Identification/Authentication Memory Protection Resource Protection Control Flow Mechanisms Isolation Security Functionalities in Some Operating Systems Trusted Computer System Evaluation Criteria.

UNIT-III
Security Software Design: Introduction A Methodological Approach to Security Software Design, Secure Operating System Design, Secure DBMS Design Security Packages Database Security Design **Statistical Database Protection & Intrusion Detection Systems:** Introduction Statistics Concepts and Definitions, Types of Attacks, Inference Controls, Evaluation Criteria for Control Comparison. Introduction IDES System RETISS System ASES System Discovery.

UNIT-IV
Models for the Protection of New Generation Database Systems -1: Introduction A Model for the Protection of Frame Based Systems A Model for the Protection of Object-Oriented Systems SORION Model for the Protection of Object-Oriented Databases.

UNIT-V
Models for the Protection of New Generation Database Systems -2: A Model for the Protection of New Generation Database Systems: the Orion Model ajodia and Kogan's Model A Model for the Protection of Active Databases Conclusions.

Suggested Reading:
1. Database Security by Castano, Pearson Edition
2. Database Security and Auditing: Protecting Data Integrity and Accessibility, 1stEdition, Hassan Afyouni, THOMSON Edition.

ReferenceBooks:
1. Data base security by Al fredbasta , melissazgola, CENGAGE learning.

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VII Semester Syllabus
CS724PE: Information Storage Management (PE–IV)

Course Objectives

- To understand the basic components of Storage System Environment.
- To understand the Storage Area Network Characteristics and Components.
- To examine emerging technologies including IP-SAN.
- To describe the different backup and recovery topologies and the irrole in providing disaster recovery and business continuity capabilities.
- To understand the local and remote replication technologies.

Course Outcomes

Students would be able to
- Understand the logical and physical components of a Storage infrastructure.
- Evaluate storage architectures, including storage subsystems, DAS,SAN, NAS, and CAS.
- Understand the various forms and types of Storage Virtualization.
- Describe the different roles in providing disaster recovery and business continuity capabilities.
- Distinguish different remote replication technologies.

UNIT-I
Introduction to Storage Technology: Data proliferation and the varying value of data with time & usage, Sources of data and states of data creation, Data center requirements and evolution to accommodate storage needs, Overview of basic storage management skills and activities, The five pillars of technology, Overview of storage infrastructure components, Evolution of storage, Information Lifecycle Management concept, Data categorization within an enterprise, Storage and Regulations.

UNIT-II
Storage Systems Architecture: Intelligent disk subsystems overview, Contrast of integrated vs. Modular arrays, Component architecture of intelligent disks ub systems, Disk physical structure-components, properties, performance, and specifications, Logical partitioning of disks, RAID & parity algorithms, hot sparing, Physical vs. logical disk organization, protection, and back end management, Array caching properties and algorithms, Front end connectivity and queuing properties, Front end to host storage provisioning, mapping, and operation, Interaction of file systems with storage, Storage system connectivity protocols.

UNIT-III
Introduction to Networked Storage: JBOD, DAS, SAN, NAS, & CAS evolution, Direct Attached Storage (DAS) environments: elements, connectivity, & management, Storage Area Networks (SAN):elements & connectivity, Fibre Channel principles, standards, & network management principles, SAN management principles, Network Attached Storage(NAS): elements, connectivity options, connectivity protocols (NFS, CIFS, ftp),& management principles, IPSAN elements, standards(iSCSI, FCIP, iFCP),connectivity principles, security, and management principles, Content Addressable Storage (CAS):elements, connectivity options, standards, and management principles, Hybrid Storage – solutions overview including technologies like virtualization & appliances.

UNIT-IV
Introductions to Information Availability: Business Continuity and Disaster Recovery Basics, Local business continuity techniques, Remote business continuity techniques, Disaster Recovery principles & techniques.
Managing & Monitoring: Management philosophies (holisticvs.system & component), Industry management standards (SNMP,SMI-S, CIM), Standard framework applications, Key management metrics (thresholds, availability, capacity, security, performance), Metric analysis methodologies & trend analysis, Reactive and proactive management best practices, Provisioning & configuration change planning, Problem reporting, prioritization, and handling techniques, Management tools overview.

UNIT-V
Securing Storage and Storage Virtualization: Define storage security. List the critical security attributes for information systems, describe the elements of a shared storage model and security extensions, Define storage security domains, List and analyze the common threats in each domain, Identify different virtualization technologies, describe block-level and file level virtualization technologies and processes.

Suggested Reading:
1. Marc Farley Osborne, "Building Storage Networks", Tata McGrawHill,2001.
2. Robert Spalding and Robert Spalding, "Storage Networks: The Complete Reference",TataMcGrawHill,2003.
3. Meeta Gupta, "Storage Area Network Fundamentals", Pearson Education Ltd.,2002.

Reference Books:
1. Gerald J Kowalski and MarkTMaybury, "Information Storage Retrieval Systems theory &I mplementation", BS Publications, 2000.
2. Th ejendraBS, "Disaster Recovery & Business continuity", Shroff Publishers & Distributors,2006.

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VII Semester Syllabus
CS725PE: Internet of Things (PE–IV)

Course Objectives

- To introduce the terminology, technology and its applications
- To introduce the concept of M2M(machine to machine) with necessary protocols
- To introduce the Python Scripting Language which is used in many IoT devices
- To introduce the Raspberry PI platform, that is widely used in IoT applications
- To introduce the implementation of web-based services on IoT devices.

Course Outcomes

Students would be able to
- Interpret the impact and challenges posed by IoT networks leading to new architectural models.
- Compare and contrast the deployment of smart objects and the technologies to connect them to the network.
- Appraise the role of IoT protocols for efficient network communication.
- Elaborate the need for Data Analytics and Security in IoT.
- Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.

UNIT-I
Introduction to Internet of Things –Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs IoT enabled Technologies–Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle

UNIT-II
IoT and M2M – Software defined networks, network function virtualization, difference between SDN and NFV for IoT Basics of IoT System Management with NETCOZF, YANG-NETCONF, YANG, SNMPNETOPEER

UNIT-III
Introduction to Python - Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, filehandling, data/time operations, classes, Exception handling Python packages-JSON, XML, HTTP Lib, URLLib, SMTPLib

UNIT-IV
IoT Physical Devices and End points-Introduction to Raspberry PI-Interfaces(serial,SPI,I2C) Programming–Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.

UNIT-V
IoT Physical Servers and Cloud Offerings – Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a REST fulweb API

Suggested Reading:
1. Internet of Things- A Hands-on Approach, Arshdeep Bahgaand Vijay Madisetti, Universities Press, 2015, ISBN:9788173719547.
2. Getting Started with RaspberryPi, MattRichardson&ShawnWallace,O'Reilly(SPD),2014,ISBN:9789350239759.

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VII Semester Syllabus
CS716PE: Cloud Computing (PE–V)
(Common to CSE-PE IV, IT – PE IV, CSE (AI & ML-PE IV), CSE (DS- PE V))

Prerequisites:
- Courses on Computer Networks, Operating Systems, Distributed Systems.

Course Objectives

- To know the basics of cloud computing and its advantages.
- To analyze the components of cloud computing and its business perspective.
- To understand various cloud service/deployment models.
- To evaluate the various cloud development tools
- To study various cloud service provider services. .

Course Outcomes

Students would be able to
- Ability to understand the fundamentals of cloud computing.
- Understand the architecture of cloud computing model.
- Ability to understand various service and deployment models of cloud.
- Understand the concept of virtualization and its types.
- Understanding cloud service providers and cloud based applications.

UNIT – I

Cloud Computing Fundamentals: Motivation for Cloud Computing, Basic Principles of Cloud computing. Five Essential Characteristics, Four Cloud Deployment Models, Three service Offering Models, Requirements for Cloud Services - Cloud Ecosystem, Cloud Application - Virtualization- approaches and types

UNIT – II

Cloud Computing Architecture and Management: Cloud architecture Layers, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Networking Technologies, Applications on the Cloud, Managing the Cloud application, Migrating Application to Cloud- Phases of Cloud Migration - Approaches for Cloud Migration

UNIT – III

Cloud Deployment Models: Private Cloud, Public cloud, Community Cloud and Hybrid Cloud – Characteristics, Suitability, Issues, Advantages and Disadvantages.

Cloud Service Models: Infrastructure as a Service, Platform as a Service, Software as a Service - Characteristics, Suitability, Pros and Cons and Summary.

UNIT – IV

Virtualization technology

Virtual Machine Technology - Types of virtualization - System virtual machines- Virtual machines and elastic computing, Virtual machine migration - Virtualization Applications In Enterprises- Security through virtualization, Desktop virtualization, Server consolidation, Automating infrastructure management, Pitfalls Of Virtualization.

UNIT – V

Cloud Service Providers and Applications: Amazon Web Services, Amazon Elastic Compute Cloud, Google Cloud Platform, Google App Engine, Microsoft Azure, Windows Azure, IBM Cloud Models – Cloud Security issues – Case studies in Cloud Computing and its applications.

Suggested Reading:
1. Essentials of cloud Computing: K. Chandrasekhran, CRC press, 2014.
2. "Enterprise Cloud Computing Technology Architecture Applications", Gautam Shroff, Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010.

Reference Books:
1. Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.
3. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly, SPD, rp 2011.

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VII Semester Syllabus
CS733PE: Privacy Preserving In Data Mining (PE–V)

Prerequisites:
- A course on "Data Mining".

Course Objectives

- The aim of the course is to introduce the fundamentals of Privacy Preserving Data Mining Methods
- The course gives an overview of- Anonymity and its Measures, Multiplicative Perturbation for Privacy-Preserving Data Mining, techniques for Utility-based Privacy Preserving Data.

Course Outcomes

Students would be able to
- Understand the concepts of Privacy Preserving Data Mining Models and Algorithms.
- Demonstrate a comprehensive understanding of different tasks associated in Inference Control Methods for Privacy- Preserving Data Mining.
- Understand the concepts of Data Anonymization Methods and its Measures.
- Evaluate and Appraise the solution designed for Multiplicative Perturbation.
- Formulate, Design and Implement the solutions for Utility-based Privacy Preserving Data.

UNIT-I
Introduction, Privacy-Preserving Data Mining Algorithms, The Randomization Method, Group Based Anonymization, Distributed Privacy-Preserving Data Mining

UNIT-II
Interface Control Methods
Introduction, A Classification of Microdata Protection Methods, Perturbative Masking Methods, Non-Perturbative Masking Methods, Synthetic Microdata Generation, Trading off Information Loss and Disclosure Risk.

UNIT-III
Measure of Anonymity
Data Anonymization Methods, A Classification of Methods, Statistical Measure of Anonymous, Probabilistic Measure of Anonymity, Computational Measure of Anonymity, reconstruction Methods for Randomization, Application of Randomization

UNIT-IV
Multiplicative Perturbation
Definition of Multiplicative Perturbation, Transformation Invariant Data Mining Models, Privacy Evaluation for Multiplicative Perturbation, Attack Resilient Multiplicative Perturbation, Metrics for Quantifying Privacy Level, Metrics for Quantifying Hiding Failure, Metrics for Quantifying Data Quality.

UNIT-V
Utility-Based Privacy- Preserving Data
Types of Utility-Based Privacy Preserving Methods, Utility- Based Anonymization Using Local Recording, The Utility-Based Privacy Preserving Methods in Classification Problems, Anonymization Merginal: Injection Utility into Anonymization Data Sets.

Suggested Reading:
1. Privacy–Preserving Data Mining: Models and Algorithms Edited by Charu C.Aggarwal and S.Yu, Springer.

Reference Books:
1. Charu C.Agarwal, Data Mining: The Text book,1stEdition, Springer.
2. J. Hanand M.Kamber, Data Mining: Concepts and Techniques, 3rdEdition, Elsevier.
3. Privacy Preserving Data Mining by Jaideep Vaidya, YuMichael Zhu and ChirstopherW.Clifton, Springer.

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VII Semester Syllabus
CS734PE: Mining Massive Datasets (PE–V)

Prerequisites:
- Students should be familiar with Data mining, algorithms, basic probability theory and Discrete math.

Course Objectives

- This course will cover practical algorithms for solving key problems in mining of massive datasets.
- This course focuses on parallel algorithmic techniques that are used for large datasets.
- This course will cover stream processing algorithms for data streams that arrive constantly, page ranking algorithms for web search, and online advertisement systems that are studied in detail.

Course Outcomes

Students would be able to
- Handle massive data using Map Reduce.
- Develop and implement algorithms for massive data sets and methodologies in the context of datamining.
- Understand the algorithms for extracting models and information from large datasets
- Develop recommendation systems.
- Gain experience in matching various algorithms for particular classes of problems.

UNIT-I
DataMining-Introduction-DefinitionofDataMining-StatisticalLimitsonDataMining,
MapReduce and the New Software Stack-Distributed File Systems, MapReduce, Algorithms Using Map Reduce.

UNIT-II
Similarity Search: Finding Similar Items- Applications of Near- Neighbor Search, Shingling of Documents, Similarity-Preserving Summaries of Sets, Distance Measures. **Streaming Data:** Mining Data Streams-The Stream Data Model, Sampling Data in a Stream, Filtering Streams.

UNIT-III
Link Analysis-Page Rank, Efficient Computation of Page Rank, Link Spam. **Frequent Item sets -**Handling Larger Datasets in Main Memory, Limited-Pass Algorithms, Counting Frequent Items in a Stream. **Clustering-**The CURE Algorithm, Clustering in Non- Euclide an Spaces, Clustering for Streams and Parallelism.

UNIT-IV
Advertising on the Web-Issues in On-Line Advertising, On-Line Algorithms, The Matching Problem, The Adwords Problem, Adwords Implementation. **Recommendation Systems-**A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering, Dimensionality Reduction, The NetFlix Challenge.

UNIT-V
Mining Social-Network Graphs-Social Networks as Graphs, Clustering of Social-Network Graphs, Partitioning of Graphs, Simrank, Counting Triangles.

Suggested Reading:
1. Jure Leskovec, An and Rajaraman, JeffUllman, Mining of MassiveDatasets,3rd Edition.

Reference Books:
1. JiaweiHan & Micheline Kamber, Data Mining–Concepts and Techniques 3rd Edition Elsevier.
2. Margaret HDunham, Data Mining Introductory and Advanced topics, PEA.
3. IanH.Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann.

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VII Semester Syllabus
CS735PE: Exploratory Data Analysis (PE–V)

Course Objectives

- This course introduces the methods for data preparation and data understanding.
- It covers essential exploratory techniques for understanding multivariate data by summarizing it through statistical methods and graphical methods.
- Supports to Summarize the insurers use of predictive analytics, data science and Data Visualization.

Course Outcomes

Students would be able to
- Handle missing data in the real-world datasets by choosing appropriate methods.
- Summarize the data using basic statistics. Visualize the data using basic graphs and plots.
- Identify the outliers if any in the data set.
- Choose appropriate feature selection and dimensionality reduction.
- Techniques for handling multi-dimensional data.

UNIT-I:
Introduction to Exploratory Data Analysis: Data Analytics lifecycle, Exploratory Data Analysis(EDA)–Definition, Motivation, Steps in data exploration, The basic datatypes Data Type Portability.

UNIT-II:
Preprocessing-Traditional Methods and Maximum Likelihood Estimation: Introduction to Missing data, Traditional methods for dealing with missing data, Maximum Likelihood Estimation – Basics, Missing data handling, Improving the accuracy of analysis. **Preprocessing Bayesian Estimation:** Introduction to Bayesian Estimation, Multiple Imputation-Imputation Phase, Analysis and Pooling Phase, Practical Issues in Multiple Imputation, Models for Missing Notation Random Data.

UNIT-III:
Data Summarization & Visualization: Statistical data elaboration, 1-D Statistical data analysis, 2-D Statistical data Analysis, N-D Statistical data analysis.

UNIT-IV:
Outlier Analysis: Introduction, Extreme Value Analysis, Clustering based, Distance Based and Density Based outlier analysis, Outlier Detection in Categorical Data. **Feature Subset Selection:** Feature selection algorithms: filter methods, wrapper methods and embedded methods, Forward selection backward elimination, Relief, greedy selection, genetic algorithms for features selection.

UNIT-V
Dimensionality Reduction: Introduction, Principal Component Analysis(PCA), Kernel PCA, Canonical Correlation Analysis, Factor Analysis, Multidimensional scaling, Correspondence Analysis.

Suggested Reading:
1. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, byGlenn J.Myatt.

Reference Books:
1. Charu C. Aggarwal, "Data Mining The Textbook",Springer,2015.
2. Craig K.Enders, "Applied Missing Data Analysis",TheGuilfordPress,2010.
3. Inge Koch," Analysis of Multivariate and High dimensional data", CambridgeUniversityPress,2014.
4. Michael Jambu,"Exploratory and multi variate data analysis", Academic PressInc.,1990.
5. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC press, 2015.

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VII Semester Syllabus
CS754PC: Web and Social Media Analytics Lab

Course Objectives

- Exposure to various web and social media analytic techniques.

Course Outcomes

Students would be able to
- Knowledge on decision support systems.
- Apply natural language processing concepts on text analytics.
- Understand sentiment analysis.
- Knowledge on search engine optimization and web analytics.

List of Experiments
1. Preprocessing text document using NLTK of Python
a. Stop word elimination
b. Stemming
c. Lemmatization
d. POS tagging
e. Lexical analysis
2. Sentiment analysis on customer review on products
3. Web analytics
a. Web usage data (web server log data, click stream analysis)
b. Hyperlink data
4. Search engine optimization-implement spamdexing
5. Use Google analytics tools to implement the following
a. Conversion Statistics
b. Visitor Profiles
6. Use Google analytics tools to implement the Traffic Sources.

Resources:
1. Stanford core NLP package
2. GOOGLE.COM/ANALYTICS

Suggested Reading:
1. Ramesh Sharda, Dursun Delen, Efraim Turban, BUSINESS INTELLIGENCE AND ANALYTICS :SYSTEMS FOR DECISION SUPPORT, Pearson Education.

Reference Books:
1. Rajiv Sabherwal, Irma　　Becerra-　　Fernandez, "Business Intelligence–Practice, Technologies and Management", JohnWiley2011.
2. LarissT.Moss,Shaku Atre,"Business Intelligence Road map", Addison-Wesley It Service.
3. Yuli Vasiliev, "Oracle Business Intelligence: The Condensed Guide to Analysis and Reporting", SPD Shroff,2012.

MAHATMA GANDHI INSTITUTE OF TECHNOLOGY (Autonomous)
B.Tech. in Computer Science & Engineering (Data Science)
Scheme of Instruction and Examination

VIII Semester

S.No.	Course Code	Course Title	Instruction Hours Per Week			Examination Max. Marks		Duration of SEE in Hours	Credits
			L	T	P/D	CIE	SEE		
1	MS802HS	Organizational Behavior	3	0	0	30	70	3	3
2	---	Professional Elective -VI	3	0	0	30	70	3	3
3	---	Open Elective-III	2	0	0	30	70	3	2
4	CS852PC	Project Stage - II	0	0	16	30	70	-	8
		Total Hours/Marks/Credits	8	0	16	120	280	-	16

L: Lecture **T**: Tutorial **D**: Drawing **P**: Practical **CIE** - Continuous Internal Evaluation **SEE** - Semester End Examination

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VIII Semester Syllabus
MS802HS: ORGANIZATIONAL BEHAVIOUR
(Common to CSE (DS), CSE (AI&ML))

Course Objective: The objectives of the course are:

- To understand the perception and attribution concepts in organizational and external environmental context.
- To discuss the concepts and theories of personality, attitudes and Motivation
- To understand the decision making and communication process in interpersonal and their intrapersonal context.
- To familiarize the students with the basic understanding of individual behavior and explore issues of power and empowerment.
- To discuss the concepts of High performance, Learning and Leadership.

Course Outcomes: After the completion of the subject, the student will be able to

- Analyze the concepts of perception and attribution of individuals and groups in organizations in terms of the key factors that influence organizational behavior
- Acquire knowledge of personality and attitudes of individuals in applying motivational theories to resolve problems of employees.
- Apply group dynamics and skills required for working in groups and identify the processes used in developing communication and decision making to overcome stress and conflicts.
- Analyze organizational behavioral issues in the context of, power, and empowerment issues.
- Acquire the knowledge of learning concepts and leadership styles to achieve high performance levels

Unit I:
Introduction, Perception and Attribution
Introduction to OB - Definition, Nature and Scope – Environmental and organizational context –Impact of IT, globalization, Diversity, Ethics, culture, reward systems and organizational design on Organisational Behaviour

Cognitive Process I: Perception and Attribution: Meaning of Perception, Nature and importance of Perception — Sensation versus Perception - Perceptual selectivity and organization – Social perception
Attribution: Meaning - Attribution Theories – Fritz heider's theory of attribution; Jones & Davis correspondent inference theory; Kelley's Covariation Model; and Weiner's Three-Dimensional Model - Locus of control –Attribution Errors – Impression Management – Types - Strategies of Impression Management.

Unit II:
Personality, Attitudes and Motivation
Cognitive Process II: Personality and Attitudes - Personality as a continuum –Meaning of personality, Personality Traits - Johari Window and Transactional Analysis.

Attitudes: Nature and Dimension of Attitudes - Job satisfaction and organizational commitment.

Motivation: Motivational needs and processes- Work-Motivation Approaches Theories of Motivation– the content theories of motivation: Maslow's hierarchy of needs; Herzberg's two factor theory of motivation; Alderfer's ERG theory – The process theories of work motivation: Vroom's expectancy theory of motivation; the Porter-Lawler's model - Motivation across cultures -Positive organizational behaviour: Optimism - Emotional intelligence - Self-Efficacy.

Unit III:
Communication, Decision-Making, Stress and Conflict
Dynamics of OB - I: Communication: Meaning and types - interactive communication in organizations – barriers to communication and strategies to improve the flow of communication.

Decision Making: Participative decision-making techniques –creativity and group decision making.

Dynamics of OB – II: Stress and Conflict: Meaning and types of stress –Meaning and types of conflict - Effect of stress and intra-individual conflict -strategies to cope with stress and conflict.

Unit IV:
Power and Empowerment
Dynamics of OB-III Power: Meaning -Types of power – Legitimate power, Coercive power, Expert power, Informal power and Referent power.

Empowerment – Benefits, Process, Determinants, Techniques of Empowerment; Groups Vs. Teams –Nature of groups – dynamics of informal groups – Dysfunctions of groups and teams –Teams in modern work place.

Unit V:
High performance, Learning and Leadership
Leading High performance: Job design and Goal setting for High Performance-Quality of Work Life-Socio technical Design and High-performance work practices -Behavioural performance management

Learning: Reinforcement and Punishment as principles of Learning – Process of Behavioural modification

Leadership: Definition of leadership – Traits of effective leaders- Leadership behaviour Vs Traits –Leadership skills – Leadership theories: Trait theories; Behavioural theories; Contingency approaches to leadership – Leadership Styles- Autocratic Leadership style, Democratic Leadership style, Free rein Leadership style, Activities and skills of Great leaders.

Text Books:

1. Luthans, Fred: Organizational Behavior, McGraw-Hill, 10th Edition, 2009
2. Robbins, P. Stephen, Timothy A. Judge: Organizational Behavior, PHI/Pearson, 12th Edition, 2009.
3. Pareek Udai: Behavioral Process at Work: Oxford & IBH, New Delhi, 2009.

Reference Books:

1. Schermerhorn: Organizational Behavior Wiley, 9th Edition, 2008.
2. Michael A Hitt: Organizational Behavior, Wiley, 2008
3. Aswathappa: Organizational Behavior, Himalaya, 2009

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VIII Semester Syllabus
CS813PE: Data Stream Mining (PE–VI)
(Common to CSE-PE V, CSE (DS- PE VI))

Prerequisites:
- A basic knowledge of "Datamining"

Course Objectives

- The aim of the course is to introduce the fundamentals of Data Stream Mining.
- The course gives an overview of–Mining Strategies, methods and algorithms for data streamlining.

Course Outcomes

Students would be able to
- Understand how to formulate a knowledge extraction problem from data streams.
- Ability to apply methods / algorithms to new data stream analysis problems.
- Evaluate the results and understand the functioning of the methods studied.
- Demonstrate decision tree and adaptive Hoeffding Tree concepts.

UNIT-I
MOA Stream Mining, Assumptions, Requirements, Mining Strategies, Change Detection Strategies Experimental Settings, Previous Evaluation Practices, Evaluation Procedures for Data Streams, Testing Framework, Environments, Data Sources, Generation Speed and Data Size, Evolving Stream Experimental Setting.

UNIT-II
Hoeffding Trees, The Hoeffding Bound for Tree Induction, The Basic Algorithm, Memory Management, Numeric Attributes, Batch Setting Approaches, Data Stream Approaches.

UNIT-III
Prediction Strategies, Majority Class, Naïve Bayes Leaves, Adaptive Hybrid, Hoeffding Tree Ensembles, Data Stream Setting, Realistic Ensemble Sizes.

UNIT-IV
Evolving Data Streams, Algorithms for Mining with Change, A Methodology for Adaptive Stream Mining, Optimal Change Detector and Predictor, Adaptive Sliding Windows, Introduction, Maintaining Updated Windows of Varying Length.

UNIT-V
Adaptive Hoeffding Trees, Introduction, Decision Treeson Sliding Windows, Hoeffding Adaptive Trees, Adaptive Ensemble Methods, New methods of Bagging using trees of different size, new method of bagging using ADWIN, Adaptive Hoeffding Option Trees, Method performance.

Suggested Reading:
1. DATASTREAM MINING: A Practical Approach by Albert Bifetand Richard Kirkby.

Reference Books:
1. Knowledge discovery from data streams by Gama João. ISBN: 978-1-4398-2611-9.
2. Machine Learning for Data Streams by Albert Bifet , Ricard Gavalda ; MITPress,2017..

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VIII Semester Syllabus
CS827PE: Video Analytics (PE –VI)

Course Objectives

- To acquire the knowledge of extracting information from surveillance videos, understand the model used for recognition of objects, humans in videos and perform gait analysis.

Course Outcomes

Students would be able to
- Understand the basics of video – signals and systems.
- Able to estimate motion in a video.
- Able to detect the objects and track them.
- Recognize activity and analyze behavior.
- Evaluate face recognition technologies.

UNIT-I
INTRODUCTION: Multidimensional signals and systems: signals, transforms, systems, sampling theorem. Digital Images and Video: human visual system and color, digital video, 3Dvideo, digital-video applications, image and video quality.

UNIT-II
MOTION ESTIMATION Image formation, motion models, 2D apparent motion estimation, differential methods, matching methods, non-linear optimization methods, transform domain methods, 3D motion and structure estimation.

UNIT-III
VIDEO ANALYTICS: Introduction-Video Basics-Fundamentals for Video Surveillance- Scene Artifacts- Object Detection and Tracking: Adaptive Background Modelling and Subtraction- Pedestrian Detection and Tracking Vehicle Detection and Tracking- Articulated Human Motion Tracking in Low-Dimensional Latent Spaces.

UNIT-IV
BEHAVIORAL ANALYSIS & ACTIVITY RECOGNITION Event Modelling- Behavioral Analysis-Human Activity Recognition- Complex Activity Recognition Activity modelling using 3D shape, Video summarization, shape- based activity models- Suspicious Activity Detection.

UNIT-V
HUMAN FACE RECOGNITION & GAIT ANALYSIS: Introduction: Overview of Recognition algorithms– Human Recognition using Face: Face Recognition from still images, Face Recognition from video, Evaluation of Face Recognition Technologies- Human Recognition using gait: HMM Framework for Gait Recognition, View Invariant Gait Recognition, Role of Shape and Dynamics in Gait Recognition.

Suggested Reading:
1. Murat Tekalp, "Digital Video Processing", second edition, Pearson, 2015
2. Rama Chellappa, AmitK. Roy- Chowdhury, Kevin Zhou. S, "Recognition of Humans and their Activities using Video", Morgan &ClaypoolPublishers,2005.
3. Yunqian Ma, Gang Qian, "Intelligent Video Surveillance: Systems and Technology", CRC Press (Taylor and Francis Group), 2009.

Reference Books:
1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
2. Yao Wang, Jorn Ostermann and Ya-Qin Zhang, "Video Processing and Communications", Prentice Hall,2001.
3. Thierry Bouwmans, FatihPorikli, Benjamin Höferlinand Antoine Vacavant, "Background Modeling and Foreground Detection for Video Surveillance: Traditional and Recent Approaches, Implementations, Benchmarking and Evaluation", CRC Press, TaylorandFrancisGroup,2014.
4. Md. Atiqur Rahman Ahad,"Computer Vision and Action Recognition- A Guide for Image Processing and Computer Vision Community for Action Understanding", AtlantisPress,2011.

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VIII Semester Syllabus
CS828PE: Blockchain Technology (PE–VI)
(Common to IT, CSE (Data Science))

Prerequisites:
- Knowledge in security and applied cryptography.
- Knowledge in distributed databases

Course Objectives

- To Introduce block chain technology and Crypto currency.

Course Outcomes

Students would be able to
- Learn about research advances related to one of the most popular technological areas today.
- Understand Extensibility of Blockchain concepts.
- Understand and Analyze Block chain Science.
- Understand Technical challenges, Business model challenges.

UNIT-I
Introduction: Block chain or distributed trust, Protocol, Currency, Cryptocurrency, How a Cryptocurrency works, Crowd funding.

UNIT-II
Extensibility of Block chain concepts, Digital Identity verification, Block chain Neutrality, Digital art, Block chain Environment.

UNIT-III
Block chain Science: Grid coin, Folding coin, Block chain Genomics, Bitcoin MOOCs.

UNIT-IV
Currency, Token, Tokenizing, Campus coin ,Coin drop as a strategy for Public adoption, Currency Multiplicity, Demurrage currency.

UNIT-V
Technical challenges, Business model challenges, Scandals and Public perception, Government Regulations.

Suggested Reading:
1. Melanie Swan, Blockchain Blue print for Economy, O'reilly.

Reference Books:
1. Building Block chain Apps, Michael Juntao Yuan, Pearson Education
2. Daniel Drescher, Block chain Basics: A Non-Technical Introduction in 25 Steps 1st Edition
3. Bradley Lakeman, Blockchain Revolution: Understanding the Crypt o Economy of the Future. A Non-Technical Guide to the Basics of Cryptocurrency Trading and Investing, ISBN:1393889158.

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VIII Semester Syllabus
CS829PE: Parallel and Distributed Computing (PE–VI)

Course Objectives

- To learn core ideas behind parallel and distributed computing.
- To explore the methodologies adopted for parallel and distributed environments.
- To understand the networking aspects of parallel and distributed computing.
- To provide an overview of the computational aspects of parallel and distributed computing.
- To learn parallel and distributed computing models.

Course Outcomes

Students would be able to
- Explore the methodologies adopted for parallel and distributed environments.
- Analyze the networking aspects of Distributed and Parallel Computing.
- Explore the different performance issues and tasks in parallel and distributed computing.
- Tools usage for parallel and distributed computing.
- Understanding high performance computing techniques.

UNIT-I

Parallel and Distributed Computing—Introduction- Benefits and Needs-Parallel and Distributed Systems- Programming Environment- Theoretical Foundations - Parallel Algorithms— Introduction-Parallel Models and Algorithms- Sorting - Matrix Multiplication- Convex Hull- Pointer Based Data Structures.

UNIT-II

Synchronization-Process Parallel Languages-Architecture of Parallel and Distributed Systems-Consistency and Replication-Security-Parallel Operating Systems.

UNIT-III

Management of Resources in Parallel Systems- Tools for Parallel Computing- Parallel Database Systems and Multimedia Object Servers.

UNIT-IV

Networking Aspects of Distributed and Parallel Computing- Process- Parallel and Distributed Scientific Computing.

UNIT-V

High-Performance Computing in Molecular Sciences-Communication Multimedia Applications for Parallel and Distributed Systems-Distributed File Systems.

Suggested Reading:
1. JacekBłażewicz,etal.,"Hand book on parallel and distributed processing", Springer Science & Business Media, 2013.
2. AndrewS.Tanenbaum, and Maarten VanSteen, "Distributed Systems: Principles and Paradigms". Prentice-Hall, 2007.

Reference Books:
1. GeorgeF.Coulouris, JeanDollimore, and TimKindberg , "Distributed systems: concepts and design", Pearson Education,2005.
2. GregorKosec and RomanTrobec,"Parallel Scientific Computing: Theory, Algorithms, and Applications of Mesh Based and Meshless Methods", Springer,2015.