PONDICHERRY UNIVERSITY

REGULATIONS AND SYLLABUS

for
MASTER OF SCIENCE
(Computer Science)

(For CBSC System in Pondicherry University)
(Effective from the academic year 2018-2019)

Eligibility for Admission

Candidates who have secured 55% of marks or above in any one of the following or equivalent, are eligible to apply: Bachelor's Degree in Computer Science/ Information Technology/ Computer Applications.

Duration of the Course

The course duration shall normally be of two years' duration spread over four semesters. The maximum duration to complete the course shall be 4 years

Medium

The medium of instruction shall be English.

Passing & Classification

Passing Eligibility & Classification for the award of the Degree are as per the Choice Based Credit System norms.

PONDICHERRY UNIVERSITY
SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE
MASTER OF SCIENCE (COMPUTER SCIENCE)
CURRICULUM
(Effective from the academic year 2018-2019)

Course Structure

Course Category	Number of Credits
Core Courses	49 Credits [40 Compulsory + 9 Supportive]
Elective Courses	18 Credits
Skill Enhancement Courses	05 Credits
Total	72

FIRST SEMESTER

S.No.	Course Code	Course Title	H/S	L	T	P	S	Credits
1	CSSC411	Design and Analysis of Algorithms	H	3	1	0	0	3
2	CSSC412	Advanced Computer Architecture	H	3	1	0	0	3
3	CSSC413	Automata Theory & Formal Languages	H	3	1	0	3	3
4		Supportive Core –I	H	3	1			3
5		Skill Enhancement – I	S	1		2		2
6	CSSC414	Practical I – Algorithms Lab	H	0	0	3	0	2
7	CSSC415	Practical II – Computer Architecture Lab	H	0	0	3	0	2

SECOND SEMESTER

S.No.	Course Code	Course Title	H/S	L	T	P	S	Credits
1	CSSC421	Modern Operating Systems	H	3	1	0	0	3
2	CSSC422	Advanced Database Systems	H	3	1	0	0	3
3		Supportive Core – II	H					3
4		Elective – I	S	3		1		3
5		Elective – II	S	3		1		3
6		Elective – III	S	3		1		3
7		Skill Enhancement – II	S	1		2		1

8	CSSC423	Practical III – Operating System Lab	H	0	0	3	0	2
9	CSSC424	Practical IV – Database System Lab	H	0	0	3	0	2

THIRD SEMESTER

S.No.	Course Code	Course Title	H/S	L	T	P	S	Credits
1	CSSC511	Network Design and Management	H	3	1	0	0	3
2		Supportive Core – III	H	3	1			3
3	CSSC 512	Web Technology	H	3	1	0	0	3
4		Elective – IV	S	3		1		3
5		Elective – V	S	3		1		3
6		Skill Enhancement – III	S	1		2		2
7	CSSC513	Practical V– Computer Networks Lab	H	0	0	3	0	2

FOURTH SEMESTER

S.No.	Code	Course Title	H/S	Credits
1	CSSC521	Project Seminar	H	4
2	CSSC522	Project Work	H	4
3	CSSC523	Project Report & Viva-Voce	H	4

SUPPORTIVE CORE COURSES (9 Credits)

Code	Course Title	H/S	Credits
CSSC431	Discrete Mathematics	S	3
CSSC432	Probability and Statistics	S	3
CSSC433	Optimization Techniques	S	3
CSSC434	Linear Programming	S	3

DOMAIN SPECIFIC ELECTIVES COURSES(18 Credits)

S.No	Code	Course Title
STREAM – 1 DATA ANALYTICS		
1	CSSC 441	Big Data (Level 1)
2	CSSC 442	Python Programming for Data Analytics (Level 1)
3	CSSC 443	Statistics for Business Analytics (Level 1)
4	CSSC 444	Marketing Analytics (Level 2)
5	CSSC 445	Social Network Analytics (Level 2)
6	CSSC 446	Risk Analytics (Level 2)
7	CSSC 447	Database Systems in Big Data (Level 3)
8	CSSC 448	Streaming Analytics (Level 3)
9	CSSC 449	Video Processing and Analytics (Level 3)
STREAM – 2 NETWORK COMPUTING		
10	CSSC 451	Principles of Distributed Computing (Level 1)
11	CSSC 452	Introduction to Parallel Computing (Level 2)
12	CSSC 453	Network Design & Management (Level 2)
13	CSSC 454	Web Services Computing (Level 2)
14	CSSC 455	Pervasive & Ubiquitous Computing (Level 3)
15	CSSC 456	Cloud Computing (Level 3)
16	CSSC 457	Internet of Things (Level 3)
STREAM – 3 ARTIFICIAL INTELLIGENCE		
17	CSSC 461	Introduction to A.I. and Expert Systems (Level 1)
18	CSSC 462	Neural Networks (Level 2)
19	CSSC 463	Fuzzy Logic (Level 2)
20	CSSC 464	Decision Support Systems (Level 2)
21	CSSC 465	Introduction to Machine Learning (Level 3)
22	CSSC 466	Introduction to Robotics (Level 3)
23	CSSC 467	Soft Computing (Level 3)

LIST OF SKILL ENHANCEMENTCOURSES (5 Credits)

S.No.	Code	Domain & Course Title	H/S	Credits
1	CSSC 531	Network Management Tools	S	1
2	CSSC 532	Statistical Tools	S	2
3	CSSC 533	Data Mining Tools	S	2
4	CSSC 534	Data Visualization Tools	S	2
5	CSSC 535	Cloud Computing Tools	S	2
6	CSSC 536	Big Data Tools	S	2
7	CSSC 537	Internet of Things (IoT) Tools	S	2

CSSC 411 Design and Analysis of Algorithms

L	T	P	C
3	1	0	3

Pre-requisite:

- *Basic Knowledge in Data Structures and Programming.*

Objectives:

- *To analyze the asymptotic performance of algorithms.*
- *To demonstrate a familiarity with major algorithms and data structures.*
- *To synthesize efficient algorithms in common engineering design situations.*

Module-I: Introduction (9 hrs)

Notion of Algorithm - Linear and Non-Linear Data Structures -Analysis of Algorithm Efficiency: Analysis Frame-Work - Asymptotic Notations and Basic Efficiency Classes - Mathematical Analysis of Non-Recursive and Recursive Algorithms - Empirical Analysis of Algorithm

Module-II:Divide and Conquer (9 hrs)

Brute Force and Divide and Conquer- General method - Binary Search - Finding the maximum and minimum - merge sort - quick sort - Strassen's matrix multiplication. Decrease-and-Conquer and Transform-and-Conquer: Insertion sort -Depth First Search -Topological sorting – Presorting - Gaussian Elimination -Balanced Search Trees - Heap Sort - Horner's Rule.

Module-III: Greedy method (9 hrs)

Greedy Method: General method - Optimal Storage on Tapes -Knapsack problem -Job Sequencing - Minimum Cost Spanning Trees:Prims'sAlgorithm and Kruskal's Algorithm -Optimal Merge Patterns -Single Source Shortest Paths - Huffman Trees.

Module-IV: Dynamic Programming and Backtracking (9 hrs)

Dynamic Programming: General method -Principle of Optimality -Multistage Graphs -All Pairs Shortest Paths: Floyd-Warshall's Algorithms - 0/1 Knapsack - Traveling Salesman Problem. Backtracking: General Method - 8-Queen Problem - Sum of Subsets - Hamiltonian Cycles - Travelling Salesman Problem.

Module-V: Branch and Bound and NP (9 hrs)

Branch and Bound: Introduction FIFO Solution -LC Branch and Bound -Rat in Maze –Traveling Salesman Problem. NP Completeness and Approximation Algorithm: Introduction - Polynomial Time -NP Completeness and Reducibility -Approximation Algorithms.

Text Books:

1. *Ellis Horowitz, Sartaj Sahani, SanguthevarRajashekaran, "Computer Algorithms/C++", Second Edition, 2008*
2. *Horowitz, E. and Sahani, S, "Fundamentals of Computer Algorithms", Second Edition, 2008*.

References:

1. *Aho A.V., Hopcroft, J.E. and Ullaman, "The Design and Analysis of Computer Algorithms", 1979.*

2. *Sara Baase, Allen Van Gelder "Computer Algorithms – An Introduction to Design and Analysis", Third Edition, 1999.*
3. *Goodman, S.E. and Hedetnieml. S.T, "Introduction to the design and analysis of algorithms" McGraw Hill Computer Science Series, 1997.*

CSSC 412 Advanced Computer Architecture

L	T	P	C
3	1`	0	3

Pre-requisite:

- *Basic knowledge in Digital Design, Microprocessor and Computer Architecture.*

Objectives:

- *To understand the evolution of computer architecture.*
- *To understand the design challenges in building a system.*

Module-I: Introduction: (9hrs)

Paradigms of Computing: Synchronous – Vector/Array – SIMD – Systolic Asynchronous – MIMD, reduction Paradigm – Hardware taxonomy: Flynn's classification – Software taxonomy: Kung's taxonomy – SPMD.

Module-II: Memory Organizations: (9 hrs)

Bus – Cache – Shared Memory – Backplane Bus Systems – Cache Memory Organizations – SharedMemory Organizations – Sequential and Weak Consistency Models.

Module-III: Pipeline and Superscalar Techniques: (9 hrs)

Pipelining and Superscalar Techniques – Linear Pipeline Processors– Nonlinear Pipeline Processors– Instruction Pipeline Design– Arithmetic Pipeline Design–Superscalar and Super Pipeline Design.

Module-IV: Parallel Computer Models:(9 hrs)

Parallel Computer Models: Evolution of Computer Architecture– Multiprocessors &Multi-computers– Vector Supercomputers & SIMD supercomputers– VLSI models– Dataflow machines.

Module-V: Parallel Computer Architectures:(9 hrs)

Design Issues–Communication Models, Interconnection Networks–Performance. SIMD Computers: Array Processors & Vector Processors. Shared Memory Multiprocessors: UMA–NUMA &COMA Multiprocessors. Message-Passing Multi-computers.

Text Books:

1. *H. El-Rewini& M. Abd-El-Barr, Advanced Computer Architecture and Parallel Processing, J. Wiley, 2005.*
2. *M. R. Bhujade, Parallel Computing, New Age Intr. Publishers, 1998.*
3. *S. Tanenbaum, Structured Computer Organization, Prentice Hall, 2007.*

References:

1. *W. Stallings, Computer Organization & Architecture, Prentice Hall, 2006.*
2. *Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, Tata McGraw-Hill, 2003.*

CSSC 413 Automata Theory and Formal Languages

L	T	P	C
3	1	0	3

***Pre-requisite**:*

- *Basic knowledge in set theory, Rational relations and Functions*

***Objectives**:*

- *To understand various Computing models like Finite State Machine, Pushdown Automata, and Turing Machine.*
- *To understand Decidability and Undecidability of various problems.*

Module-I: Finite Automata (9 hrs)

Introduction- Basic Mathematical Notation and Techniques- Finite State systems – Basic Definitions – Finite Automaton – DFA & NDFA – Finite Automaton with €- moves – Regular Languages- Regular Expression – Equivalence of NFA and DFA – Equivalence of NDFA's with and without €-moves – Equivalence of finite Automaton and regular expressions –Minimization of DFA- Pumping Lemma for Regular sets – Problems based on Pumping Lemma.

Module-II: Grammars (9 hrs)

Grammar Introduction– Types of Grammar - Context Free Grammars and Languages– Derivations and Languages – Ambiguity- Relationship between derivation and derivation trees – Simplification of CFG – Elimination of Useless symbols - Unit productions - Null productions – GreibachNormal form – Chomsky normal form – Problems related to CNF and GNF.

Module-III: Pushdown Automata (9 hrs)

Pushdown Automata- Definitions – Moves – Instantaneous descriptions – Deterministic Pushdown automata – Equivalence of Pushdown automata and CFL - pumping lemma for CFL – problems based on pumping Lemma.

Module-IV: Turing Machine (9 hrs)

Turing Machines- Introduction – Formal definition of Turing machines – Instantaneous descriptions- Turing Machine as Acceptors – Turing Machine as Transducers Computable Languages and functions – Turing Machine constructions – Modifications of Turing Machines.

Module-V: Computational Complexity (9 hrs)

Undecidability- Basic definitions- Decidable and undecidable problems - Properties of Recursive and Recursively enumerable languages – Introduction to Computational Complexity: Definitions-Time and Space complexity of TMs – complexity classes – introduction to NP-Hardness and NP-Completeness.

Text Book:

1. *Hopcroft J.E., Motwani R. and Ullman J.D, Introduction to Automata Theory, Languages and Computations, Pearson Education, Second Edition, 2008.*

Reference Books:

1. *John.C.Martin, Introduction to Languages and the Theory of Computation, McGraw-Hill Education, 2010.*
2. *Michael Sipser, Introduction to the Theory of Computation, Cengage Learning, 2012.*
3. *Peter Linz, An introduction to formal languages and automata, Jones & Bartlett Learning, 2001.*

CSSC 414 Algorithm Lab

L	T	P	C
0	0	3	2

***Skills to be acquired**:*

- *Able to analyzeperformance of algorithms and the ability to get them implemented.*

***Lab Software Requirements**:*

- *Any programming Language*

***List of Exercises**:*

Programs should include but not limited to:

1. *Write a program that implements Binary Search*
2. *Write a program that implements Quick Sort*
3. *Write a program that implements Strassen's matrix multiplication*
4. *Write a program that implements Prim's Algorithm*
5. *Write a program that implements Kruskal's Algorithm*
6. *Write a program that implements All pair shortest path problem*
7. *Write a program that implements N-Queen Problem*
8. *Write a program that implements Heapsort*
9. *Write a program that implements Travelling Salesperson Problem*
10. *Write a program that implements Knapsack using greedy Method*

CSSC 415Computer Architecture Lab

L	T	P	C
0	0	3	2

***Skills to be acquired**:*

- *Able to Understand Computer Architecture components and the ability to implement.*

***Lab Software Requirements**:*

- *Any Simulation Software.*

List of Exercises:

1. *Simulation of Computer Components.*
2. *Simulation of Pipeline.*
3. *Simulation of Instruction Level Parallelism.*
4. *Simulation of Cache Memory.*
5. *Simulation of Multiprocessor.*
6. *Simulation of Vector Processor.*
7. *Simulation of Thread Level Parallelism.*
8. *Simulation of Data Level Parallelism.*

CSSC 421 Modern Operating Systems

L	T	P	C
3	1	0	3

***Pre-requisite**:*

- *Computer Organizations and Data Structure*

***Objectives**:*

- *To acquire knowledge in Distributed operating.*
- *To know the components of distributed resource management.*
- *To know the components and management aspects of Real time, Mobile operating systems.*

Module-I:Basics of Operating Systems (9 hrs)

Overview – Synchronization Mechanisms – Processes and Threads – Process Deadlocks – Issues in Distributed Operating Systems – Communication Primitives – Limitations of a Distributed System

Module-II:Memory Management (9 hrs)

Memory Management - Paging - Segmentation - Virtual Memory- Demand paging - Replacement Algorithms – Design Issues – Implementation Issues – Research on Memory Management.

Module-III:File Systemsand I/O (9 hrs)

File systems - Design issues - User interface to file– File System Implementation –File System Management and Optimization.Principle of I/O Hardware & Software - Systems I/O device management - Disk Scheduling approaches

Module-IV:Mobile and Real Time Operating Systems (9 hrs)

Basic Model of Real Time Systems – Characteristics – Applications of Real Time Systems – Real Time Task Scheduling – Handling Resource Sharing. Mobile Operating Systems – Architecture – Layers – Microkernel Design – Kernel Extensions – Processes and Threads – Memory Management – File system – Android – iOS

Module-V:Mainframe and Linux (9 hrs)

Mainframe – z/OS – Overview of z/OS Facilities – Virtual Storage and other Mainframe Concepts – Workload Management – I/O and Data Management – Supervising the Execution of Work in the System – Cross-memory Services – Characteristics of z/OS. Linux – Design Principles – Kernel Modules – Process Management – Scheduling – Memory Management – I/O Management – File System – Interprocess Communication.

***Text Books**:*

1. *Andrew S. Tanenbaum and Herbert Bos, "Modern Operating Systems", Fourth Edition, Prentice Hall, 2014.*
2. *Mukesh Singhal, Niranjan Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database and Multiprocessor Operating Systems", Tata McGraw-Hill, 2001.*
3. *Rajib Mall, "Real-Time Systems: Theory and Practice", Prentice Hall, 2006.*

***Reference Books**:*

1. *Jonathan Levin, "Mac OS X and iOS Internals: To the Apple‟s Core", John Wiley & Sons, 2012.*
2. *Mike Ebbers, John Kettner, Wayne O‟Brien, Bill Ogden, "Introduction to the New Mainframe: z/OS Basics", Third Edition, International Business Machines Corporation, 2011.*

3. *Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", Wiley, Eighth edition, 2008.*

CSSC 422 ADVANCED DATABASE SYSTEMS

L	T	P	C
3	1	0	3

***Pre-requisite**:*

- *Basic knowledge in Database systems.*

***Objectives**:*

- *To introduce the fundamental concepts of database systems,*
- *To acquaint the students with the use of current relational database systems,*
- *To build a solid foundation for advanced studies in database area.*

Module-I: Introduction (9 hrs)

Introduction: Purpose of Database Systems - View of Data - Database Languages - Data Storage and Querying - Database Users and Administrators. Relational Databases: Introduction to the Relational Model - Structure of Relational Databases-Database Schema -Keys-Schema Diagrams - Functional Dependency – Normalization. Relational Query Languages - Relational operations. Advanced SQL - Accessing SQL from a Programming Language – Triggers.

Module-II:Transaction Management and Concurrency Control (9 hrs)

Transaction Management: Overview of Transaction Management- The ACID Properties - Transactions and Schedules- Concurrent Execution of Transactions - Lock-Based ConcurrencyControl - Performance of Locking - Introduction to Crash Recovery.Concurrency Control: 2PL, Serializability, and Recoverability - Introduction to LockManagement - Lock Conversions - Dealing with Deadlocks - Specialized Locking Techniques -Concurrency Control without Locking.

Module-III:Parallel and Distributed Databases (9 hrs)

Parallel DBMS:Architecture - Query evaluation - Query optimization -Parallelizing individual operations.Distributed DBMS:Architecture - Storing data - Cataloguing - Query processing - Updations Transactions – Concurrency and Recovery.

Module-IV: Object and Object Relational Databases (9 hrs)

Object oriented Databases: Object oriented DBs -Object modeling in database systems- Object identity OODBMS architecture and storage issues - Querying persistent objects- Transactions and concurrency control clustering indexing - case study

Module-V: Multimedia and Mobile Database Technologies (9 hrs)

Multimedia Databases: Nature of Multimedia data and applications - Data Management Issues - Multimedia database applications. Mobile Databases: Mobile computing architecture – Mobile environment – characteristics - Data Management Issues.

***Text Books**:*

1. *R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Fifth Edition, Pearson Education/Addison Wesley, 2007.*
2. *Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Third Edition, Pearson Education, 2007.*
3. *Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", Fifth Edition, McGraw Hill, 2006.*

Reference Books:

1. *L. Dunckley, "Multimedia Databases: An Object Relational Approach", Addison-Wesley, 2003.*
2. *Vijay Kumar, "Mobile Database Systems", John Wiley & Sons, 2006*
3. *Raghu Ramakrishnan "Database Management Systems",Third Edition, McGrawHill, 2003.*

CSSC 423 Operating System Lab

L	T	P	C
0	0	3	2

***Skills to be acquired**:*

- *Able to understand the design issues associated with Operating Systems.*

***Lab Software Requirements**:*

- *Any Programming Language*

List of Exercises:

1. *Write a program to simulate the following non-preemptive CPU scheduling algorithms to find turnaround time and waiting time. (a) FCFS (b) SJF (c) Round Robin (pre-emptive) (d) Priority.*
2. *Write a program to simulate the following file allocation strategies.*
   (a) Sequential (b) Indexed (c) Linked.
3. *Write a program to simulate paging technique of memory management.*
4. *Write a program to simulate the following file organization techniques*
   (a) Single level directory (b) Two level directory (c) Hierarchical.
5. *Write a program to simulate Bankers algorithm for the purpose of deadlock avoidance.*
6. *Write a program to simulate disk scheduling algorithms*
   (a) FCFS (b) SCAN (c) C-SCAN.
7. *Write a program to simulate page replacement algorithms*
   (a) FIFO (b) LRU (c) LFU.
8. *Write a program to simulate producer-consumer problem using semaphores.*
9. *Write a program to simulate the concept of Dining-Philosophers problem.*

CSSC 424 Database Systems Lab

L	T	P	C
0	0	3	2

***Skills to be acquired**:*

- *Able to use database efficiently in applications to handle data.*

***Lab Software Requirements**:*

- *Database like MySQL / SQL Server.*

***List of Exercises**:*

1. *Distributed Database for Bookstore*
2. *Deadlock Detection Algorithm for distributed database using wait- for graph*
3. *Object Oriented Database – Extended Entity Relationship (EER)*
4. *Parallel Database – University Counselling for Engineering colleges*
5. *Parallel Database – Implementation of Parallel Join & Parallel Sort*
6. *Active Database – Implementation of Triggers & Assertions for Bank Database*
7. *Deductive Database – Constructing Knowledge Database for Kinship Domain (Family Relations)*
8. *Study and Working of WEKA Tool*
9. *Query Processing – Implementation of an Efficient Query Optimizer*
10. *Designing XML Schema for Company Database*

CSSC 511 Advanced Computer Networks

L	T	P	C
3	1	0	3

***Pre-requisite**:*

- *Fundamental knowledge about Computer Networks*

***Objectives**:*

- *To acquaint the students with the application of networking.*
- *Detail description of the various TCP/IP protocols.*
- *Working of ATM and its performance, Network security and authentication.*
- *Various algorithms related to it has been dealt, to get a practical approach.*

Module-I:TCP/IP Protocol (9 hrs)

Layered protocols, internet Addressing, mapping internet address to physical address, internet protocol, OSPF, RIP, RARP, BOOTP, DHCP, BGP, ARP, IP, Ipv6, ICMP Transport protocols: UDP, TCP and SNMP

Module-II:Connection oriented networks (9 hrs)

Frame relay, B-ISDN, ATM protocol stack, ATM switching, internetworking with ATM Networks, trafficmanagement in ATM.

Module-III: High Speed LAN (9 hrs)

LAN Ethernet, fast Ethernet, gigabit Ethernet, FDDI, DSL, ADSL

Module-IV: Wireless communication (9 hrs)

Wireless networks, wireless channels, channel access, network architecture, IEEE 802.11, Bluetooth.

Module-V: Network Analysis and Modelling (9 hrs)

Queuing theory, modeling network as a graph, network management system and standard.

Text Books:

1. *J. Walrand& Pravin Varaiya , Morgan Kaufman, "High performance communication networks", 1999.*
2. *Douglas E. Comer, "Internetworking with TCP/IP Vol.1: Principles, Protocols, and Architecture", 4th Edition.*
3. *Rainer Handel, Manfred N. Huber, Stefan Schroder, "ATM networks: Concepts, Protocols, Applications", Addison Wesley.*
4. *William Stallings, "Cryptography & Networks Security", 3rd edition.*

References:

1. *Tanenbaum, Andrew S, "Computer Networks", Prentice Hall, 4th edition, 2002.*
2. *Forouzan, B. A., "Data Communication and Networking", Mcgraw Higher Ed. 2006.*
3. *Uyless, Black, "Computer Networks: Protocols, Standards and Interfaces", Prentice Hall*

CSSC 512 WEB TECHNOLOGY

L	T	P	C
3	1	0	3

***Pre-requisite**:*

- *Basic Knowledge in computer network, working of Internet and java language.*

***Objectives**:*

- *To inculcate knowledge of web technological concepts and functioning of internet*
- *To learn and program features of web programming languages.*
- *To understand the major components of internet and associated protocols.*
- *To design an innovative application for web.*

Module-I: Review of the Internet technologies (9 hrs)

Introduction Web essentials: Web Vs Internet - Clients -Servers - Communication - Internet Address - Ports – Sockets - DNS - Firewall - Proxy - Internet Service Provider - Internet Services Protocols. Introduction to static web page creation using HTML (Tables, Frames, Forms) and Cascading Style Sheets.

Module-II: Client-Side Scripting (9 hrs)

Client-Side Scripting: Introduction - JavaScript – Data Types – Variable declarations - Language Constructs – JavaScript Functions. Windows Manipulation – Working with Forms and elements – Cookies.

Module-III: Server-Side Scripting (9 hrs)

Sever Side Scripting: Introduction – PHP Language Basics: Data Types – Variable declarations – Arrays – Functions – Language Constructs – OOP with PHP. Session Management – Authentication and Security – Reporting. Database manipulation with PHP and MYSQL.

Module-IV: XML (9 hrs)

XML: Introduction - XML Syntax - XML basics - XML Parser and Processors - XML DTD: Elements and Attributes - Types - XML Schema. SOAP - Creating Simple web services.

Module-V:AJAX (9 hrs)

AJAX: Introduction - creating and sending requests - XML in JavaScript and AJAX – server-side AJAX with PHP.

Text Books:

1. *Laure Lemay, Web Publishing with HTML4, Techmedia, First Edition.*
2. *Ivan Bayross, Commercial Web Development, Second Edition.*

Reference Books:

1. *Thau, The book of JavaScript: a practical guide to interactive Web pages, Second Edition.*
2. *David Lane, Hugh E. Williams, Web Database Application with PHP and MySQL, Second Edition*
3. *Deital and Deital, XML How to program, Pearson Education, 2001.*

CSSC 513 Networks Lab

L	T	P	C
0	0	3	2

***Skills to be acquired**:*

- *Able to establish and Configure Computer Networks.*

***Lab Software Requirements**:*

- *Any Network Simulator*

List of Exercises:

1. *To analyze the performance of various configurations and protocols in LAN.*
    a. *Establishing a LAN.*
    b. *Connecting two LANs using multi-router topology with static routes.*
2. *To configure Dial-On-Demand Routing.*
3. *To analyze the performance of RIP and OSPF redistribution.*
4. *To analyze the network security for improving the security of the network.*
5. *To Control Traffic Flow in a network.*
6. *To configure the standard access list for a network*
7. *To configure the extended access control list for a network.*
8. *To configure a firewall and analyze it for a network.*

CSSC 514 Web Technology Lab

L	T	P	C
0	0	3	2

***Skills to be acquired**:*

- *Able to design and develop web applications.*

***Lab Software Requirements**:*

- *Dreamweaver or Xampp*

List of Exercises:

1. *To create a simple webpage using HTML that includes all tags.*
2. *Applying Style to an HTML Page Using CSS.*
3. *Client-Side Programming:*
    a. *Java script for Displaying and Comparing Date*
    b. *Form Validation including text field, radio buttons, check boxes, list box and other controls.*
4. *Online Applications using PHP.*
5. *Online application with data access.*
6. *Creation of XML document.*
7. *XML document and DTD.*
8. *Parsing an XML document using DOM and SAX Parsers.*

CSSC 431 Discrete Mathematics

L	T	P	C
3	1	0	3

***Pre-requisite**:*

- *Basic knowledge in Mathematics.*

***Objectives**:*

- *Reason mathematically about basic data types and structures (such as numbers, sets, graphs, and trees) used in computer algorithms and systems; distinguish rigorous definitions and conclusions from merely plausible ones; synthesize elementary proofs, especially proofs by induction.*
- *Model and analyze computational processes using analytic and combinatorial methods.*
- *Apply principles of discrete probability to calculate probabilities and expectations of simple random processes.*
- *They will be able to use these methods in subsequent courses in the design and analysis of algorithms, computability theory, software engineering, and computer systems.*

Module-I: Set Theory and its Relation (9 hrs)

Definition of Sets - Venn Diagrams – complements - cartesian products - power sets - counting principle - cardinality and countability (Countable and Uncountable sets) - proofs of some general identities on sets - pigeonhole principle. Relation: Definition - types of relation - composition of relations - domain and range of a relation - pictorial representation of relation - properties of relation - partial ordering relation. Function: Definition and types of function - composition of functions - recursively defined functions.

Module-II: Propositional logic (9 hrs)

Proposition logic - basic logic - logical connectives - truth tables – tautologies - contradiction - normal forms (conjunctive and disjunctive) - modus ponens and modus tollens – validity - predicate logic, universal and existential quantification. Notion of proof: proof by implication – converse – inverse - negation, and contradiction - direct proof - proof by using truth table - proof by counter example.

Module-III:Combinatorics (9 hrs)

Mathematical induction - recursive mathematical definitions - basics of counting – permutations – combinations - inclusion-exclusion .

Module-IV: Recurrence Relations (9 hrs)

Recurrence relations -nth order recurrence relation with constant coefficients - Homogeneous recurrence relations - Inhomogeneous recurrence relation - generating function (closed form expression, properties of G.F., solution of recurrence relation using G.F - solution of combinatorial problem using G.F.).

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Module-V:Algebraic Structure (9 hrs)

Binary composition and its properties definition of algebraic structure - - Monoid Groups - Abelian Group - properties of groups - Permutation Groups - Sub Group - Cyclic Group - Rings and Fields (definition and standard results)

***Text Books**:*

1. *Kenneth H. Rosen, "Discrete Mathematics and its Applications", McGraw Hill, 2002.*

2. *J.P.Tremblay& R. Manohar, "Discrete Mathematical Structure with Applications to Computer Science', Mc. Graw Hill, 1975.*

Reference Books:

1. *V. Krishnamurthy, "Combinatories:Theory and Applications", East-West Press.*
2. *Seymour Lipschutz, M.Lipson, "Discrete Mathemataics" Tata McGraw Hill, 2005.*
3. *Kolman, Busby Ross, "Discrete Matheamatical Structures", Prentice Hall International*.

CSSC 432 Probability and Statistics

L	T	P	C
3	1	0	3

***Pre-requisite**:*

- *Introduction concepts in Probability/Statistics*
- *Basic discrete Probability*
- *Basic mathematical concepts like Sets, Number Line*
- *Equations and Inequalities*

***Objectives**:*

- *Understand concepts of discrete probability, conditional probability, independence, and can apply these concepts to engineering applications (selected by instructor).*
- *Understand mathematical descriptions of random variables including probability mass functions (PMFs), cumulative distribution functions (CDFs), probability distribution functions (PDFs), conditional mass, conditional distribution and conditional density functions.*

Module-I: Introduction** **(8 hrs)

Combinatorial methods- Principles of counting – Permutation – Combination – Binomial theorem-problems

Module-II: Probability** **(9 hrs)

Probability: Classical - relative frequency and axiomatic definitions of probability - addition rule and conditional probability - multiplication rule - total probability - Bayes' Theorem and independence – problems.

Module-III: Random Variables** **(10 hrs)

Random Variables: Discrete - continuous and mixed random variables - probability mass - probability density and cumulative distribution functions - mathematical expectation – Variance- moments - probability and moment generating function - median and quantiles - Markov inequality.

Module-IV: Special Distributions** **(9 hrs)

Special Distributions: Discrete uniform – binomial – geometric - negative binomial – hypergeometric – Poisson - continuous uniform – exponential – gamma – Weibull – Pareto – beta – normal – lognormal - inverse Gaussian – Cauchy - double exponential distributions - reliability and hazard rate - reliability of series and parallel systems - problems.

Module-V: Joint Distributions** **(9 hrs)

Joint Distributions: Joint - marginal and conditional distributions - product moments - correlation and regression - independence of random variables - bivariate normal distribution - problems.

***Text Books**:*

1. *Gupta, S.C. and Kapoor, V.K.(2000): Fundamentals of Mathematical Statistics, 10/e, Sultan Chand and Sons*

Reference Books:

1. *Irwin Miller and Marlyees Miller (2002): John E Freund's Mathematical Statistics, 6/e, PHI*

2. *S.M. Ross, Introduction to Probability and Statistics for Engineers and Scientists,2009, 4th edition, Elsevier*

CSSC433 Optimization Techniques

L	T	P	C
3	1	0	3

***Pre-requisite**:*

- *Fundamental knowledge of calculus and linear programming problem*
- *Mathematical models*

***Objectives**:*

- *To introduce the fundamental concepts of Optimization Techniques;*
- *To make the learners aware of the importance of optimizations in real scenarios;*
- *To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable.*

Module-I: Introduction to Classical Methods & Linear Programming Problems Terminology(9 hrs)

Introduction to Classical Methods & Linear Programming Problems Terminology: Design Variables – Constraints - Objective Function - Problem Formulation. Calculus method - Kuhn Tucker conditions - Method of Multipliers. Linear Programming Problem - Simplex method - Concept of Duality.

Module-II: Single Variable Optimization (9 hrs)

Single Variable Optimization: Problems Optimality Criterion - Bracketing Method - Region Elimination Methods - Interval Halving Method - Fibonacci Search Method - Golden Section Method. Gradient Based Methods: Newton - Raphson Method - Bisection Method - Secant Method - Application to Root finding.

Module-III: Multivariable Optimization Algorithms (9 hrs)

Multivariable Optimization Algorithms Optimality: Criteria - Unidirectional Search. Direct Search Methods: Hooke - Jeeves pattern search method - Powell's Conjugate Direction Method. Gradient Based Methods: Cauchy's Steepest Descent Method - Newton's method - Marquardt's Method.

Module-IV: Advance Optimization Techniques (9 hrs)

Quadratics Programming – sequential quadratic programming - Integer Programming - Penalty Function Method - Branch and Bound Method - Geometric Programming.

Module-V: Dynamic Programming (9 hrs)

Dynamic Programming: Genetic algorithm - Problem formulation and application in Design of continuous beam and Optimal geometric layout of a truss - Capacity expansion and Reservoir operation.

Text Books:

1. *S. S. Rao: Engineering Optimization, New Age International.*
2. *E. J. Haug and J.S. Arora, Applied Optimal Design, Wiley, New York.*

Reference Books:

1. *Kalyanmoy Deb, Optimization for Engineering Design, Prentice Hall of India, Second Edition, 2012.*
2. *A. Ravindran and K.M. Rogsdell, G.V. Reklaites, Engineering Optimization: Methods and Applications, Wiley, Second Edition, 2006.*

CSSC434 Linear Programming

L	T	P	C
3	1	0	3

***Pre-requisite**:*

- *Introduction concepts in linear Programming/Operations, Linear Algebra, Differential Calculus, Mathematical models.*
- *Basic mathematical concepts such as sets, functions, vectors, matrices, etc*

***Objectives**:*

- *Understand the linear programming problem*
- *Enumerate LPP simplex methods*
- *Discuss LPP duality*
- *Differentiate Non-Linear Programming Problem and LPP*

Module-I: Linear Programming Problem (9 hrs)

Operations Research: Introduction – Applications of OR – Linear Programming Problem: LPP Introduction – Formulation of Linear Programming Model- Illustration on Mathematical Formulation of LPP – Graphical Solution – General LPP – Canonical and Standard forms of LPP

Module-II: LPP Simplex Method (9 hrs)

Introduction – Fundamental Properties of Solution – The Computational Procedure – Use of Artificial Variables – Degeneracy in LPP – Solutions of Simultaneous Linear Equations– Big M Method- Applications of Simplex Method

Module-III: Duality in Linear Programming (9 hrs)

Duality LPP – General Prime-Dual Pair – Formulating a Dual Problem – Primal-Dual Pair in Matrix Form – Duality Theorems– Dual Simplex Method – Two-Phase Method

Module-IV: Dynamic Programming (9 hrs)

Dynamic Programming:Introduction – The Recursive Equation Approach – Characteristics of DPP – Dynamic Programming Algorithm - Applications of DPP.

Module-V: Network Routing and Scheduling (9 hrs)

Network Routing: Network Flow Problems – Minimal Spanning Tree Problem – Shortest Route Problems – Applications of Shortest Route Problem. Network Scheduling:Introduction– Logical Sequencing – Concurrent Activities – Critical Path Analysis – PERT – CPM

***Text Books**:*

1. *R.Panneerselvam, "Operations Research", PHI, 2006.*
2. *Kanti Swaroop, Man Mohan and P.K. Gupta, "Operations Research", Sultan Chand and Sons, 2005.*
3. *Hamdy A Taha, "Operations Research –An Introduction", Prentice Hall India, 2003.*

***Reference Books**:*

1. *Philips, Ravindran and Solberg, "Operations Research", John Wiley, 2002.*
2. *Ronald L.Rardin, "Optimization in Operation Research", Pearson Education Pvt. Ltd. New Delhi, 2005.*

DOMAIN SPECIFIC ELECTIVES
(12 Credits)

DATA ANALYTICS

CSSC 441 Big Data

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Data mining and Information Systems*

***Objectives**:*

- *This course brings together several key big data technologies used for storage, analysis and manipulation of data.*
- *To recognize the key concepts of Hadoop framework, MapReduce, Pig, Hive, and No-SQL.*
- *To prepare a sample project in Hadoop API.*

Module-I: Introduction to Big Data (9 hrs)

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

Module-II: Big Data Technologies (9 hrs)

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 – Crowd Sourcing Analytics – Inter- and Trans-Firewall Analytics - Information Management.

Module-III: Processing Big Data (9 hrs)

Integrating disparate data stores - Mapping data to the programming framework - Connecting and extracting data from storage - Transforming data for processing - Subdividing data in preparation for Hadoop Map Reduce.

Module-IV: Hadoop MapReduce (9 hrs)

Employing Hadoop Map Reduce - Creating the components of Hadoop Map Reduce jobs - Distributing data processing across server farms –Executing Hadoop Map Reduce jobs - Monitoring the progress of job flows - The Building Blocks of Hadoop Map Reduce - Distinguishing Hadoop daemons - Investigating the Hadoop Distributed File System Selecting appropriate execution modes: local, pseudo-distributed, fully distributed.

Module-V:Advanced Analytics Platform (9 hrs)

Real-Time Architecture – Orchestration and Synthesis Using Analytics Engines – Discovery using Data at Rest – Implementation of Big Data Analytics – Big Data Convergence – Analytics Business Maturity Model.

Text Books:

1. *Michael Minelli, Michehe Chambers, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business", 1st Edition, Ambiga Dhiraj, Wiely CIO Series, 2013.*
2. *Arvind Sathi, "Big Data Analytics: Disruptive Technologies for Changing the Game", 1st Edition, IBM Corporation, 2012.*
3. *Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", 1st Edition, Wiley and SAS Business Series, 2012.*

Reference Book(s):

1. *Tom White, "Hadoop: The Definitive Guide", 3rd Edition, O'reilly, 2012.*

CSSC 442 Python Programming for Data Analytics

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Programming knowledge in any OO language.*

***Objectives**:*

- *Understanding the basic concepts of Python*
- *Preparing and pre-processing data*
- *Understanding the data aggregation and grouping concepts*
- *Leveraging web scraping*
- *Visualizing the results of analytics effectively*

Module-I: Python Concepts, Data Structures, Classes (9 hrs)

Interpreter – Program Execution – Statements – Expressions – Flow Controls – Functions - Numeric Types – Sequences - Strings, Tuples, Lists and - Class Definition – Constructors – Inheritance – Overloading – Text & Binary Files - Reading and Writing.

Module-II: Data Wrangling (9 hrs)

Combining and Merging DataSets – Reshaping and Pivoting – Data Transformation – String Manipulation, Regular Expressions.

Module-III: Data Aggregation, Group Operations, Timeseries (9 hrs)

GoupBy Mechanics – Data Aggregation – GroupWise Operations and Transformations – Pivot Tables and Cross Tabulations – Date and Time Date Type tools – Time Series Basics – Data Ranges, Frequencies and Shifting.

Module-IV: Web Scraping (9 hrs)

Data Acquisition by Scraping web applications –Submitting a form - Fetching web pages – Downloading web pages through form submission – CSS Selectors.

Module-V: Visualization in Python (9 hrs)

Matplotlib package – Plotting Graphs – Controlling Graph – Adding Text – More Graph Types – Getting and setting values – Patches.

Text Book(s):

1. *Mark Lutz, "Programming Python", O'Reilly Media, 4th edition, 2010.*
2. *Mark Lutz, "Learning Python", O'Reilly Media, 5th Edition, 2013.*
3. *Tim Hall and J-P Stacey, "Python 3 for Absolute Beginners", Apress, 1st edition, 2009.*
4. *Magnus Lie Hetland, "Beginning Python: From Novice to Professional", Apress, Second Edition, 2005.*
5. *Shai Vaingast, "Beginning Python Visualization Crafting Visual Transformation Scripts", Apress, 2nd edition, 2014.*

Reference Book(s):

1. *Wes Mc Kinney, "Python for Data Analysis", O'Reilly Media, 2012.*
2. *White, "Hadoop: The Definitive Guide", Third Edition - O'Reilly , 2012.*
3. *Brandon Rhodes and John Goerzen, "Foundations of Python Network Programming: The Comprehensive Guide to Building Network Applications with Python",Apress, Second Edition, 2010.*
4. *http://blog.matthewrathbone.com/2013/11/17/python-map-reduce-on-hadoop---a-beginnerstutorial.html*

5. *http://www.michael-noll.com/tutorials/writing-an-hadoop-mapreduce-program-in-python/*
6. *http://allthingshadoop.com/category/python/*

CSSC 443 Statistics for Business Analytics

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Data mining and its concepts*

***Objectives**:*

- *To identify the association between various types of data.*
- *To apply statistical inference techniques.*
- *To apply methods of inference to applied business situations.*
- *To identify, build and validate appropriate statistical regression models*

Module-I: Introduction

Data -Data Tables - Categorical and Numerical Data - Recoding and Aggregation - Time Series - Describing Categorical Data - Charts of Categorical Data -The Area Principle - Mode and Median - Describing numerical data - Summaries of Numerical Variables -Histograms and the Distribution of - Numerical Data – Boxplot - Shape of a Distribution

Module-II: Association in Categorical and Numerical Data:

Contingency Tables -Lurking Variables and Simpson's Paradox - Strength of Association – Scatterplots - Association in Scatterplots - Measuring Association - Summarizing Association with a Line - Spurious Correlation

Module-III: Probability

Probability - Conditional Probability - Random Variables - Association between Random Variables - Probability models for Counts - Normality – Managing Financial Risk - Modeling Sampling Variation

Module-IV:Inference

Samples and Surveys - Sampling Variation and Quality - Confidence Intervals- Hypothesis Tests - Alternative Approaches to Inference - Data for Comparisons -Two-sample T-test - Confidence Interval for the Difference - Rare Events -Testing Association.

Module-V: Regression Models - I

Linear Patterns - Curved Patterns - Simple Regression – Regression Diagnostics - Multiple Regressions.

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Text Book(s):

1. *Robert Stine, Dean Foster, "Statistics for Business: Decision Making and Analysis", Pearson Education, 2nd edition, 2013.*
2. *Paul Newbold, William L. Carlson, Betty Thorne, "Statistics for Business and economics", Pearson Education, 6th edition.*

Reference Book(s):

1. *Keller Gerald, "Statistics for Management and Economics", Cengage Learning, 1oth edition, 2014.*

CSSC 444 Marketing Analytics

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Data mining with Statistics*

***Objectives**:*

- *Learn how to tap a simple and cost-effective tool, Microsoft Excel, to solve specific business problems using powerful analytic techniques.*
- *Helps to forecast sales and improve response rates for marketing campaigns.*
- *Explores how to optimize price points for products and services, optimize store layouts, and improve online advertising.*

Module-I: Marketing Data Summarization (9 hrs)

Slicing and Dicing Marketing Data with PivotTables - Using Excel Charts to Summarize Marketing Data - Using Excel Functions to Summarize Marketing Data.

Module-II: Forecasting Techniques (9 hrs)

Simple Linear Regression and Correlation - Using Multiple Regression to Forecast Sales - Forecasting in the Presence of Special Events - Modeling Trend and Seasonality - Ratio to Moving Average Forecasting Method - Winter's Method - Using Neural Networks to Forecast Sales.

Module-III: Customer Needs (9 hrs)

Conjoint Analysis - Logistic Regression - Discrete Choice Analysis – Customer Value - Introduction to Customer value, Benefits.

Module-IV: Market Segmentation (9 hrs)

Cluster Analysis - User-Based Collaborative Filtering - Collaborative Filtering – Using Classification Trees for Segmentation.

Module-V: Retailing and Market Research Tools (8 hrs)

Retailing - Introduction to retailing, Market Basket Analysis and Lift - Marketing Research Tools - Principal Components Analysis.

Text Book(s):

1. *Wayne.L.Winston, "Marketing Analytics: Data driven techniques with MS-Excel", Wiley, 1st ed. 2014.*

Reference Book(s):

1. *Stephan Sorger, "Marketing Analytics: Strategic models and metrics", CreateSpace Independent Publishing Platform, 1st ed., 2013.*

CSSC 445 Social Network Analytics

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Nil.*

***Objectives**:*

- *Analyse the structure and evolution of networks*
- *Able to gain knowledge from disciplines as diverse as sociology, mathematics, computer science.*
- *Understand the Online interactive demonstrations and hands-on analysis of real-world data sets.*

Module-I: Introduction (9 hrs)

Social network data-Formal methods- Paths and Connectivity-Graphs to represent social relations-Working with network data- Network Datasets-Strong and weak ties - Closure, Structural

Module-II: Social Influence (9 hrs)

Homophily- Mechanisms Underlying Homophily, Selection and Social Influence, Affiliation,Tracking Link Formation in On-Line Data, Spatial Model of Segregation - Positive and Negative Relationships - Structural Balance - Applications of Structural Balance, Weaker Form of Structural Balance.

Module-III: Information Networks and The World Wide Web (9 hrs)

The Structure of the Web- World Wide Web- Information Networks, Hypertext, and Associative Memory- Web as a Directed Graph, Bow-Tie Structure of the Web- Link Analysis and Web Search Searching the Web: Ranking, Link Analysis using Hubs and Authorities- Page Rank- Link Analysis in Modern Web Search, Applications, Spectral Analysis, Random Walks, and Web Search.

Module-IV: Social Network Mining (9 hrs)

Clustering of Social Network graphs: Betweenness, Girvan Newman algorithm-Discovery of communities- Cliques and Bipartite graphs-Graph partitioning methods-Matrices-Eigen values Sim-rank.

Module-V: Network Dynamics (9 hrs)

Cascading Behaviour in Networks: Diffusion in Networks,Modelling Diffusion - Cascades and Cluster, Thresholds, Extensions of the Basic Cascade Model- Six Degrees of Separation-Structure and Randomness, Decentralized Search- Empirical Analysis and Generalized Models- Analysis of Decentralized Search.

***Text Books**:*

1. *Easley and Kleinberg, "Networks, Crowds, and Markets: Reasoning about a highly connected world", Cambridge Univ. Press, 2010.*
2. *Robert A. Hanneman and Mark Riddle, "Introduction to social network methods", University of California, 2005.*
3. *Jure Leskovec,StanfordUniv.AnandRajaraman,Milliway Labs, Jeffrey D. Ullman, "Mining of Massive Datasets", Cambridge University Press, 2 edition, 2014.*

***Reference Books**:*

1. *Wasserman, S., & Faust, K, "Social Network Analysis: Methods and Applications", Cambridge University Press; 1 edition, 1994.*

2. *Borgatti, S. P., Everett, M. G., & Johnson, J. C., "Analyzing social networks", SAGE Publications Ltd; 1 edition, 2013.*
3. *John Scott , "Social Network Analysis: A Handbook" , SAGE Publications Ltd; 2nd edition, 2000.*

CSSC 446 Risk Analytics

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Nil.*

***Objectives**:*

- *To understand the functioning of Banking and apply analytic techniques to mitigate risks*
- *To understand the operations of Insurance sector and apply analytic techniques to mitigate risks and improve profitability*
- *To understand the processes involved in Healthcare industry and use data analysis to improve patient care and optimize cost*
- *To understand human relationship management techniques for effective management of people.*

Module-I: Introduction (9 hrs)

Risk – Definitionand Examples, Components and Factors; Understanding Risk Assessment, Risk Mitigation and Risk Management; Risk Analytics- Definition and Objectives.

Module-II: Risk Analytics for Banking Domain (9 hrs)

Introduction to Banking Sector; National and International laws; Credit Risk Analytics, Internal capital Adequacy Assessment Process Related Risk Analytics, Limit Management, Risk-Adjusted Performance Management,Fraud Risk; Case Studies.

Module-III: Risk Analytics for Insurance Domain (9 hrs)

Introduction to Insurance Sector; Property & Causality Insurance Companies and Life Insurance Companies; Using Analytics for Customer Acquisition and Retention; Detecting, Preventing and Managing Fraud using Analytics; Case Studies

Module-IV: Risk Analytics for Healthcare Domain (9 hrs)

Introduction to Healthcare Sector;HIPAA,Four Enterprise Disciplines of Health Analytics, Health Outcome Analysis, Health Value and Cost; Customer Insights, Actuary Services, Framework for Customer Analytics; Risk Management

Module-V: Workforce Analytics (9 hrs)

Workforce Environment and Psychology, HR Analytics and Talent Management- Understanding and Predicting Retention, Boosting Employee Engagement, Sources of Hire and Quality of Hire, Profiling High Performers

.

***Text Books**:*

1. *Clark Abrahams and Mingyuan Zhang, "Credit Risk Assessment: The New Lending System for Borrowers, Lenders, and Investors", ISBN 978-0-470-46168-6*
2. *Naeem Siddiqi, "Credit Risk Scorecards: Developing and Implementing Intelligent Credit Scoring", ISBN 978-0-471-75451-0*

***Reference Books**:*

1. *Laura B. Madsen, "Data-Driven Healthcare: How Analytics and BI are Transforming the Industry", M.S.ISBN 978-1-118-77221-8*
2. *Jason Burke, "Health Analytics: Gaining the Insights to Transform Health Care", John Wiley Sons Inc., 2013, ISBN: 978-1-118-38304-9*

3. *Jac Fitz-Enz , John R. Mattox II, "Predictive Analytics for Human Resources", ISBN-13: 978-126552153.*
4. *James C. Sesil, "Applying Advanced Analytics to HR Management Decisions: Methods for Selection, Developing Incentives, and Improving Collaboration", ISBN-13: 978-0133064605*

CSSC 447 Database Systems in Big Data

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Nil.*

***Objectives**:*

- *To understand the design of database in Big Data.*

Module-I: Getting Started With Cassandra (9 hrs)

Introduction of NoSQL Database concepts: -: ACID Vs. BASE, Advantages, Where Applicable, Schema, Two Phase Commit, Sharding and Share Nothing Architecture, Feature Based, Key Based, Lookup Table Based, NoSQL Databases, Brewers CAP Theorem, Cassandra Definition and Features, Distributed and Decentralised, Elastic Scalability, High Availability and Fault Tolerance, Tuneable Consistency, Strict Consistency, Casual Consistency, Weak (Eventual Consistency), Column Orientation, Schema Free, High Performance, Features and comparisons of few NOSQL Databses (Cassandra, Mongo, Cloudera, CouchDB, HBase.

Module-II: Understanding Cassandra Data Model (9 hrs)

USE Cases for Cassandra, Cassandra Installation:Installing Cassandra, Running the CommandLine Client Interface, Basic CLI Commands, Help, Connecting to a Server, Describing the Environment, Creating and Keyspace and Column Family, Writing and Reading Data, The Relational Data Model, Simple Introduction, Cluster, Keyspaces, Column Families, Column Family Options, Columns, Wide Rows, Skinny Rows, Column Sorting, Super Columns, Composite Keys, Design Differences between RDBMS and CASSANDRA, Query Language, Referential Integrity, Secondary Indexes, Sorting, DeNormalisation, Design Patterns, Materialized Views.

Module-III: Understanding Cassandra Architecture (9 hrs)

System Keyspace, Peer-To-Peer, Gossip and Failure Detection, Anti-Entropy and Read Repair, Memtables, SSTables, and Commit Logs, Hinted Handoff, Compaction, Bloom Filters, Tombstones, Staged Event-Driven Architecture (SEDA), Read, Mutation, Gossip, Response, Anti-Entropy, Load Balance, Migration, Streaming, Managers and Services, Casssandra Daemon, Storage Service, Messaging Service, Hinted Handoff Manager.

Module-IV: Creating Sample Application (9 hrs)

Database Design, Sample Application RDBMS Design, Sample Application Cassandra Design, Application Code, Creating Database, Loading Schema, Data Structures, Setting Connections, Population of database, Application Features.INTEGRATING CASSANDRA WITH HADOOP - Hadoop, MapReduce, Cassandra Hadoop Source Package, Outputting Data to Cassandra, PIG, HIVE, Use Cases.

Module-V: Configuring, Reading and Writing Data In Cassandra (9 hrs)

Key spaces, Replicas, Replica Placement Strategy, Replication Factor, Partitioner, Snitches, Creating Clusters, Dynamic Ring Participation, Security, Miscellaneous Settings, Additional Tools, Query differences between RDBMS and Cassandra, Basic Write Properties, Consistency Level, Basic Read Properties, API's, Set Up and Inserting Data, Slice Predicate, Get Range Slices, Multiget Slice, Deleting, Programmatically Defining Keyspaces and Column Families. CQL-Data Definition language(DDL) Statements, Data Manipulation Language (DML), Create and modify Users, User permission, Capture CQL output to a file, Import and export data, CQL scripts from within CQL, CQL Scripts from the command prompt.

***Text Books**:*

1. *Tom Plunkett,BrianMacdonald,Bruce Nelson "Oracle Big Data Handbook, (Oracle Press), Fujitsu*
2. *MadhuJagadeesh, SoumendraMohanty, HarshaSrivatsa, "Big Data Imperatives: Enterprise Big Data Warehouse, BI Implementations and Analytics", 1st Edition, Apress (2013)*
3. *Frank J. Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley Publishers (2012)*

Reference Book(s):

1. *CristianMolaro, Surekha Parekh, Terry Purcell, "DB2 11: The Database for BigData&Analytics",MC Press, 2013.*

CSSC 448 Streaming Analytics

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Nil.*

***Objectives**:*

- *Understanding the need for stream computing*
- *Comprehend the architecture of stream analytics*
- *Building data flow management pipelines for streams.*
- *Processing streaming data*
- *Delivering the results of streaming analytics*

Module-I: Introduction to Stream Computing (9 hrs)

Streaming Data – Sources – Difference between Streaming Data and Static Data. Overview of Large Scale Stream Processing Engines – Issues in Stream Processing.

Module-II: Streaming Analytics Architecture (9 hrs)

Phases in Streaming Analytics Architecture - Vital Attributes - High Availability – Low Latency – Horizontal Scalability-Fault Tolerance - Service Configuration and Management – Apache ZooKeeper.

Module-III:Data Flow Management (9 hrs)

Distributed Data Flows – At Least One Delivery – Apache Kafka – Apache Flume – Zero MQ - Messages, Events, Tasks & File Passing.

Module-IV: Processing & Storing Streaming Data (9 hrs)

Distributed Stream Data Processing: Co-ordination, Partition and Merges, Transactions. Duplication Detection using Bloom Filters - Apache Spark Streaming Examples Choosing a storage system – NoSQL Storage Systems.

Module-V: Delivering Streaming Metrics (9 hrs)

Visualizing Data – Mobile Streaming Apps –Times Counting and Summation – Stochastic Optimization – Delivering Time Series Data.

***Text Books**:*

1. *Byron Ellis, "Real-Time Analytics: Techniques to Analyze and Visualize Streaming Data", Wiley, 1st edition, 2014.*
2. *SherifSakr, "Large Scale and Big Data: Processing and Management", CRC Press, 2014.2014.*
3. *Bill Franks, "Taming The Big Data Tidal Wave Finding Opportunities In Huge Data Streams With Advanced Analytics", Wiley, 2012.*
4. *Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, "Mining of Massive Datasets", Cambridge University Press, 2014.*

***Reference Book(s)**:*

1. *Paul C Zikopoulos, Chris Eaton, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGraw-Hil, 1st edition, 2011.*
2. *kafka.apache.org*

3. *flume.apache.org*
4. *zookeeper.apache.org*
5. *spark.apache.org*
6. *zeromq.org*

CSSC 449 Video Processing and Analytics

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Image processing and its working*

***Objectives**:*

- *To have a better knowledge about videos*
- *To enrich students with data analytics*
- *To understand the video content analysis*
- *To expose the student to various applications and case studies of Video analytics.*

Module-I: Video Fundamentals (9 hrs)

Basic concepts and Terminology-Monochrome Analog video – Colour in Video – Analog video standards – Digital video basics – Analog-to Digital conversion – Colour representation and chroma sub sampling – Digital video formats and standards Video sampling rate and standards conversion.

Module-II: Video Segmentation and Video Features (9 hrs)

Fundamentals of Motion Estimation – Optical flow - Pixel Video Features - colour, shape features, Textural features - Feature selection and Dimensionality Reduction.

Module-III: Introduction to Analytics (9 hrs)

Big-Data - Descriptive data analysis - Analytic Processes and Tools - Regression – Classification - Clustering algorithms - Validation - Multimodal approach to Image and Video data mining - Probabilistic semantic mode - Model based annotation and video mining.

Module-IV: Video Content Analysis and Analytics (9 hrs)

Introduction- Detecting Shot Boundaries in Video – Parsing a Video into Semantic Segments – Video Indexing and Abstraction for Retrievals – Affective Video Content Analysis – Automatic Video Trailer Generation - Video database - Video categorization - Video query categorization

Module-V: Emerging Trends (9 hrs)

Object Segmentation and Tracking in the Presence of Complex Background – Video In painting – Video Summarization – Forensic video analysis

***Text Books**:*

1. *Oges Marques, Practical Image and Video Processing Using MATLAB, Wiley-IEEE Press, 2011.*
2. *Michael Berthold, David J.Hand, Intelligent Data Analysis, Springer, 2007.*

***Reference Book(s)**:*

1. *Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.*

NETWORK COMPUTING

CSSC 451 Principles of Distributed Computing

L	T	P	C
3	0	1	3

***Pre-requisite**:*

Basic knowledge in Operating System and Computer Networks.

***Objectives**:*

- *To learn the principles, architectures, algorithms and programming models used in distributed systems.*
- *To examine state-of-the-art distributed systems, such as JINI.*
- *To design and implement sample distributed systems.*

Module-I: Introduction (*9 hrs)*

Definition-Goals-Hardware and Software Concepts Client/Server Model Communication – Layered Protocols RPC-Remote Object Invocation Message Oriented Communication

Module-II: Client Server and Naming Entity (*9 hrs)*

Threads Client Server - Code Migration - S/W Agents - Naming Entity - Location Mobile Entity

Module-III: Synchronization and Distributed Transactions (9 hrs)

Synchronization - Clock Synchronization - Logical Clocks - Global States-Election Algorithms - Mutual Exclusion - Distributed Transaction Consistence and Replication – Introduction - Data Centric Consistence - Fault Tolerance - Reliable Client/Server Communication - Distributed Commit - Recovery

Module-IV: Distributed Object Database System (9 hrs)

Distributed Object Database System: CORBA - DCOM - GLOBE.

Module-V:Distributed File System (9 hrs)

Distributed File System - Distributed Document Base System -WWW - Distributed Co-ordination Base System - JINI

Text Books:

1. *Andrew S.Tanenbaum, Maarten van Steer, "Distributed Systems Principles and Paradigms", 2002, Prentice Hall India.*

Reference:

1. *George Couloursis, Jean Dollomore and Tim Kinderberg, "Distributed Systems - Concepts and Design", Addison Wesley.*

CSSC 452 Introduction to Parallel Computing

L	T	P	C
3	0	1	

Total Hours: 45

***Pre-requisite**:*

- *Basic knowledge in computer architecture and computer networks.*

***Objectives**:*

- *To study various types of parallel computers and their architectures,*
- *To describe the concepts underlying the design, implementation, and use of message-passing computing and shared-memory computing,*
- *To set up cluster computing systems, code and evaluate the performance of parallel programs*
- *To choose suitable programming strategies in parallelizing computational tasks.*

Module-I: Introduction (8 hrs)

Introduction – Motivation – Scope - Parallel Programming Platforms: Implicit Parallelism – Limitations of Memory System Performance - Dichotomy of Parallel Computing Platforms – Communication cost in Parallel Machines – Routing Mechanism for Interconnection Networks.

Module-II: Principles of Parallel Algorithm (10 hrs)

Decomposition Techniques – Characteristics of Tasks and Interactions – Mapping Techniques for Load Balancing – Methods for containing Interaction overheads – Parallel Algorithm Models – Basic communication Operations: One-to-all Broadcast and All-to-one Reduction – Scatter and Gather – Improving the Speed of some communication Operations.

Module-III: Analytical Modelling of Parallel programs (10 hrs)

Sources of Overhead in Parallel Programs – Performance metrics for parallel systems – effect of granularity and data mapping on performance – scalability of parallel systems – Minimum analysis of parallel Programs – other Scalability Metrics.

Module-IV: Programming using Message Passing Paradigm (10 hrs)

Principles of Message-Passing Programming – The Building Blocks: Send and ReceiveOperations – MPI: The Message Passing Interface – Topologies and Embedding -Overlapping Communication with Computation - Collective Communication and Computation Operations - Groups and Communicators.

Module-V: Parallel Algorithms and Applications (8 hrs)

Dense Matrix Algorithms: Matrix-Vector Multiplication - Matrix-Matrix Multiplication - Solving a System of Linear Equations. Sorting: Issues in Sorting on Parallel Computers - Sorting Networks - Bubble Sort and its Variants – Quick sort - Bucket and Sample Sort - Other Sorting Algorithms

Text Book(s):

1. *Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, 'Introduction to Parallel Computing', 2nd edition, AddisonWESLEY, 2003.*

Reference Books:

1. *Peter S. Pacheco, 'An introduction to Parallel Programming', Morgan Kaufmann, 1st edition, 2011.*
2. *Fayez Gebali, 'Algorithms and Parallel Computing', Wiley series, 2011.*

CSSC 453 Network Design and Management

L	T	P	C
3	0	1	3

Perquisite:

Basic knowledge in computer networks.

Objectives:

- *Understand security best practices and how to take advantage of the networking gear that is already available*
- *Learn design considerations for device hardening, Layer 2 and Layer 3 security issues, denial of service, IPSec VPNs, and network identity*
- *Understand security design considerations for common applications such as DNS, mail, and web*
- *Identify the key security roles and placement issues for network security elements such as firewalls, intrusion detection systems, VPN gateways, content filtering, as well as for traditional network infrastructure devices such as routers and switches.*
- *Understand the various testing and optimizations strategies to select the technologies and devices for secure network design.*

Module-I: Introduction (8 hrs)

Basic Networking Concepts: Network – Telephone Network - Network Architecture Types - Network Services – LANs, MANs and WANs – OSI Model and IEEE Standards: Protocols for Data Transmission – Protocol Stacks – OSI Management – Layering Concepts – IEEE 802 Standards.

Module-II: Protocols, Services and Interfaces (8 hrs)

Definition – The X.25 Protocol – Routable Protocols – Non-Routable Protocols – Connectionless and Connection Oriented Protocols – TCP/IP Protocol Suite – IP Addressing – Subnetting – IPX/SPX Protocol Suite – Other Protocols within the TCP/IP Suite: Microsoft Protocol Suite - AppleTalk Protocol Suite.

Module-III: Network Designs and Ethernet Networking (8 hrs)

Physical Topologies – Bus, Star, Ring, Mesh - Network Types – ARCNet – The Ethernet – Fast Ethernet Networks – Token Ring Networks – FDDI. Settings in Network Adapters.

Module-IV: Wired and Wireless Media (9 hrs)

Network cables – Wired Media – Twisted-Pair Cable – Fiber-Optic Cable – HFC Cable – Multiplexing – Multiple Access Systems – Microwaves – Network Design Considerations – Token-Ring, CDDI and FDDI Networks – Future Trends in Networking – Quality of Service (QoS).

Module-V: SNMP and RMON (8 hrs)

SNMP and UDP – Management Information Bases (MIBs) – Types of MIBs - Lexicographic Order – Structure of Management Information (SMI) Standards – SNMPv1 – SNMPv2 – RMON: Structure of MIB Defined in RFC 1751 – Host Group – Packet Capture Group – Control of RMON Devices

Text Books:

1. *Steven T. Karris, Network Design and Management, Orchard Publications, 2002.*
2. *Teresa C. Piliouras, Network Design: Management and Technical Perspectives, Second Edition, Auerbach Publications, 2004.*

Reference Books:

1. *Oppenheimer, Top-Down Network Design, CISCO, 2010.*
2. *Ralph J Tyser, S Raghavan, Telecommunications Network Design and Management, Springer Science Business Media, 2014.*

CSSC 454 Web Services Computing

L	T	P	C
3	0	1	

***Pre-requisite**:*

- *Basic knowledge in Web Technology and Computer Networks.*

***Objectives**:*

- *To understand the details of Web services technologies: SOAP, WSDL, UDDI*
- *To learn how to implement and deploy web service clients and servers.*
- *To explore interoperability between different frameworks.*
- *To learn basic concepts of SOA.*

Module-I: Fundamental Concepts and Theories (9 hrs)

Introduction to Web Services — The definition of web services, basic operational model of web services, tools and technologies enabling web services, benefits and challenges of using web services.
Web Services Architecture — Web services Architecture and its characteristics, core building blocks of web services, standards and technologies available for implementing web services, web services communication models, basic steps of implementing web services.

Module-II: Service Oriented Architecture (8 hrs)

Overview of Service Oriented Architecture — SOA concepts, Key Service Characteristics, Technical Benefits of a SOA. SOA and Web Services — Web Services Platform, Service-Level Data Models, Discovery, Security and Interaction Patterns, Atomic and Composite services, Service—level communication and alternative transports.

Module-III: Web Services using SOAP (8 hrs)

Fundamentals of SOAP — SOAP Message Structure, SOAP encoding, SOAP message exchange models, SOAP communication and messaging, SOAP security.
Developing Web Services using SOAP — Building SOAP Web Services, developing SOAP Web Services using Java and Axis, limitations of SOAP.

Module-IV: Tools and Technologies (9 hrs)

Describing Web Services — WSDL — WSDL in the world of Web Services, Web Services life cycle, anatomy of WSDL definition document, WSDL bindings, WSDL Tools, limitations of WSDL.
Discovering Web Services — Service discovery, role of service discovery in a SOA, service discovery mechanisms, UDDI — UDDI Registries, uses of UDDI Registry, Programming with UDDI, UDDI data structures, Publishing API, Publishing, searching and deleting information in a UDDI Registry, limitations of UDDI.

Module-V: Web Services Interoperability (8 hrs)

Web Services Interoperability — Means of ensuring Interoperability, Overview of .NET, Creating a .NTE client for an Axis Web Service, Creating java client for a web service, Challenges in Web Services Interoperability. Web Services Security — XML security frame work, Goals of Cryptography, Hash Cipher, Symmetric Cipher, Asymmetric Cipher, XML encryption, Digital signature, Digital Certificate, XML Encryption, SAML, structure.

Text Book(s):

1. *Developing Java Web Services, R. Nagappan, R. Skoczylas, R.P. Sriganesh, Wiley India, rp - 2008.*
2. *Understanding SQA with Web Services, Eric Newcomer and Greg Lomow, Pearson Edition - 2009*
3. *Java Web Service Architecture, James McGovern, Sameer Tyagi et.al., Elsevier – 2009.*

Reference Book(s):

1. *Building Web Services with Java, 2nd Edition, S. Graham and others, Pearson Edn., 2008.*
2. *Java Web Services, D.A. Chappell & T. Jewell, O'Reilly, SPD.*
3. *McGovern, et al., "Java Neb Services Architecture", Morgan Kaufmann Publishers, 2005.*

4. *J2EE Web Services, Richard Monson-Haefel, Pearson Education*.

CSSC 455 Pervasive and Ubiquitous Computing

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Basic knowledge in Distributed systems.*

***Objectives**:*

- *The course aims at providing a sound conceptual foundation in the area of Pervasive Computing aspects.*
- *The course attempts to provide a balanced treatment of the mechanisms and environments of pervasive computing and initiates senior CS students to the state-of-the-art in the area.*
- *At the end of this course, students should be able to conceptualize, analyze and design select classes of pervasive computing systems.*

Module-I: Fundamental Concepts and Theories (9 hrs)

Introduction to ubiquitous Computing-History, Development – The Ubiquitous Portal – Grid, RFID Technologies-Ambient Intelligence.

Module-II: Development and Design Methodologies (9 hrs)

Ubiquitous and Pervasive Application Design- Designing Pervasive and MultimodalInteractive System-pervasive computing: A Conceptual Framework-Deploying UserInterfaces for workflow information systems- Ubiquitous and Pervasive case study Applications.

Module-III: Tools and Technologies (9 hrs)

Deploying Pervasive Technologies- Embedding ubiquitous Technologies- Ubiquitous Computing Technologies in Education- Potential and possibilities, problem and pitfalls.

Module-IV: Utilization and Application (9 hrs)

Pervasive Healthcare: Problems and Potentials- Implementing RFID technologies in Hospital- Ubiquitous Healthcare (RFID) in Hospitals- Ubiquitous Risk Analysis, RFID: A framework of Uses and Opportunities.

Module-V: Critical Issues and Emerging Trends (9 hrs)

Privacy Issues of Applying RFID – An Evaluation of the EFID Security Benefits, Security and Privacy Issues in RFID based Wireless Networks, Pervasive and Ubiquitous Computing Databases: critical Issues and Challenges, Emerging Trends-case study.

Text Book:

1. *Symonds, Judith, ed. Ubiquitous and Pervasive Computing: Concepts, Methodologies, Tools, and Applications: Concepts, Methodologies, Tools, and Applications. IGI Global, 2009.*

Reference Book:

1. *Bakhouya, Mohamed. "Ubiquitous and pervasive computing: architectures and protocols for applications design." Proceedings of the 3rd workshop on Agent-oriented software engineering challenges for ubiquitous and pervasive computing. ACM, 2009.*

CSSC 456 Cloud Computing

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Basic knowledge in distributed systems.*

***Objectives**:*

- *To analyze the components of cloud computing and its business perspective.*
- *To evaluate the various cloud development tools.*
- *To collaborate with real time cloud services.*
- *To analyze the case studies to derive the best practice model to apply when developing and deploying cloud based applications.*

ModuleI: Introduction (9 hrs)

Overview of Computing Paradigm - Recent trends in Computing - Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing - Evolution of cloud computing - Cloud Computing (NIST Model) – Characteristics - Pros and Cons of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing - Role of Open Standards - Cloud Computing Architecture - Cloud computing stack - Service Models (XaaS) - Deployment Models.

ModuleII: Infrastructure as a Service (IaaS) (9 hrs)

Infrastructure as a Service(IaaS) – Introduction- IaaS definition, virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM) - Resource Virtualization – Server, Storage, Network, Virtual Machine(resource) provisioning and manageability, storage as a service, Data storage in cloud computing (storage as a service) - Examples - Amazon EC2 - Renting, EC2 Compute Unit, Platform and Storage, pricing, customers – Eucalyptus.

ModuleIII: Platform as a Service(PaaS) (8 hrs)

Platform as a Service(PaaS) - Introduction - What is PaaS, Service Oriented Architecture (SOA) - Cloud Platform and Management – Computation, Storage – Examples - Google App Engine, Microsoft Azure, SalesForce.com, Force.com platform - Software as a Service(PaaS) - Introduction to SaaS - Web services - Web 2.0 - Web OS - Case Study on SaaS.

ModuleIV: Service Management in Cloud Computing (8 hrs)

Service Management in Cloud Computing - Service Level Agreements(SLAs) - Billing & Accounting - Comparing Scaling Hardware: Traditional vs. Cloud - Economics of scaling: Benefitting enormously - Managing Data - Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud, Large Scale Data Processing.

ModuleV: Cloud Security (10 hrs)

Cloud Security - Infrastructure Security - Network level security, Host level security, Application level security - Data security and Storage - Data privacy and security Issues, Jurisdictional issues raised by Data location - Identity & Access Management - Access Control - Trust, Reputation, Risk - Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations.

Text Book(s):

1. *Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 2011.*

2. *Ronald L. Krutz, Russell Dean Vines, "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley-India, 2010.*

Reference Book(s):

1. *Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", Mc Graw Hill Education, 2013.*
2. *Nikos Antonopoulos, Lee Gillam, "Cloud Computing: Principles, Systems and Applications", Springer, 2012.*
3. *Barrie Sosinsky, "Cloud Computing Bible", Wiley-India, 2010.*

CSSC 457 Internet of Things

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Basic knowledge in computer networks and working of sensors.*

***Objectives**:*

- *Vision and Introduction to IoT.*
- *Understand IoT Market perspective.*
- *Data and Knowledge Management and use of Devices in IoT Technology.*
- *Understand State of the Art – IoT Architecture.*
- *Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.*

Module-I: M2M and IoT- Introduction (9 hrs)

The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics.

Module-II: M2M and IoT-A Market Perspective (9 hrs)

Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Module-III: M2M and IoT Technology Fundamentals (9 hrs)

Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management.

Module-IV: IoT Architecture-State of the Art (9 hrs)

Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model

Module-V: IoT Reference Architecture (9 hrs)

Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control. Industrial Automation- Service-oriented architecture-based device integration.

Text Book:

1. *Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.*

Reference Books:

1. *Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.*
2. *Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.*

ARTIFICIAL INTELLIGENCE

CSSC 461 Introduction to Artificial Intelligence and Expert Systems

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Exposure to Algorithms, Data structure and Mathematical Logic*

***Objectives**:*

- *Explore basic concepts of AI and expert systems*

Module-I: Introduction (9 hrs)

AI – Foundations of AI , Intelligent Agents – Agents and Environments – Good Behaviour – Nature of Environments – Structure of Agents

Module-II: Problem solving (8 hrs)

Problem Solving Agents – Searching for solutions- Uninformed Search Strategies – Informed Search Strategies, heuristic functions

Module-III: Search Algorithms (9 hrs)

Local search algorithms and optimization problems – Searching with nondeterministic Actions, Constraint satisfaction problems

Module-IV: Expert systems (9 hrs)

Expert systems – Introduction – Difference between expert system and conventional programs – Expert system organization – Architecture of Expert system – Knowledge representation techniques- Knowledge acquisition techniques - Inference Engine- Explanation systems

Module-V: Languages and Tools (8 hrs)

Working with LISP,Prolog – Apache Spark

Text Books:

1. *Stuart J Russell and Peter Norvig, Artificail Intelligence – A Modern Approach, 2010, Third Edition, PHI.*
2. *Patterson W D, "Introduction to Artificial Intelligence and Expert Systems", 1995, First Edition, PHI.*

Reference Book:

1. *Elaine Rich and Kelvin Knight,"Artificial Intelligence", 2009, Third Edition, TMH.*

CSSC 462 Neural Networks

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Knowledge in Artificial Intelligence*

***Objectives**:*

- *Develop the skill in basic understanding on neural network*
- *Explore the Advanced methods of representing information in ANN*
- *Exposure to many real-world control problems.*

Module-I: Introduction (8 hrs)

Fundamentals of neural networks – model of an artificial neuron – neural network architectures – Learning methods – Taxonomy of Neural network architectures – Standard back propagation algorithms – selection of various parameters – variations Applications of back propagation algorithms.

Module-II: ANN Architectures (8 hrs)

Associative memory – exponential BAM – Associative memory for real coded pattern pairs– Applications adaptive resonance theory – introduction – ART 1 – ART2 – Applications.

Module-III: Self organizing maps (8 hrs)

Kohenenself-organizing maps – learning vector quantization – counter propagation networks – industrial applications.

Module-IV: Advances in NN (8 hrs)

Fundamentals of genetic algorithms – genetic modeling – hybrid systems – integration of fuzzy logic, neural networks and genetic algorithms – nontraditional optimization techniques like ant colony optimization – Particle swarm optimization and artificial immune systems

Module-V: Applications (8 hrs)

Pattern recognition-Prediction-Robotics-Case study

***Text Books**:*

1. *James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, 2003, Addison Wesley, 2003.*
2. *LauranceFausett, Fundamentals of Neural Networks, 1992, Prentice hall.*
3. *C.M.Bishop, Neural networks and Pattern recognition, 2003, Oxford University*
4. *Mitchell Melanie, An Introduction to Genetic Algorithm,1996, MIT Press.*

CSSC 463 Fuzzy Logic

L	T	P	C
3	0	1	3

***Pre-requisites**:*

- *Mathematical Foundation of Computer Science and probability theory*
- *Knowledge in programming languages*

***Objectives**:*

- *To develop an elementary practical theory for automatic control of uncertain or imperfectly modelled systems encountered in engineering applications.*
- *To provide a basic exposition to the goals and methods of Fuzzy Logic*

Module-I: Fuzzy Set Theory (9 hrs)

The notion of fuzziness - what, why and when to apply fuzzy set, operations on fuzzy sets, fuzzy numbers, Crisp relations, fuzzy relations, Max-composition of fuzzy relation, Max_-transitive closure, probability measures of fuzzy events, fuzzy expected value, fuzzy inference principle, Examples of use of fuzzy logic in control of real-world systems

Module-II: Neural Networks and Fuzzy Logic Fundamentals (9 hrs)

Artificial Neural Network Representation, Exclusive- OR-Problem, Linear Separability, learning and training algorithms, Back propagation – Back propagation training algorithm

Module-III: Neuro Fuzzy Modelling (9 hrs)

Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum

Module-IV: Fuzziness Measures (9 hrs)

Fuzzy measures – belief, plausibility and their properties, Dempster's rule of combination, consonant body of evidence – possibility, necessities, Measures of uncertainty Axiomatic formulation of Hartley information, Shannon's entropy, concepts of joint and conditional entropy and their properties; measures of non-specificity, Measures of dissonance and confusion

Module-V: Case Study (9 hrs)

Fuzzy geometry Applications to some selected topics like pattern recognition, image processing, computer vision, optimization, control, data mining, Integration with other computing paradigm

Reference Books:

1. *G. J. Klir and T. A. Folger: Fuzzy Sets, Uncertainty, and Information, Prentice Hall, Englewood Cliffs, 1988*
2. *A. Kandel: Fuzzy Mathematical Techniques With Applications, Addison-Wesley, Englewood Cliffs, 1986.*
3. *J. C. Bezdek and S. K. Pal (Eds.): Fuzzy Models for Pattern Recognition – Methods that Search for Structures in Data, IEEE Press, Los Alamos, California, 1992.*
4. *S. K. Pal and D. Dutta Majumder: Fuzzy Mathematical Approach to Pattern Recognition, John Wiley (Halsted Press), New York, 1986.*
5. *M. M. Gupta: Fuzzy Mathematical Models with Applications to Engineering and Management Science, North Holland, Amsterdam, 1988.*

6. *T. J. Ross: Fuzzy Logic With Engineering Applications, McGraw Hill, Singapore, 1997.*
7. *J. C.Bezdek, J. M. Keller, R. Krishnapuram, and N. R. Pal: Fuzzy Models and Algorithms for Pattern Recognition and Image Processing, Kluwer Academic Publisher, Boston, 1999.*

CSSC 464 Decision Support Systems

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Exposure to AI and Mathematical Logic*

***Objectives**:*

- *Explore basic concepts of DSS*

Module-I: Decision making systems (9 hrs)

Management support systems, Decision making systems, modelling and support – Introduction – Systems - models- Phases of decision making process- Making process- intelligence Phase – Design Phase- Choice phase – Implementation Phase – Decision makers – case study

Module-II: Decision Support system (9 hrs)

Overview – DSS configurations – Characteristics and capabilities of DSS – Components of DSS – Data Management Subsystem – Model management subsystems- Knowledge management subsystem – User- hardware- Classifications- Case study
Modelling and Analysis - MSS modelling – Static and dynamic models – Certainty and uncertainty and Risk – Influence diagrams – Structure of MSS mathematical models

Module-III: Business Intelligence and DSS Development (9 hrs)

Nature and Sources of data, Data collections, problem and quality, DBMS in DSS- Data warehousing – Data Mart- Business Intelligence – OLAP- Data mining – Data visualization – GIS
Introduction to DSS development- Change management – Technology levels and tools- Platforms- Tool selections- Team developed and End user developed DSS

Module-IV: Collaborative Computing and intelligent (9 hrs)

Group decision making, communication and collaboration – Group support system – GSS technologies – GSS meeting process- Distance learning and creativity and idea generation
Intelligent systems over Internet – Web based intelligent systems – Intelligent agents – Characteristics, classification, types of agents – Intelligent based software agents – DSS agents and multi-agents – Web based recommendation system – managerial issues of Intelligent agents

Module-V: Languages and Tools (9 hrs)

Working with Lumina Analytical, Open rules, paramount decisions, PROSUITE

Text Book:

1. *E Turban, J E Aronson, "Decision Support systems and Intelligent systems", 2005, Seventh Edition, Pearson Education.*

CSSC 465 Introduction to Machine Learning

L	T	P	C
3	0	1	3

***Pre-requisite**:*

- *Basic knowledge in artificial intelligence, learning activities*

***Objectives**:*

- *To understand the concepts of machine learning*
- *To appreciate supervised and unsupervised learning and their applications*
- *To appreciate the concepts and algorithms of learning*

Module-I: Introduction (9 hrs)

Introduction : Definition-Examples of machine learning applications –Well posed learning problems- Designing a learning system- Perspectives and issues Concept learning and general to specific ordering : Inductive learning hypothesis- Concept learning as search – candidate elimination algorithm-inductive bias.

Module-II: Regression and classification (9 hrs)

Regression: Linear Regression-Simple-Multiple Decision Tree-Pruning : Introduction –representation-Algorithm-issues Classification: Support Vector machine – Naïve Bayes-Applications

Module-III: Clustering and Learning (9 hrs)

Clustering : k-Means clustering– adaptive Hierarchical clustering –Applications- Neural network :Perceptron-, multilayer network- backpropagation- introduction to deep neural network Instance based learning :k-NN– Radial basis functions Case based reasoning- Reinforcement learning -Applications.

Module-IV: Probabilistic graphical models (9 hrs)

Graphical Models: Undirected graphical models - Markov Random Fields - Directed Graphical Models -Bayesian Networks - Conditional independence properties - Inference – Learning Generalization - Hidden Markov Models - Conditional random fields(CRFs)

Module-V: Machine learning experiments (9 hrs)

Design-Cross validation - Measuring Performance -Hypothesis testing- Assessing Performance -Comparison of algorithms, Datasets-Case study

***Text Books**:*

1. *Tom M. Mitchell, Machine learning, 1997, McGraw-Hill*
2. *EthemAlpaydin, Introduction to Machine Learning,2014, Third Edition, MIT Press.*

CSSC 466 Introduction to Robotics

L	T	P	C
3	0	1	3

***Pre-requisites**:*

- *Mathematical Foundation of Computer Science*
- *Machine Learning*
- *Natural Language Processing*

***Objectives**:*

- *To understand the different robotic configurations and their subsystems*

Module-I: Introduction (9 hrs)

Introduction to Robotics: Robot Anatomy - Co ordinate Systems, Manipulators & Mobile Robots, Classification of Robots, Robot and effectors - special reference to servomotors Transmission and actuators, Robot Applications - Industrial application environment and work cells, Feeders and Oriented Device.

Module-II: Drive systems (9 hrs)

Types of Robot Drives: Mechanical – Magnetic – Vacuum, Robot arm kinematics, World, Tool, DH transformation and Inverse Kinematics. Fundamentals of Closed loop control, PWM amplifiers, PID control.

Module-III: Sensors and Machine Vision (9 hrs)

Robotics sensors: Range, Proximity, Touch, Force and Torque Sensing, uses of sensors in Robotics, Applications- Inspection – Identification - Visual Serving and Navigatio, Machine Vision - The sensing and digitizing function in Machine Vision - Image processing and analysis, Training and vision system, Robotic Application - Low and High-level vision.

Module-IV: Robot Programming (9 hrs)

Features of various programming methods, Robot Task planning: concept, different methods, robot learning, Mobile Robot: Introduction, obstacle Representatives, Motion Planning in fixed and Changing structure - Simple Programs.

Module-V: Industrial Applications and Case Studies (9 hrs)

Application of robots: Material handling - Machine loading and unloading – Assembly – Inspection – Welding - Pray Painting - Mobile Robot Micro Robots - Recent developments in Robotics- Safety Considerations.

Text Books:

1. *Deb, S. R., Robotics Technology and Flexible Automation, Book_ Tata McGraw Hill publishing company limited, 1994.*
2. *Richard David Klafter, Thomas A. Chmielewski, Michael Negin, Robot Engineering: An integrated Approach, 1994, Prentice Hall of India Pvt. Ltd, New Delhi*

Reference Books:

1. *King Sun Fu, Rafael C. González, C. S. George Lee, Robotics: control, sensing, vision, and intelligence, 1987, McGraw-Hill, Singapore.*

2. *Craig, J. J, Introduction to Robotics: Mechanics and Control, Addison-Wesley, London*
3. *M.P.Groover, M. Weins, R.N.Nage, N.C.Odrey, Industrial Robotics, McGraw Hill*
4. *K.D. Richard, Chmielewski T.A and Michael "Robotic Engineering" PHI*
5. *K.S. Fu Gonzalez, Lee, Robotics Control, Sensing, Vision and intelligence.*

CSSC 467 Soft Computing

L	T	P	C
3	0	1	3

***Pre-requisites**:*

- *Linear Algebra, Multivariate Calculus, Probability Theory*
- *Knowledge in programming languages*

***Objectives**:*

- *To provide a strong foundation of fundamental concepts in Artificial Intelligence*
- *To provide a basic exposition to the goals and methods of Artificial Intelligence*
- *To enable the student to apply these techniques in applications which involve perception, reasoning and learning Course Outcome*

Module-I: Introduction (9 hrs)

Introduction to soft computing - brief description of separate theories, Introduction to biological and artificial neural network, Classification algorithms- Decision Trees, Bayesian classifier - Neural Networks and Probabilistic Reasoning

Module-II: Neural Networks (9 hrs)

Basic concepts of neural networks, Neural network architectures, Learning methods, Supervised and un-supervised learning, Architecture of a back-propagation network, Applications

Module-III: Fuzzy Sets (9 hrs)

Fundamentals of fuzzy sets and fuzzy logic theory, fuzzy inference principle, Examples of use of fuzzy logic in control of real-world systems

Module-IV: Optimization (9 hrs)

Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search

Module-V: Applications of computational intelligence (9 hrs)

AI Search algorithm-Predicate calculus- rules of interface - Semantic networks – frames – objects -Hybrid models, Applications -Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction

Reference Books:

1. *Jang J.S.R.,Sun C.T and Mizutami E - Neuro Fuzzy and Soft Computing Prentice hall, New Jersey,1998*
2. *Munakata, T.: Fundamentals of the New Artificial Intelligence, Springer-Verlag New York, Inc., 1998. ISBN 0-387-98302-3*
3. *Goldberg : Introduction to Genetic Algorithms*
4. *Jang, " Nero-Fuzzy & Soft Computing", Pearsons*
5. *Cordón, O., Herrera, F., Hoffman, F., Magdalena, L.: Genetic Fuzzy systems, World Scientific Publishing Co. Pte. Ltd., 2001, ISBN 981-02-4016-3*

6. *Kecman, V.: Learning and Soft Computing, The MIT Press, 2001, ISBN 0-262-11255-8*
7. *Nih.J.Ndssen Artificial Intelligence,Harcourt Asia Ltd.,Singapore,1998.*

SKILL ENHANCEMENT COURSES

CSSC 531 Network Management Tools

***Pre-requisite**:*

- *Basic knowledge about Computer Networks*

***Objectives**:*

- *To gain knowledge on how to install, maintain, and manage Local Area Networks and internetworks.*
- *To understand network management architectures and protocols.*
- *To be comfortable with using the different TCP/IP Protocols.*
- *To be comfortable using a variety of network management tools.*
- *To be familiar with a variety of computer network security issues.*

Module-I: ***(7 hrs)***

Data Communications and Network Management Overview-Review of Computer Network Technology

Module-II: ***(8 hrs)***

Basic Foundations: Standards, Models, and Language

Module-III: ***(7 hrs)***

Network Management Tools and Systems -Network Management Applications -Web-Based Management

Module-IV: ***(7 hrs)***

OpUtils - Network Management Tools

Module-V: ***(7 hrs)***

Case study on Designing and Managing a Network

Reference Materials:

1. *Network Management: Principles and Practice; by Mani Subramanian; Addison Wesley; 2000; ISBN 0-201-35742-9.*
2. *The Cuckoo's Egg: Tracking a Spy through the Maze of Computer Espionage by Clifford Stoll Pocket Books ISBN 0671726889.*

CSSC 532 Statistical Tools

***Pre-requisite**:*

- *Fundamentals of Statistics.*

***Objectives**:*

- *Understand the difference between descriptive & inferential statistics*
- *Understand the concepts of hypothesis testing: risks, p-value, confidence intervals, power*
- *Understand the importance of sample size calculations and the required input parameters*
- *Analyze data more quickly and more accurately*

Module-I: ***(7 hrs)***

Introduction- Statistics and its importance–Classification of variables -Importance of identifying the type & role of variables -Descriptive statistics: Visualizing and summarizing data distributions -Frequency tables for categorical variables- Pearson's correlation coefficient for continuous variables.

Module-II: ***(8 hrs)***

Plotting Data: Histograms, Scatter, box-plots, bar charts-Inferential statistics - Hypothesis testing principles: Null and alternative hypothesis, one vs. two-tailed test.

Module-III: ***(7 hrs)***

Test statistics: T-test, F-tests - Observed significance level or "p-value"-Statistical significance & decision rules -The importance of sample size calculations -Statistical inference with confidence Intervals -Numerical application to the single sample case

Module-IV: ***(8 hrs)***

SPSS / SAS

Module-V: ***(7 hrs)***

MATLAB

Text Books:

1. *Elementary Statistics, Allan G. Bluman, 1992.*
2. *Statistical Analysis Handbook, Dr. M.J de Smith, 2014.*
3. *ARice, John.* Mathematical Statistics and Data Analysis*. Duxbury Press, 2006.*

CSSC 533 Data Mining Tools

Pre-requisite: *NIL*

Objectives:

- *To introduce students to the basic concepts and techniques of Data Mining.*
- *To develop skills of using recent data mining software for solving practical problems.*
- *To gain experience of doing independent study and research.*

Module - I: ***(7 hrs)***

Introduction to Data Mining - Related technologies - Machine Learning, DBMS, OLAP, Statistics - Data Mining Goals - Stages of the Data Mining Process - Data Mining Techniques Knowledge Representation Methods - Data Warehouse and OLAP Data Warehouse and DBMS Multidimensional data model OLAP operations - Data preprocessing - Data cleaning - Data transformation - Data reduction.

Module - II: ***(9 hrs)***

Discretization and generating concept hierarchies - Installing Weka 3 Data Mining System - Experiments with Weka - filters, discretization - Data mining knowledge representation - Task relevant data - Background knowledge - Interestingness measures Representing input data and output knowledge Visualization techniques - Experiments with Weka - visualization - Attribute-oriented analysis - Attribute generalization - Attribute relevance Class comparison Statistical measures - Experiments with Weka - using filters and statistics.

Module - III: ***(8 hrs)***

Data mining algorithms: Association rules - Motivation and terminology - Correlation analysis - Experiments with Weka - mining association rules - Data mining algorithms: Classification - Basic learning/mining tasks - Inferring rudimentary rules: 1R algorithm - Decision trees - Covering rules - Experiments with Weka - decision trees, rules - Data mining algorithms: Prediction - The prediction task - Statistical (Bayesian) classification Bayesian networks - Instance-based methods (nearest neighbor) - Linear models - Experiments with Weka - Prediction - Evaluating what's been learned - Basic issues - Training and testing - Estimating classifier accuracy (holdout, cross-validation, leave-one-out) - Combining multiple models (bagging, boosting, stacking) - Minimum Description Length Principle (MLD).

Module - IV: ***(9 hrs)***

Experiments with Weka - training and testing - Mining real data - Preprocessing data from a real medical domain. - Applying various data mining techniques to create a comprehensive and accurate model of the data. Clustering - Basic issues in clustering First conceptual clustering system: Cluster/2 - Partitioning methods: k-means, expectation maximization (EM) - Hierarchical methods: distance-based agglomerative and divisible clustering - Conceptual clustering: Cobweb.

Module - V: ***(7 hrs)***

Experiments with Weka - k-means, EM, Cobweb - Advanced techniques, Data Mining software and applications - Text mining: extracting attributes (keywords), structural approaches (parsing, soft parsing) - Bayesian approach to classifying text- Web mining: classifying web pages, extracting knowledge from the web.

Required Software:

- *Weka*

Data Mining System with Free Open Source Machine Learning Software in Java.

Data Mining software and Data Sets

- *WEKA (Source: Java)*
- *RapidMiner*
- *MLC++ (Source: C++)*
- *SIPINA*
- *List from KDNuggets (Various)*
- *List from Data Management Center (Various)*

Data Sets

- *IDS data sets*
- *Data Sets for Data Mining*
- *Competition Data Set*
- *UCI Machine learning repository*
- *Quest data repository*
- *KDNuggets*

Reference Books:

1. *Pang-Ning Tan, Michael Steinbach, and Vipin Kumar, "Introduction to Data Mining", 2005.*
2. *Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", 2000.*

CSSC 534 Data Visualization Tools

Pre-requisite:

No previous knowledge of course material is expected. Prior experience in image editing or object oriented programming may lead to a more sophisticated final project but is not required.

Objectives:

- *To introduce visual perception and core skills for visual analysis*
- *To understand visualization for time-series analysis*
- *To understand visualization for ranking analysis*
- *To understand visualization for deviation analysis*
- *To understand visualization for distribution analysis*
- *To understand visualization for correlation analysis*
- *To understand visualization for multivariate analysis*
- *To understand issues and best practices in information dashboard design*

Module - I: CORE SKILLS FOR VISUAL ANALYSIS

Information visualization - effective data analysis - traits of meaningful data - visual perception - making abstract data visible - building blocks of information visualization - analytical interaction - analytical navigation - optimal quantitative scales - reference lines and regions - trellises and crosstabs - multiple concurrent views - focus and context - details on demand - over-plotting reduction - analytical patterns - pattern examples

Module - II: TIME-SERIES, RANKING, AND DEVIATION ANALYSIS

Time-series analysis - time-series patterns - time-series displays - time-series best practices- part-to-whole and ranking patterns - part-to-whole and ranking displays - best practices - deviation analysis - deviation analysis displays - deviation analysis best practices

Module - III: DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS

Distribution analysis - describing distributions - distribution patterns - distribution displays - distribution analysis best practices - correlation analysis - describing correlations – correlation patterns - correlation displays - correlation analysis techniques and best practices – multivariate analysis - multivariate patterns - multivariate displays - multivariate analysis techniques and best practices

Module - IV: INFORMATION DASHBOARD DESIGN I

Information dashboard - categorizing dashboards - typical dashboard data - dashboard design issues and best practices - visual perception - limits of short-term memory - visually encoding data - Gestalt principles - principles of visual perception for dashboard design

Module - V: INFORMATION DASHBOARD DESIGN II

Characteristics of dashboards - key goals in visual design process - dashboard display media - designing dashboards for usability - meaningful organization - maintaining consistency - aesthetics of dashboards - testing for usability - case studies: sales dashboard, CIO dashboard, Telesales dashboard, marketing analysis dashboard

Reference Books:

1. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.

2. Stephen Few, "Information Dashboard Design: The effective visual communication of data", O'Reilly, 2006.

3. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.

4. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.

5. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.

6. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.

7. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.

CSSC 535 CLOUD COMPUTING TOOLS

***Pre-requisite**:*

- Nil-

***Objectives**:*

- *Analyze the components of cloud computing showing how business agility in an organization can be created*
- *Evaluate the deployment of web services from cloud architecture*
- *Critique the consistency of services deployed from a cloud architecture*
- *Compare and contrast the economic benefits delivered by various cloud models based on application requirements, economic constraints and business requirements.*

Module-I: Cloud Computing

Definition, Cloud types; IaaS, PaaS, SaaS - Benefits and challenges of cloud computing, public vs private clouds, role of virtualization in enabling the cloud; Business Agility: Benefits and challenges to Cloud architecture. Application availability, performance, security and disaster recovery; next generation Cloud Applications.

Module-II: Cloud Applications

Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages

Module-III: Management Of Cloud Services

Performance and scalability of services, tools and technologies used to manage cloud services deployment; Cloud Economics: Cloud Computing infrastructures available for implementing cloud based services - Choosing a Cloud platform for an organization, based on application requirements, economic constraints and business needs (e.g Amazon, Microsoft and Google, Salesforce.com, Ubuntu and Redhat)

Module-IV: Application Development

Service creation environments to develop cloud based applications - Development environments for service development; Amazon, Azure, Google App.

Module-V: Cloud IT Model

Analysis of Case Studies when deciding to adopt cloud computing architecture - How to decide if the cloud is right for your requirements - Cloud based service, applications and development platform deployment so as to improve the total cost of ownership

***Text Books**:*

1. *Paul J. Deitel, Harvey Deitel, Abbey Deitel, "Internet and World Wide Web How to Program", Edition 5, 2011.*
2. *Chris Bates, "Web Programming – Building Intranet applications", Wiley Publications, 3rd Edition, 2009.*

***Reference Books**:*

1. *Jeffrey C. Jackson, "Web Technologies A computer Science Perspective", Pearson, 2011.*
2. *Eilliote, Rusty Harold, "Java Network Programming", 3/e, O'Reilly Media, Inc, 2004.*
3. *"Java server programming java JavaEE5 Black Book", Kogent Solutions Inc, Dreamtech Press, 2012.*
4. *AJAX, "black book", new edition, Kogent Solutions Inc, Dreamtech Press, 2008.*

CSSC 536 BIG DATA TOOLS

Pre-requisite:

Processing Big Data with Apache Hadoop.

Objectives:

This course provides practical foundation level training that enables immediate and effective participation in big data projects. The course provides grounding in basic and advanced methods to big data technology and tools, including MapReduce and Hadoop and its ecosystem.

Module - I: BIG DATA

Introduction- distributed file system -Definition and taxonomy - Big Data and its importance - Big data value for the enterprise- Setting up the demo environment- Four Vs, Drivers for Big data, Big data analytics, Big data applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map

Module - II: Introduction to Hadoop

The Hadoop ecosystem-Big Data - Apache Hadoop & Hadoop EcoSystem - Moving Data in and out of Hadoop - Loading data into Hadoop - Handling files in Hadoop - Getting data from Hadoop -Understanding inputs and outputs of MapReduce - Data Serialization. Hadoop components: MapReduce/Pig/Hive/HBase

Module-III: Hadoop Architecture

Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read., NameNode, Secondary NameNode, and DataNode, Hadoop MapReduce paradigm, Map and Reduce tasks, Job, Task trackers - Cluster Setup - SSH & Hadoop Configuration - HDFS Administering -Monitoring & Maintenance-Querying big data with Hive - From SQL to HiveQL

Module - IV: Hadoop Ecosystem and Yarn

Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New Features Name Node High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.

Module - V: HIVE AND HIVEQL, HBASE

Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.

Software(s):

Apache, Hadoop

Reference Books:

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.
2. Chris Eaton, Dirk deroos et al., "Understanding Big data", McGraw Hill, 2012.
3. Tom White, "HADOOP: The definitive Guide", O'Reilly 2012.

CSSC 537 INTERNET OF THINGS (IOT) TOOLS

Pre-requisite:

- Nil-

Objectives:

Students will understand the concepts of Internet of Things and can able to build IoT applications objectives:

- *To understand the fundamentals of Internet of Things.*
- *To build a small low cost embedded system using Arduino / Raspberry Pi or equivalent boards.*
- *To apply the concept of Internet of Things in the real world scenario*

Module - I: Fundamentals of IOT

Introduction to IoT- Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs

Module - II: IOT Design Methodology

Introduction to IoT - Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & APIs- IoT systems management - IoT Design Methodology – Specifications Integration and Application Development.

Module - III: Building IOT with Raspberry PI

Network & Communication aspects Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination Physical device – Raspberry Pi Interfaces – Programming – APIs / Packages – Web services.

Module - IV: Building IOT With Galileo/Arduino

Intel Galileo Gen2 with Arduino - Interfaces - Arduino IDE – Programming - APIs and Hacks- Design challenges, Development challenges, Security challenges-Other challenges

Module - V: Case Studies and Advanced Topics

Home automation, Industry applications, Surveillance applications, Various Real time applications of IoT - Connecting IoT to cloud – Cloud Storage for Iot – Data Analytics for IoT - Software & Management Tools for IoT

Reference Books:

1. *Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.*
2. *Manoel Carlos Ramon, "Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers", Apress, 2014.*
3. *Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014*
4. *Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach"*
5. *Waltenegus Dargie,Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice".*