PONDICHERRY UNIVERSITY
(A CENTRAL UNIVERSITY)

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE

REGULATIONS, CURRICULUM & SYLLABUS
FOR

MASTER OF COMPUTER APPLICATIONS

(M.C.A.)

(For CBCS System in Pondicherry University Department)
(Effective from the Academic Year 2020 - 2021)

PONDICHERRY UNIVERSITY (A CENTRAL UNIVERSITY), PUDUCHERRY
REGULATIONS AND SYLLABUS
FOR
MASTER OF COMPUTER APPLICATIONS (M.C.A.)

(For CBCS System in Pondicherry University)

(Effective from the Academic Year (2020 - 2021)

Eligibility forAdmission:

Candidates who have secured 55% of marks or above in any one of the following or equivalent, are eligible to apply:

(i)   Bachelor's Degree in Computer Science / Information Technology / Computer Applications / Commerce / Corporate Secretaryship / Economics / Business Administration (with Mathematics / Business Mathematics / Statistics / Computer Applications as one of the subjects)

OR

(ii)   Bachelor's Degree in Science with Mathematics / Statistics as one of the subjects.

Duration of the Course:

The course shall 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

The minimum marks for passing and classification for the award of the MCA Degree shall be as per the existing norms of other PG degree courses of Pondicherry University.

PONDICHERRY UNIVERSITY (A CENTRAL UNIVERSITY), PUDUCHERRY MASTER

OF COMPUTER APPLICATIONS (MCA)

(For CBCS System in Pondicherry University)

(Effective from the Academic Year 2020 - 21)

COURSE STRUCTURE

Course Category	Number of Credits
Core Courses	**55** Credits [49 Compulsory + 6 Supportive]
Elective Courses	**12** Credits [9 Domain Specific + 3 Open Elective]
Skill Enhancement Courses	**04** Credits [2 x 2 Credits]
Out Reach Programme: (Conferences/Symposiums/Technical Meets/Workshops/Etc.,)	**01** Credit
Total	**72 Credits**

M.C.A. CURRICULUM

BRIDGE COURSES

S. No.	Course Code	Course Title	Hours*
1.	CSCA 001	Fundamentals of Computers	30
2.	CSCA 002	Introduction to Problem Solving	30
3.	CSCA003	Introduction to Computer Programming	30

***15 Days x 6 Hours = 90 Hours

FIRST SEMESTER

S. No.	Course Code	Course Title	H/S	L	T	P	Credits
1.	CSCA 411	Data Structures and Algorithms	H	3	0	0	3
2.	CSCA 412	Object Oriented Programming	H	3	0	0	3
3.	CSCA 413	Database Management Systems	H	3	0	0	3
4.		Supportive Core #1	H	3	0	0	3
5.	CSCA 414	Data Structures and Algorithms Lab	H	0	0	3	2
6.	CSCA 415	Object Oriented Programming Lab	H	0	0	3	2
7.	CSCA 416	Database Management Systems Lab	H	0	0	3	2
		Total Credits					18

SECOND SEMESTER

S. No.	Course Code	Course Title	H/S	L	T	P	Credits
1.	CSCA 421	Computer Networks	H	3	0	0	3
2.	CSCA 422	Operating Systems	H	3	0	0	3
3.		Domain Specific Elective # 1	S	3	0	0	3
4.		Domain Specific Elective # 2	S	3	0	0	3
5.		Open Elective #1	S	3	0	0	3
6.	CSCA 423	Communication Skills	H	1	0	2	2
7.	CSCA 424	Computer Networks Lab	H	0	0	3	2
8.	CSCA 425	Operating Systems Lab	H	0	0	3	2
		Total Credits					21

THIRD SEMESTER

S. No.	Course Code	Course Title	H/S	L	T	P	Credits
1.	CSCA 511	Software Engineering	H	3	0	0	3
2.	CSCA 512	Internet and Web Technologies	H	3	0	0	3
3.		Supportive Core #2	H	3	0	0	3
4.		Domain Specific Elective # 3	S	3	0	0	3
5.		Skill Enhancement Programme #1	S	0	1	2	2
6.		Skill Enhancement Programme #2	S	0	1	2	2
7.		Academic Out-Reach Programme	H	-	-	-	1
8.	CSCA 513	Mini Project*	H	0	0	3	2
9.	CSCA 514	Internet and Web Technologies Lab	H	0	0	3	2
		Total Credits					21

* Mini project shall be in carried out in any of the Domain Specific Areas / Electives

FOURTH SEMESTER

S. No.	Course Code	Course Title	H/S	Credits
1.	CSCA 521	Project Work	H	4
2.	CSCA 522	Project Seminar	H	4
3.	CSCA 523	Project Report And Viva-voce	H	4
		Total Credits		12

SUPPORTIVE CORE COURSE (3 Credits)

S. No.	Course Code	Course Title	H/S	L	T	P	Credits
1	CSCA 431	Mathematics for Computer Science	H	3	0	0	3
2	CSCA 432	Management Concepts and Strategies	H	3	0	0	3

SKILL ENHANCEMENT COURSES (4 Credits)

S. No.	Course Code	Domain & Course Title	H/S	L	T	P	Credits
1	CSEL 530	Online / Certification Courses	S	-	-	-	2
2	CSEL 531	Simulation and Modeling Tools (SCI Lab)	S	0	1	2	2
3	CSEL 532	Mobile Application Development	S	0	1	2	2
4	CSEL 533	Software Testing Tools	S	0	1	2	2
5	CSEL 534	Multimedia Tools	S	0	1	2	2
6	CSEL 535	Python Programming	S	0	1	2	2

Any Two of the Skill Enhancement Courses should be credited to constitute the Four Credits.

OPEN ELECTIVE COURSES (3 Credits)

One Course from any other Department (Non Computer Science)

(or)

Domain Specific Electives of any Specialisation related to Computer Science

DOMAIN SPECIFIC ELECTIVES COURSES (9 Credits)

S. No.	COURSE CODE	COURSE TITLE	H/S	L	T	P	Credits
		STREAM 1: INFORMATION SECURITY					
1	CSEL 441	Fundamentals of Cryptography (Level 1)	S	3	0	0	3
2	CSEL 442	Database and Application Security (Level 2)	S	3	0	0	3
3	CSEL 443	Mobile and Digital Forensics (Level 2)	S	3	0	0	3
4	CSEL 444	Malware Analysis (Level 2)	S	3	0	0	3
5	CSEL 445	Information System Audit (Level 3)	S	3	0	0	3
6	CSEL 446	Information Security Management (Level 3)	S	3	0	0	3
7	CSEL 447	Cloud Security (Level 3)	S	3	0	0	3
8	CSEL 448	Ethical Hacking (Level 3)	S	3	0	0	3
		STREAM 2: SOFTWARE ENGINEERING					
9	CSEL 451	Object Oriented System Design (Level 1)	S	3	0	0	3
10	CSEL 452	Software Architecture (Level 1)	S	3	0	0	3
11	CSEL 453	Software Project Management (Level 2)	S	3	0	0	3
12	CSEL 454	Software Testing (Level 2)	S	3	0	0	3
13	CSEL 455	Software Quality Assurance (Level 3)	S	3	0	0	3
14	CSEL 456	Software Risk Management & Maintenance (Level 3)	S	3	0	0	3
15	CSEL 457	AGILE Software Process (Level 3)	S	3	0	0	3
		STREAM 3: HUMAN COMPUTER INTERACTION					
16	CSEL 461	Foundations of Human Computer Interaction (Level 1)	S	3	0	0	3
17	CSEL 462	Introduction to Web Accessibility (Level 1)	S	3	0	0	3
18	CSEL 463	Introduction to Mobile Accessibility (Level 1)	S	3	0	0	3
19	CSEL 464	Fundamentals of Context Aware Computing (Level 2)	S	3	0	0	3
20	CSEL 465	Digital Accessibility Audit (Level 2)	S	3	0	0	3
21	CSEL 466	User Interface Engineering (Level 3)	S	3	0	0	3
22	CSEL 467	Computer Vision and Applications (Level 3)	S	3	0	0	3
		STREAM 4 – DATA ANALYTICS					
23	CSEL 561	Big Data (Level 1)	S	3	0	0	3
24	CSEL 562	Python Programming for Data Analytics (Level 1)	S	3	0	0	3
25	CSEL 563	Statistics for Business Analytics (Level 1)	S	3	0	0	3
26	CSEL 564	Marketing Analytics (Level 2)	S	3	0	0	3
27	CSEL 565	Social Network Analytics (Level 2)	S	3	0	0	3
28	CSEL 566	Risk Analytics (Level 2)	S	3	0	0	3
29	CSEL 567	Database Systems in Big Data (Level 3)	S	3	0	0	3
30	CSEL 568	Streaming Analytics (Level 3)	S	3	0	0	3
31	CSEL 569	Video Processing and Analytics (Level 3)	S	3	0	0	3
		STREAM 5 – NETWORK COMPUTING					
32	CSEL 571	Principles of Distributed Computing (Level 1)	S	3	0	0	3
33	CSEL 572	Introduction to Parallel Computing (Level 2)	S	3	0	0	3
34	CSEL 573	Network Design and Management (Level 2)	S	3	0	0	3
35	CSEL 574	Web Services Computing (Level 2)	S	3	0	0	3
36	CSEL 575	Pervasive and Ubiquitous Computing (Level 3)	S	3	0	0	3
37	CSEL 576	Cloud Computing (Level 3)	S	3	0	0	3

38	CSEL 577	Internet of Things (Level 3)	S	3	0	0	3
		STREAM 6 ARTIFICIAL INTELLIGENCE					
39	CSEL 581	Introduction to A.I. and Expert Systems (Level 1)	S	3	0	0	3
40	CSEL 582	Neural Networks (Level 2)	S	3	0	0	3
41	CSEL 583	Fuzzy Logic (Level 2)	S	3	0	0	3
42	CSEL 584	Decision Support Systems (Level 2)	S	3	0	0	3
43	CSEL 585	Introduction to Machine Learning (Level 3)	S	3	0	0	3
44	CSEL 586	Introduction to Robotics (Level 3)	S	3	0	0	3
45	CSEL 587	Soft Computing (Level 3)	S	3	0	0	3

Programme Outcomes

The Master of Computer Applications (MCA) programme is designed to impart fundamental knowledge in computing domain, programming skills to enable the students to cater the needs of the IT industry and / or to pursue higher education. The following are the specific programme outcomes:

- Ability to understand and apply the mathematical concepts, domain knowledge in computer science for solving problems.

- Analyse customer requirements, formulate high level design, implement robust and reliable software systems.

- Implement various computing applications using modern computing tools and techniques and use them with dexterity.

- Analyze the safety, security and applicability aspects in designing an application.

- Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.

- Communicate effectively and present technical information in oral and written reports.

- Involve in perennial learning for a continued career development and progress as a computer professional.

- Function effectively both as a team leader and team member on multi-disciplinary projects to demonstrate computing and management skills.
- Impart entrepreneurship vision to facilitate creation of wealth using technology based innovation with the overall goal of betterment of the individual and society.

M.C.A.
BRIDGE COURSES

CSCA 001: FUNDAMENTALS OF COMPUTERS

Objectives:

- To get familiar with the fundamental concepts of Computers.

Outcomes:

- Ability to gain basic knowledge in computer science domain.

MODULE-I

Computer Basics: Simple Model of a Computer, Characteristics of Computers – Computer classifications and generations - Data Representation.

MODULE-II

Introduction to Microprocessor - Input / Output Units – Computer Memory – Storage – Database Management Systems - Binary Arithmetic – Logic Circuits.

MODULE-III

Introduction to Operating Systems – Programming languages – Multimedia - Computer Networks.

Text Book:

1. V. Rajaraman, Neeharika Adabala : Fundamentals of computers,Prentice Hall India Learning Private Limited; 6th Revised Edition (2014)

CSCA 002: INTRODUCTION TO PROBLEM SOLVING

Objectives:

* To get familiar with various problem solving techniques.

Outcomes

* Ability to solve problems using various approaches.

MODULE-I

Introduction to problem solving – Top-down design – Implementation of algorithms – program verification – efficiency & analysis of algorithms.

MODULE-II

Basic problem solving approaches: Factoring methods – Array techniques – Merging, Sorting & Searching.

MODULE-III

Text processing - Pattern searching – Dynamic Data Structures - Recursive algorithms.

Text Book:

1. R. G. Dromey, How to Solve it by Computer, Pearson Education India; 1st edition (2006).

CSCA 003: INTRODUCTION TO COMPUTER PROGRAMMING

Objectives:
- To develop C Programs using basic programming constructs
- To develop C programs using arrays, strings, functions, structures & Files.

Outcomes:
- Ability to code in C Language.

MODULE - I

Introduction to programming paradigms - Structure of C program - C programming: Data Types – Storage classes - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Pre-processor directives - Compilation process.

MODULE - II

Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays – String operations: length, compare, concatenate and copy – Introduction to functions: Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursive function.

MODULE - III

Structure - Nested structures – Pointer and Structures – Array of structures – Files – Create, Open, Close, Processing of file content.

Text Book:
1. Reema Thareja, Programming in C, Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie, D.M., The C Programming language, Pearson Education, Second Edition, 2006.

M.C.A.
FIRST SEMESTER

CSCA 411: DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	0	0	3

Pre-requisite:
- Introductory knowledge about Computing.

Objectives:
- To impart knowledge about various data structures, their representation, and applications.
- To Acquaint with various Algorithmic techniques and applications.

Outcomes:
- Ability to understand and apply various data structures such as arrays, queues, linked lists, stacks, trees and graphs.
- Ability to understand the fundamental concepts in algorithms &analyze algorithms using space & time complexity.
- Ability to understand and implement various types of algorithms such as divide & conquer, greedy method, dynamic programming.

Module-I: (9 Hrs)
Data Structures: Basic Terminologies – Algorithms: Definition, Pseudocode Representation – Time complexity and space complexity - efficiency of algorithms - O-notation - Omega notation and Theta Notation Arrays: One dimensional & multidimensional arrays – Searching.

Module-II: (9 Hrs)
Stacks: Representation - Operations – Applications. Queues: Representation – Operations – Applications.
Linked List: Single Linked List, Double Linked List, Circular Linked List, Applications of Linked List.

Module-III: (9 Hrs)
Trees: Basic Terminologies - Binary trees: Representation, Operations, Traversals, Types - Applications of Trees.
Graphs: Basic Terminologies, Representation, Operations, Traversals – Applications: Shortest path problem, Topological sorting, Minimum Spanning trees.

Module-IV: (9 Hrs)
Divide and Conquer: General method – binary search - merge sort - quick sort--Recursive algorithms, analysis of non-recursive and recursive algorithms, solving recurrence equations.
Greedy Method: General method – knapsack problem – minimum spanning tree algorithms – single source shortest path algorithm – scheduling - Huffman codes

Module - V: **(9 Hrs)**
Dynamic Programming: 0/1 Knapsack and Traveling salesman problem – Backtracking: n-Queen problem - Graph Colouring - Introduction to NP-Hard and NP-Completeness.

Text Book(s):
1. Ellis Horowitz and Sartaj Sahni,Susan Anderson-Freed, Fundamentals of Data Structures in C (Second Edition), 2008.
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar, Rajasekaran, Fundamentals of Computer Algorithms, Galgotia Publications Pvt. Ltd., 2008.
3. Debasis Samanta, Classic Data Structures, Second Edition, Prentice-Hall of India, Pvt. Ltd., India, 2009.

Reference books:
1. Dinesh P Mehta & Sartaj Sahni, Handbook of Data Structures and Applications, Chapman and Hall. 2005.

Web References:
> https://www.geeksforgeeks.org/data-structures/

CSCA 412: OBJECT ORIENTED PROGRAMMING

L	T	P	C
3	0	0	3

Pre-requisite:

- Basic Programming knowledge.

Objectives:
- Acquiring skills to do Object Oriented programming using C++ and Java

Outcomes:
- Ability to understand and build Object Oriented Programs.
- Ability to understand and build Java programs using applets, AWT, Swing, Java Beans and Servlets.

Module-I: (9 Hrs)
Introduction to C++ - Applications of C++ - Structure of a Simple C++ Program – Compiling and Executing C++ programs – Programming elements – C++ Library function – User Defined Functions: Call by value , call by reference.

Module-II: (9 Hrs)
Object oriented programming paradigm – Basic OOP concepts – Benefits – C++ Class definition – Member functions – Static members – Constructor and destructors: various types. Operator overloading: Unary, binary – Rules for Operator overloading – Type conversions - Function overloading – Friend and Virtual Functions. Inheritance: Various Types , Applications – Abstract classes – Virtual base classes.

Module-III: (9 Hrs)
Introduction to Java Applet programming – Graphic Programming - Managing input and output files – Java Collections.

Module-IV: (9 Hrs)
Event Handling – Applets – AWT: Working with windows, Graphics and Text – AWT controls – layout Managers and Menus – Images.

Module-V: (9 Hrs)
Java Swing and its controls– Java Beans – Servlets.

Text Books:

1. E.Balagurusamy (2013): Object Oriented Programming With C++, McGraw-Hill Education, Sixth Edition.

2. E. Balagurusamy, Programming with Java, A Primer, 2010, Fourth Edition, McGraw Hill.

3. Herbert Schildt, The Complete Reference: Java 2, 2002, Fifth Edition, McGraw Hill.

CSCA 413: DATABASE MANAGEMENT SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite:
                - NIL-

Objectives:
- Understand the fundamentals of data models and conceptualize and depict a database system using ER diagram
- Study of SQL and relational database design.
- Understand about Data Storage Techniques and Query processing.
- Impart knowledge in Transaction processing, Concurrency control techniques and recovery procedures.

Outcomes:
- Effectively conceptualize and depict a database system using ER diagram
- Design database and perform SQL queries
- Understand transaction processing, files and special purpose databases.

Module-I: Introduction   (9 Hrs)
File systems versus Database systems – Data Models – DBMS Architecture – Data Independence – Data modeling using Entity – Relationship Model – Enhanced E-R Modeling.

Module-II: Relational Model and Query Evaluation   (9 Hrs)
Relational Model Concepts – Relational Algebra – SQL – Basic Queries – Complex SQL Queries – Views – Constraints – Relational Calculus – Tuple Relational Calculus – Domain Relational Calculus –overview of commercial RDBMSs – Database Design – Functional Dependencies – Normal Forms – 1NF – 2NF-3NF-BCNF – 4NF-5NF - Algorithms for Executing Query Operations — Cost Estimation.

Module-III: Transaction Processing   (9 Hrs)
Transaction Processing – Properties of Transactions - Serializability – Transaction support in SQL - Locking Techniques – Time Stamp ordering – Validation Techniques – Granularity of Data Items – Recovery concepts – Shadow paging – Log Based Recovery – Database Security Issues – Access control – Statistical Database Security.

Module-IV: Files and Indexing   (9 Hrs)
File operations – Hashing Techniques – Indexing – Single level and Multi-level Indexes – B+ tree – Static Hashing - Indexes on Multiple Keys.

Module-V: Special Purpose Databases   (9 Hrs)
OODBMS- - Object-Based Databases - OO Data Model - OO Languages – Persistence – Object Relational Databases - XML – Structure of XML - Temporal Databases – Mobile Databases – Spatial Databases – Case Study for Design and Manage the Database for any Project.

Text Books:
1. Abraham Silberschatz, Henry F. Korth and S.Sundarshan "Database System Concepts", 6th Edition, McGraw Hill, 2010.
2. C.J. Date, "An Introduction to Database Systems", 8th Edition, Pearson Education, 2003.

Reference Books:

1. Ramez Elamassri and Shankant B-Navathe, "Fundamentals of Database Systems", 6th Edition, Pearson Education Delhi, 2010.
2. Raghu Ramakrishnan, Johannes Gehrke,' Database management systems" McGraw Hill, 2003.
3. Peter Rob, Carlos Coronel, "Database System Concepts", Cengage Learning, 2008.
4. Frank. P. Coyle, "XML, Web Services and The Data Revolution", Pearson Education, 2012.
5. Lee Chao, "Database Development and Management", Auerbach Publications, 2010.
6. Peter Rob, Carlos coronel, "Data base system concepts", Ceange Learning 2008.

CSCA 414 - DATA STRUCTURES AND ALGORITHMS LAB

Skills to be acquired:

- Implementation of various Data Structures
- Implementation of various Algorithms.

Lab Software Requirements:

- Any Programming language

List of Exercises:

1. Searching Algorithms (with the number of key comparisons) - Sequential, Binary and Fibonacci search algorithms

2. Evaluation of arithmetic expression.

3. Stack, Queue, Circular queue, priority queue

4. Singly Linked List, Doubly Linked List, Circular Linked List.

5. Tree Traversal techniques.

6. Graph Traversal techniques.

7. Dijkstra's Algorithm to obtain the shortest paths

8. Binary search using Divide-and-Conquer technique.

9. Sorting algorithms using Divide-and-Conquer technique.

10. Knapsack using Greedy technique.

11. Traveling Salesman algorithms using Dynamic Programming technique.

12. 8 Queens with the design of Backtracking.

CSCA 415: OBJECT ORIENTED PROGRAMMING LAB

L	T	P	C
0	0	3	2

List of Exercises:

1. Working with Class and Objects.
2. Program to work with Inheritance and Packages.
3. Program to work with Interfaces.
4. Program to work with Exception Handling Technique.
5. Program to work with to input/output streams.
6. Program to work with File handling technique.
7. Program to work with Threading.
8. Program to work with various AWT controls.
9. Working with Java Beans
10. Program to work with Swings
11. Program to work with Servlets

CSCA 416: DATABASE MANAGEMENT SYSTEMS LAB

L	T	P	C
0	0	3	2

Laboratory Components:

Skills to be acquired:

- Practicing the different types of data storage techniques and query processing.

Lab Software:

- MySQL/ ORACLE / Microsoft SQL Server, etc.,

List of Exercises:

1. Creation of base tables and views.

2. Data Manipulation INSERT, DELETE and UPDATE in Tables. SELECT, Sub Queries and JOIN

3. Data Control Commands

4. High level language extensions – PL/SQL. Or Transact SQL – Packages

5. Use of Cursors, Procedures and Functions

6. Embedded SQL or Database Connectivity.

7. Oracle or SQL Server Triggers – Block Level – Form Level Triggers

8. Working with Forms, Menus and Report Writers for a application project in any domain

9. Front-end tools – PHP, Visual Basic, etc.,

M.C.A.
SECOND SEMESTER

CSCA 421: COMPUTER NETWORKS

L	T	P	C
3	0	0	3

Pre-requisite:
- Basic Knowledge in Computers

Objectives:
- To understand the fundamentals of Computer Networks
- To get familiarized with Various Layers of Computer Networks
- To understand the working principles of Various Protocols
- To get familiarized with Network Security

Outcomes:
- Ability to understand the various hardware and software components of computer networks.
- Ability to understand the layered network architecture.
- Ability to configure networks and debug issues in networks.

Module-I: Introduction to Networks   (9 Hrs)
Network Topology - Network Architecture - Reference Models - Example Networks - APRANET, NSFNET, Internet - Physical Layer - Transmission media.

Module-II: The Data Link Layer   (9 Hrs)
 Data Link Layer design issues - Error Detection and Correction Methods - Elementary Data Link Protocols - Sliding Window Protocols Protocol - Verification Methods - Channel Allocation Multiple Access protocols - IEEE 802 Standards.

Module- III: The Network Layer   (9 Hrs)
Network Layer design issues - Routing algorithms - Congestion Control algorithms - Internetworking Network Layer in Internet.

Module- IV: The Transport Protocols   (9 Hrs)
Transport Service - Transport Protocols - Internet Transport Protocols - UDP - TCP - Performance issues.

Module- V: The Application Layer   (9 Hrs)
Application Layer design issues - Domain Name System - Electronic Mail - World Wide Web - Other Applications - Network Security - Basic Cryptography – Symmetric and Asymmetric Cryptography.

Text Book:
1. Behrouz Forouzan, Data Communications and Networking, McGraw Hill, 4thEdition, 2017.

Reference Books:
1. Andrew S. Tanenbaum, Computer Networks, International Economy Edition, 5th edition, 2010.
2. William Stallings, Cryptography and Network Security: Principles and Standards, Prentice Hall India, 4th Edition, 2005.

CSCA 422: OPERATING SYSTEMS

L	T	P	C
3	0	0	3

Pre-requisite:
- Familiarity with Fundamentals of Computers

Objectives:
- To Understand the Basic features of Operating System
- To Introduce Different Functions of Operating Systems
- To Introduce Various Types of Operating Systems

Outcomes:
- Ability to understand various functions of operating systems.
- Analyze various memory management and process management functions.
- Ability to install and configure various operating systems.

Module-I: introduction (9 Hrs)

Types of operating systems-operating systems Structures-Systems components operating systems services-System calls-Systems programs-Processes-process concept- process scheduling-operation on processes-co-operating processes-Inter process communications-CPU Scheduling-Scheduling criteria-Scheduling algorithms-Multiple-processor Scheduling.

Module-II: Process Synchronization (9 Hrs)

Critical Section problem – Semaphores-Classical problems of synchronization-critical Regions-Monitors-Deadlock Characterization-Deadlock Handling-Deadlock Prevention-Deadlock Avoidance-Deadlock Detection-Deadlock Recovery –Threads- Multithreading Models.

Module-III: Memory Management (9 Hrs)

Memory Management-Swapping-Contiguous Memory Allocation-Paging-Segmentation-Virtual Memory-Demand Paging-Page Replacement-Thrashing.

Module-IV: Disk Scheduling and Distributed Systems (9 Hrs)

Disk Structures-Disk Scheduling-File Systems Interface-File Concepts-Access Methods-Directory Structures-File System Implementation-File Systems Structures-Directory Implementation-Allocation Methods-Free Space Management-Distributed File Systems-Naming and Transparency-Remote File Accesses- Stateful Versus Stateless Service-File replication.

Module-V: Case Studies (9 Hrs)

Linux System-design Principles- process Management-File Systems- MS Windows -Systems Structures-Process management-memory Management-Android OS-Virtual machine OS.

Text Books:

1. Abraham Silberschatz Peter B Galvin, G. Gagne," Operating Systems Concepts", 7th Edition, Addison Wesley, 2010.
2. Andrew S. Tanenbaum, "Modern operating Systems", 3rd Edition, PHI Learning Pvt. Ltd., 2008.

Reference Books:

1. William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2011.
2. H M Deital, P J Deital and D R Choffnes, "Operating Systems", 3rd Edition, Pearson Education, 2011.
3. D M Dhamdhere, "Operating Systems: A Concept-based Approach", 2nd Edition, Tata McGraw-Hill, 2007.

CSCA 423: COMMUNICATION SKILLS

L	T	P	C
1	0	2	2

Module-I: (9 Hrs)
Session I: Communication: Concepts and definition - Importance - Process- communication - Model - Types - Mode of communication - Objectives - Inter, Intra personal Communication - Barriers - Commandments of communication.

Module-II: (9 Hrs)
Session II: Developing Communication Skills: a) Reading: Preparation - Reading Styles - Linear reading - Faster Reading - Reading Techniques b) Writing: Effective writing - Report writing - Speech Writing - Minutes - Communication aids - Agenda Writing - Letters - Article writing - Improving English language Writing - When to write and when not to write.
Session III: Listening and Speaking: a) Listening: Listening - Importance - Art of Listening - Advantages - Mode of expression - Listening tests b) Speaking: Art of conversation – Using telephone - Methods of asking questions - Brain Storming - Presenting reports –Improving speech delivery - Expressing Techniques

Module-III: (9 Hrs)
Session-IV: Interviews Techniques: What and Why? - Types of Interviews - Understanding the intricacies - Planning for interviews - Answering skills – Effective Communication during interviews - TIPS - Mock Interview.
Session V: Group Discussion: Group Discussion - Purpose - Process of Group Discussion - Preparation - Getting Started - Art of guiding and controlling discussion - Personality test through group discussion - Lateral thinking - Participation techniques - mock G.D.

Module-IV: (9 Hrs)
Session VI: Body Language: Origin and development of body language - Tool for personality identification - Analysis of body language - Types - Desirable body language - Attitude and body language - Body language as a powerful communication.
Session VII: Negotiation Techniques: Meaning - Importance - Fundamentals - Preparation - Techniques of Negotiation - Managing process of negotiation - Inter-personal behaviour – Case Study - Mock negotiations
Session VIII: Meetings: Meaning - Importance - Objectives - Leading and participating in meetings - Success indicators - Understanding the process of meetings – Communication skills for meetings - Mock Meetings - Seminars.

Module-V: (9 Hrs)
Session-IX: Management Communication Relationships: Communication in Management - Semantics - Employee and Employer communication - Communication within Management - Downward and Upward communication - Communication by specialists - The Union's role in communication.
Session-X: Presentation: Meaning and types of presentation - Understanding the audience - Planning - Designing - Written and oral - Making use of notes and outlines _ Techniques for delivering presentation - personal style - A postscript - model presentation.
Session - XI: A whole review of the ten sessions and evaluation of the Students.
Session XII: Practical communication with a cross section of the Society.

CSCA 424: COMPUTER NETWORKS LAB

L	T	P	C
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Skills to be acquired:

- Practicing the different types Networking Concepts and Basic Communication model.

List of Exercises:

1. Write a program in Java for simplex communication using Connection Oriented service.

2. Write a program in Java for simplex communication using Connection Less service.

3. Write a program in Java for full duplex communication using Connection Oriented service.

4. Write a program in Java for full duplex communication using Connection Less service.

5. Implement an Unrestricted Simplex Protocol of Data Link Layer.

6. Implement A Simplex Stop-and-Wait Protocol of Data Link Layer.

7. Implement A Simplex Protocol for a Noisy Channel of Data Link Layer.

8. Implement the following Sliding Window Protocol:
   a. A One-Bit Sliding Window Protocol
   b. A Protocol Using Go Back N
   c. A Protocol Using Selective Repeat

9. Implement Multicast Routing of Network Layer.

10. Implement Transfer a File from one system to another system using FTP.

CSCA 425: OPERATING SYSTEMS LAB

L	T	P	C
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Skills to be acquired:

- Practicing the different types Operating System Concepts and features.

List of Exercises:

1. Implementation of System Calls

2. Implementation of File Permissions

3. Implementation of File Operations

4. Implementation of File Copy and Move

5. Implementation of Dining Philosophers Problem

6. Implementation of Producer-Consumer Problem

7. Implementation of First in First Serve Algorithm

8. Implementation of Shortest Job First Scheduling Algorithm

9. Implementation of Round Robin Scheduling Method

10. Implementation of Priority Scheduling Algorithm

M.C.A.
THIRD SEMESTER

CSCA 511: SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

Pre-requisite:
- Familiarity with Programming in Object Oriented Languages

Objectives:
- To Introduce Different Software Life Cycle Models
- To Understand the Significance of Software Development Process
- To Design and Develop Robust Software Products

Outcomes:
- Ability to understand various phases of software development life cycle.
- Ability to acquire software project management skills.

Module-I: Introduction to Software Engineering   (9 Hrs)
Software Process Structure – Process Models & Activities – Agile Development - Requirements Engineering.

Module-II: Software Modeling   (9 Hrs)
Design Concepts - Architectural Design - Component Level Design – User Interface Design- Web Application Design.

Module-III: Software Quality Management   (9 Hrs)
Review Techniques - Software Quality Assurance – Software Testing Strategies – Software Configuration Management – Product Metrics.

Module-IV: Managing Software Projects   (9 Hrs)
Project Management Concepts – Process and Project Metrics – Estimation for Software Projects – Project Scheduling - Risk Management.

Module-V: Software Reliability & Security   (9 Hrs)
Reliability Engineering- Reliability and availability – Reliability Testing. Security Requirements & Design.

Text Books:

1. Roger S. Pressman, Software Engineering: A Practitioner's Approach, McGraw-Hill Education, 8th edition, 2014.
2. Ian Summerville, Software Engineering, Pearson Publishers, 10th Edition, 2015.

CSCA 512: INTERNET AND WEB TECHNOLOGIES

L	T	P	C
3	0	0	3

Pre-requisite:
- Basic Understanding of Computer Networks & Programming Concepts

Objectives:
- Understand the concepts and architecture of the World Wide Web.
- Understand and practice markup languages
- Understand and practice embedded dynamic scripting on client side Internet Programming
- Understand and practice web development techniques on client-side

Outcomes:
- Ability to understand the working mechanism of internet and world wide web.
- Ability to build web pages using various web technologies.
- Build web applications using clients and server side scripts.

Module-I: Introduction (9 Hrs)
Internet Standards – Introduction to WWW – WWW Architecture – SMTP – POP3 – File Transfer Protocol - Overview of HTTP, HTTP request – response –– Generation of dynamic web pages.

Module-II: UI Design (9 Hrs)
Markup Language (HTML): Introduction to HTML and HTML5 - Formatting and Fonts – Commenting Code – Anchors – Backgrounds – Images – Hyperlinks – Lists – Tables – Frames - HTML Forms. Cascading Style Sheet (CSS): The need for CSS, Introduction to CSS – Basic syntax and structure - Inline Styles – Embedding Style Sheets - Linking External Style Sheets – Backgrounds – Manipulating text - Margins and Padding - Positioning using CSS.

Module-III: Introduction to Java script (9 Hrs)
Introduction - Core features - Data types and Variables - Operators, Expressions, and Statements - Functions - Objects - Array, Date and Math related Objects - Document Object Model - Event Handling - Controlling Windows & Frames and Documents - Form handling and validations.

Module-IV: Advanced Java script (9 Hrs)
Browser Management and Media Management – Classes – Constructors – Object-Oriented Techniques in JavaScript – Object constructor and Prototyping - Sub classes and Super classes – JSON - jQuery and AJAX.

Module-V: PHP & MySQL (9 Hrs)
Introduction - How web works - Setting up the environment (LAMP server) - Programming basics - Print/echo - Variables and constants – Strings and Arrays – Operators, Control structures and looping structures – Functions – Reading Data in Web Pages - Embedding PHP within HTML – Establishing connectivity with MySQL database.

Text Books:

1. Harvey & Paul Deitel & Associates, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web - How to Program", 5th Edition, Pearson Education, 2011.

2. Achyut S Godbole and Atul Kahate, "Web Technologies", 2nd Edition, Tata McGraw Hill, 2012.

3. Thomas A Powell, Fritz Schneider, "JavaScript: The Complete Reference", 3rd Edition, Tata McGraw Hill, 2013.

Reference Books:

1. David Flanagan, "JavaScript: The Definitive Guide, Sixth Edition", O'Reilly Media, 2011.

2. Steven Holzner, "The Complete Reference - PHP", Tata McGraw Hill, 2008.

3. Mike Mcgrath, "PHP & MySQL in easy Steps", Tata McGraw Hill, 2012.

CSCA 513: MINI PROJECT

L	T	P	C
0	0	3	2

Laboratory Components:

Skills to be Acquired:

- Ability to develop real time software applications.

Lab Software Requirements:

- Based on the project requirements

CSCA 514: INTERNET AND WEB TECHNOLOGIES LAB

L	T	P	C
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<u>Skills to **be Acquired**</u>:

- Designing Static and Dynamic Web Pages
- Designing Web Applications with Persistent Storage

<u>Lab Software Requirements</u>:

- Open Source Web Development tools. (Linux – Apache – MySQL – PHP)

<u>List of Exercises</u>:

1. *Exercises to make the student acquire Static Web Page designing skills.*

2. *Exercises to make the student acquire Style Sheet Design and usage skills.*

3. *Exercises to make the student acquire Client Side Scripting skills.*

4. *Exercises to make the student acquire Server Side Scripting skills*

5. *Exercises to make the student acquire Database Manipulation skills.*

M.C.A.
FOURTH SEMESTER

PROJECT WORK & VIVA-VOCE

M.C.A.
SUPPORTIVE CORE COURSE
(3 CREDITS)

CSCA 431: MATHEMATICS FOR COMPUTER SCIENCE

L	T	P	C
3	0	0	3

Pre-requisite:
- Knowledge of functions and basic Algebra

Objectives:
- Introduce the mathematical concepts fundamental to Computer science.
- To illustrate the applications of Mathematical concepts to Computer science

Outcomes:
- Ability to understand the fundamental mathematical concepts involved in Computer Science
- Getting familiarized with mathematical concepts such as number theory, algebraic structures.

Module-I: (10 Hrs)
Logics and Proofs: Propositional Logic – Predicates – Proofs – Methods and strategies.

Module-II: (9 Hrs)
Basic Structures and Relations: Sets – Functions – Sequences – Sums – Matrices. Relations – properties – representation

Module-III: (9 Hrs)
Number Theory: Divisibility and Modular Arithmetic – integer – algorithm – prime and GCD – Congruences.

Module-IV: (9 Hrs)
Algebraic Structures: Groups – cyclic group - Homomorphism – Cosets and Lagrange's Theorem- Normal Subgroups –Rings and Fields (definition and examples)

Module-V: (8 Hrs)
Counting: Basics – Pigeon hole principle – Permutations and combinations – Binomial coefficients.

Text Books:
1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 7th Edition, Jones & Bartlett Learning, 2012.
2. Trembley. J.P and Manohar.R." Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Com. Ltd., New Delhi, Reprinted in 2007.

CSCA 432: MANAGEMENT CONCEPTS AND STRATEGIES

L	T	P	C
3	0	0	3

Course Pre-requisite:

- Nil -

Course Objectives:

At the end of the Course the Student will be able to:
- Discuss Fundamentals of Management & Decision Making
- Analyze Management & Communication Process Concepts
- Understanding techniques for Management System

Outcomes:
- Understand Fundamentals of Management & Decision Making
- Analyze Management & Communication Process Concepts
- Understand various techniques for Management

Module-I:Management Theories   (9 Hrs)

Science Theory and Practice - Management and Society: Social Responsibility and Ethics. The nature and purpose of planning - objectives – Strategies Policies and planning premises.

Module-II:Decision Making   (9 Hrs)

The Nature and purpose of organizing - Basic departmentalization - Line/Staff Authority and Decentralization - Effective Organizing and organizational culture.

Module-III:Human Resource Management & Selection   (9 Hrs)

Performance appraisal and career strategy - Manager and organizational development.

Module-IV:Managing the Human factor   (9 Hrs)

Motivation - Leadership -Communication.

Module-V:The System & Process of Controlling   (9 Hrs)

Control techniques and Information Technology - Productivity and Operations Management - Overall and Preventive Control - Towards a Unified, Global management theory.

TEXT BOOKS:

1. Herald Knootz and Heinz Weihrich, "Essentials of Management", McGraw-Hill Publishing Company, Singapore International Edition, 2000.
2. Ties AF, Stoner and R. Edward Freeman, "Management", Prentice Hall of India Pvt., Ltd., New Delhi, 2003.
3. Joseph l, Massie, "Essentials of Management", Prentice Hall of India Pvt., Ltd., New Delhi, 2002.

M.C.A.
SKILL ENHANCEMENT COURSES

CSEL 530 ONLINE/ CERTIFICATE COURSE

L	T	P	C
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Guidelines:

(1) Any Relevant Online Courses from NPTEL / CoursEra / Udacity, Edx, etc.,

(2) The Duration of the Online Course should be for a Minimum of Eight weeks.

(3) The Online Courses should be Chosen with the Formal Prior Approval of the Concern Faculty Advisor.

(4) The Successful Completion Certificate from the Concerned E-Learning website, need to be submitted within the Duration as per Pondicherry University Regulations.

CSEL 531: SIMULATION AND MODELLING TOOLS

L	T	P	C
0	1	2	2

Pre-requisite:
- Knowledge in any Structured Programming Language and OOPs.

Objectives:

- To understand the various components of SciLab and SimPy

Outcomes:

- Ability to simulate using various components of SciLab and SimPy

Module-I: Introduction to SciLab   (25 Hrs)
Introduction to SciLab – SciLab Objects – SciLab Programming – Input & Output Functions – SciLab Graphics – Interfacing.

Modeling & Simulation in SciLab
Types of Models – Ordinary Differential Equations – Boundary value Problems – Differential Algebraic Equations – Hybrid Systems. Simulation Tools.

Optimization in SciLab
General Optimization – Solving Nonlinear Equations – Nonlinear Least Squares – Parameter Fitting – Linear and Quadratic Programming.

Module-II: Introduction to SimPy   (20 Hrs)
Basic Concepts – Environments & Events – Process Interaction – Shared Resources – Real Time Simulations

Text Book(s):
1. Stephen L. Campbell, Jean-Philippe Chancelier and Ramine Nikoukhah "Modeling and Simulation in SciLab/Scicos", Springer, 2006.

2. SimPy Documentation, "Team SimPy", 2019.

CSEL 532 MOBILE APPLICATION DEVELOPMENT

L	T	P	C
0	1	2	2

Pre-requisite:

- Basic Understanding of Programming Concepts

Objectives:

- To Understand System Requirements for Mobile Applications
- To Acquire Mobile Application Development Skills

Outcomes:

- Understand system requirements for Mobile Applications
- Ability to develop various mobile applications.

Module-I: Introduction to Mobile Application   (9 Hrs)
Embedded System-Market and Business drivers for Mobile Application-Publishing and delivering of Mobile Application-Requirements gathering and validation for Mobile Application

Module-II: Basic Design   (9 Hrs)
Basics of Embedded system design –Embedded OS- Design constraints for Mobile Application for both for hardware and software. Architecture for Mobile Application- User Interface for Mobile Application- Touch events and Gestures-Achieving Quality constraints: Performance, Usability, Scalability, Availability and Modifiability

Module-III: Advanced Design   (9 Hrs)
Designing application with Multi Media and web access capabilities – Introduction with GPS and social media- Networking Applications-Accessing Applications hosted in cloud computing Environment-Design platform for Mobile Application

Module-IV: Basic Android Technology   (9 Hrs)
Introduction-Establishing the development Environment-Android Architecture- Activities and Views-Interacting with User Interface -Persisting data using SQLite - Packaging and development

Module-V: Advanced Android Technology   (9 Hrs)
Introduction to server-side Application- Using Google Apps- GPS- Wifi - Introduction to social media application

Text Books:

1. Jeff McWherter and Scott Gowell, "Professional Mobile Development", Wrox Publications.
2. Charlie Collins and Micheal Galpin, "Android in Practice", Dream Tech.2012.

CSEL 533 SOFTWARE TESTING TOOLS

L	T	P	C
0	1	2	2

Pre-requisite:
- Basic programming skills

Objectives:
- To Get Familiarized with Software Testing Concepts & Tools
- To Understand the Test Automation Process

Outcomes:
- Performing software testing using various tools.

Module-I: Testing Fundamentals (9 Hrs)

Software Testing - Introduction – Importance- Seven Fundamental Principles of Testing-SDLC Vs STLC- Software Testing Life Cycle.

Module-II: Types of Testing (9 Hrs)

Manual Testing Tutorials for Beginners- Automation Testing- Unit Testing- Integration Testing- System Testing- Smoke and Sanity Testing- other Testing Techniques

Module-III: Basics of automation testing (9 Hrs)

Why, when and how to perform automation Testing-Factors for choosing a particular tool-An overview for the major functional testing Tools-Overview of Test management and bug tracking tools

Module-IV: (9 Hrs)
Test Management Tool-Test Link, *Load Testing Tool* -LoadUIPro

Module-V: (9 Hrs)
Automated Testing Tool-Selenium

Text Books:

1. Glenford J Myers, Corey Sandler & Tom Badgett, "The Art of Software Testing", 3rd Edition, 2011.
2. Lee Copeland, "A Practitioner's Guide to Software Test Design", 2004.
3. Boris Beizer, "Software Testing Techniques", 2nd edition,1990.

CSEL 534: MULTIMEDIA TOOLS

L	T	P	C
0	1	2	2

Pre-requisite:
- Basic Computer knowledge.

Objectives:
- Gain an ability to create a graphics presentation
- Gain an understanding of designing web page using Dreamweaver.
- Gain an understanding of advanced web design tools such as Flash.
- Gain an ability to use Photoshop.

Outcomes:
- Ability to use various multimedia tools to build presentations, advertisements, business brochure etc.

Module-I: (25 Hrs)
Introduction to Multimedia concepts – Components of multimedia: Text, image, audio, video and animation -Linear and Non-linear multimedia – Interactive multimedia – web based multimedia.

Module-II: (20 Hrs)
Create multimedia graphics presentation, an advertisement, business brochure - Take and edit photographs using multimedia tools.

Text Books:
1. Mohammad Dastbaz, "Design & Development of Interactive Multimedia Systems", McGraw-Hill Education, 2002.
2. David Hillman, "Multimedia: Technology and Applications", Galgotia Publications, Delhi.
3. Adele Droblas Greenberg and Seth Greenberg, "Photoshop 6: The Complete Reference", Tata McGraw-Hill Publishing Company Limited, New Delhi.
4. Banerji, "Multimedia Technologies", Tata McGraw-Hill Education 2010.

CSEL 535: PYTHON PROGRAMMING

L	T	P	C
0	1	2	2

Pre-requisite:
- Basic Knowledge in Programming Concepts

Objectives:
- To impart Python programming skills.
- To enable the students to build solutions with Python

Outcomes:
- Developing basic Python programs.

Module-I: (10 Hrs)

Introduction to Python – Advantages of using Python – Executing Python Programs – Python's Core data types – Numeric Types – String Fundamentals.

Module-II: (20 Hrs)

Lists – Dictionaries – Tuples – Python Statements: Assignments – Expressions – If Tests – While and For Loops.

Functions: Definition, Calls – Scopes – Arguments – Recursive Functions – Functional Programming tools.

Classes and Object Oriented programming with Python - Modules and Packages: Purpose, using packages– Exception Handling with Python.

Module-III: (15 Hrs)

Database Handling using Python – NumPy – Pandas – Machine learning with Python – Data Visualization in Python.

Reference Books:

1. Mark Lutz, Learning Python, Fifth Edition, O'Reilly, 2013.
2. Michael Dawson, Python Programming for the absolute Beginner, 2010.

MOOC Courses:

1. The Joy of Computing using Python, NPTEL, https://nptel.ac.in/courses/106106182/

M.C.A.
OPEN ELECTIVE COURSES
(3 Credits)

One Course from other Department (Non Computer Science)

(or)

Domain Specific Electives of any specialisation related to Computer Science

M.C.A.
DOMAIN SPECIFIC ELECTIVES
(9 Credits)

STREAM 1:INFORMATION SECURITY

CSEL 441: FUNDAMENTALS OF CRYPTOGRAPHY

L	T	P	C
3	0	0	3

Prerequisites:
- Basic knowledge of Cryptographic Concepts

Objectives:
- To Learn Mathematical Cryptographic Algorithms
- To Learn Modern Cryptography
- To learn Secure Protocols for Secure Transactions

Outcomes:
- Ability to understand various cryptography concepts.
- Acquiring skills to work with block chain and analyse various cryptographic protocols.

Module-I: Introduction to Cryptography   **(9 hrs)**
History and overview of Cryptography – Introduction to Secure Programming - API's for Secure Programming - Java Cryptography Extension – .Net Cryptography Extension

Module-II: Elementary Number Theory   **(9 hrs)**
Prime numbers, Factoring – Modular Arithmetic – Fermat's & Euler's Theorem – GCD, Euclid's Algorithm – Discrete Logarithm Problem – Implementing all the algorithms and Theorems using JCE/. NCE

Module-III: Modern Cryptography   **(9 hrs)**
Symmetric Key Encryption - Message Integrity – Public Key Cryptography – Digital Signatures – Implementation of DES, RSA, TDES, ECC, IDEA, MD, SHA – Implementing all the algorithms using JCE/. NCE

Module-IV: Financial Cryptography   **(9 hrs)**
Cryptocurrency - Block chain Applications – Contactless Payments and Ticketing Systems – Digital Cash and Payment Systems – Secure banking and Financial Services – Microfinance and Micropayments – Implementation of Cryptocurrency and Block chain using JCE/. NCE

Module-V: Cryptographic Protocols   **(9 hrs)**
SSL/TLS, SSH, TLS, HTTP/HTTPS, IPSEC, P2P, PGP – Security Protocols – Implementation of All Protocols using JCE/. NCE

Text Books:
1. David Hook 'Beginning Cryptography with Java' 2005, ISBN:978-0-7645-9633-9
2. William Stallings, Cryptography and network security, Pearson Education.
3. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, Hand- book of Applied Cryptography, CRC Press.

Reference Books:

1. Margaret Cozzens, Steven J Miller, The mathematics of encryption, American Mathematical Society
2. Bruce Schneier Applied Cryptography, John Wiley and Sons
3. Mark Stamp, Information Security: Principles and Practice, John Wiley and Sons
4. Matt Bishop, Computer Security, Art and Science, Pearson Education
5. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder Bitcoin and Cryptocurrency Technologies, Draft 2015.

CSEL 442: DATABASE AND APPLICATION SECURITY

L	T	P	C
3	0	0	3

Prerequisites:
- Knowledge of Database Management Systems and Database Administration

Objectives:
- Describe and apply Security Policies on Databases
- Understand Authentication and Password Security
- Know about Application Vulnerabilities
- Understand about Auditing Techniques

Outcomes:
- Ability to understand various components of database and application security.
- Acquiring skills to encrypt and audit the data, analysing application security and vulnerabilities.

Module-I: Database Security   **(9 Hrs)**
Introduction to database Security – Security in Information Technology – importance of data – data review – identity theft – levels of security – Human level: Corrupt/careless user, Network/User Interface, Database application program, Database system, Operating System, Physical level

Module-II: Authentication and Authorization   **(9 Hrs)**
Passwords, Profiles, Privileges and Roles - Authentication – operating system authentication, database authentication, Network or third-party authentication, Database vector password policies -Authorization – User Account authorization - Database/Application Security - Limitations of SQL Authorization – Access Control in Application Layer - Oracle Virtual Private Database – Privacy

Module-III: Securing Database to Database Communications   **(9 Hrs)**
Monitor and limit outbound communications – secure database links – protect link usernames and passwords – monitor usage of database links – secure replication mechanisms - map and secure all data sources and sinks. Trojans – four types of database Trojans.

Module-IV: Encrypting and Auditing the Data   **(9 Hrs)**
Encrypting data in transit – encrypting data at rest – auditing architectures – audit trail – architectures of external audit systems - archive auditing information – secure auditing information – audit the audit system.

Module-V: Application Security & Vulnerabilities   **(9 Hrs)**
Application Security – Application Vulnerabilities - OWASP Top 10 Web Security Vulnerabilities - Unvalidated input, Broken access control, Broken account/session management, Cross-site scripting (XSS) flaws, Buffer overflows - SQL Injection flaws, Improper error handling, Insecure storage, Denial-of service, Insecure configuration management – Insecure File Handling

Text Books:

1. Ron Ben-Natan, "Implementing Database Security and Auditing: A Guide for DBAs, Information Security Administrators and Auditors", Published by Elsevier, 2005.
2. Silvana Castano, "Database Security", Published by Addison-Wesley, 1994.
3. Alfred Basta, Melissa Zgola, Dana Bullaboy, Thomas L. Witlock SR, "Database Security", google books, 2011.
4. Silberschatz, Korth and Sudarshan, "Database System Concepts", 6th Edition, 2010.

Web Resources:

1. The Open Web Application Security Project, http://www.owasp.org
2. Web application security scanners, http: // www. Window security. com / software/Web-Application-Security
3. SQL Injection, http://www.cgisecurity.com/development/sql.shtml
4. 9 ways to hack a web app, http: / / developers. sun. com / learning / javaone online/2005/webtier/TS-5935.pdf
5. Database security, http:/ /docs.oracle.com/cd / B19306_01 / server.102 / b14220/security.htm

CSEL 443: MOBILE AND DIGITAL FORENSICS

L	T	P	C
3	0	0	3

Prerequisites:
- Knowledge of Computer Networks and information security

Objectives:
- Understand the Basics of wireless technologies and security
- Become Knowledgeable in mobile phone forensics and Android Forensics
- Learn the methods of investigation using Digital Forensic techniques

Outcomes:

- Ability to understand the processes involved in mobile and digital forensics.
- Acquiring skills to analyse mobile and digital forensics techniques.

Module-I: Introduction to Wireless Technologies   **(9 Hrs)**
Overview of wireless technologies and security: Personal Area Networks, Wireless Local Area Networks, Metropolitan Area Networks, Wide Area Networks. Wireless threats, vulnerabilities and security: Wireless LANs, War Driving, War Chalking, War Flying, Common Wi-Fi security recommendations, PDA Security, Cell Phones and Security, Wireless DoS attacks, GPS Jamming, Identity theft.

Module-II: Security Framework for Mobile Systems   **(9 Hrs)**
CIA triad in mobile Phones-Voice, SMS and Identification data interception in GSM: Introduction, practical setup and tools, implementation- Software and Hardware Mobile phone tricks: Netmonitor, GSM network service codes, mobile phone codes, catalog tricks and AT command set- SMS security issues.

Module-III: Mobile Phone Forensics   **(9 Hrs)**
Crime and mobile phones, evidences, forensic procedures, files present in SIM card, device data, external memory dump, evidences in memory card, operators systems- Android forensics: Procedures for handling an android device, imaging android USB mass storage devices, logical and physical techniques.

Module-IV: Introduction to Digital Forensics   **(9 Hrs)**
Digital forensics: Introduction – Evidential potential of digital devices: closed vs. open systems, evaluating digital evidence potential- Device handling: seizure issues, device identification, networked devices and contamination.

Module-V: Analysis of Digital Forensic Techniques   **(9 Hrs)**
Digital forensics examination principles: Previewing, imaging, continuity, hashing and evidence locations- Seven element security model- developmental model of digital systems- audit and logs- Evidence interpretation: Data content and context.

References:

1. Iosif I. Androulidakis, "Mobile phone security and forensics: A practical approach", Springer publications, 2012.

2. Andrew Hoog, "Android Forensics: Investigation, Analysis and Mobile Security for Google Android", Elsevier publications, 2011.

3. Angus M. Marshall, "Digital forensics: Digital evidence in criminal investigation", John – Wiley and Sons, 2008

4. Gregory Kipper, "Wireless Crime and Forensic Investigation", Auerbach Publications.

CSEL 444: MALWARE ANALYSIS

L	T	P	C
3	0	0	3

Prerequisites:
- Network Security

Objectives:
- To understand the Computer infection program
- To implement the Covert channel and mechanisms
- To test and exploit various malware in open source environment
- To analyze and design the famous virus and worms

Outcomes:
- Ability to understand various types of malware and threats.
- Acquiring skills to use open source to analyse malware.

Module-I: Introduction (9 hrs)
Computer Infection Program- Life cycle of malware- Virus nomenclature- Worm nomenclature- Tools used in computer virology.

Module-II: Implementation of Covert Channel (9 hrs)
Non-self-reproducing Malware- Working principle of Trojan Horse- Implementation of Remote access and file transfer- Working principle of Logical Bomb - Case Study: Conflicker C worm.

Module-III: Virus Design and Its Implications (9 hrs)
Virus components- Function of replicator, concealer and dispatcher- Trigger Mechanisms- Testing virus codes- Case Study: Brute force logical bomb.

Module-IV: Malware Design Using Open Source (9 hrs)
Computer Virus in Interpreted programming language- Designing Shell bash virus under Linux- Fighting over infection- Anti –antiviral fighting – Polymorphism- Case study: Companion virus.

Module-V: Virus and Worm Analysis (9 hrs)
Klez Virus- Clone Virus- Doom Virus- Black wolf worm- Sassar worm- Happy worm 99.

Text Books:
1. ErciFiliol, "Computer Viruses: from theory to applications", Springer, 1st edition, 2005. ISBN 10: 2-287-23939-1
2. Mark. A. Ludwig, "The Giant black book of computer viruses, Create Space Independent Publishing Platform, 2nd edition, 2009, ISBN 10: 144140712X.

Web Resources:
1. http://www.crysys.hu/downloads/vihimb01/2017/MW-meres.pdf

CSEL 445: INFORMATION SYSTEM AUDIT

L	T	P	C
3	0	0	3

Prerequisites:
- Basic knowledge on Information Systems and Security

Objectives:
- Examine the Multiple layers of IS security in organizations.
- Analyze the Risk management approach to information assets' security with respect to operational and organizational goals.
- Evaluate Physical and logical security controls, and the automated approaches in IS security.

Outcomes:

- Ability to understand auditing Information Systems process.
- Acquiring skills to perform information system audit.

Module-I: Introduction **(9 hrs)**
Information Systems Audit Standards and Practices and Information System Security and Control Practices: Standards and Guidelines for IS Auditing -The Control Objectives - Other Laws and Regulations

Module-II: Auditing Information Systems Organization and Management **(9 hrs)**
Information Systems Strategies to achieve business management objectives - Policies and Procedures - Information Systems Management Practices - Organizational Structure - Audit and Evaluation Techniques

Module-III: Auditing the Information Systems Process **(9 hrs)**
Information Systems Hardware Platform - Information Systems Software Platform - Information Systems Network and Telecommunication Infrastructure - Information System Operational Practices

Module-IV: Information Systems Integrity, Confidentiality and Availability **(9 hrs)**
Logical Access Controls - Physical Access Controls - Environmental Controls - Data validation, processing and balancing controls - Business Continuity Planning and testing

Module-V: Auditing Information Systems Software Development, Acquisition and Maintenance **(9 hrs)**
System Integration Concepts - SDAM Methodologies - SDAM Practices - Information Systems Maintenance Practices

Text Books:

1. "Principles of Information Security", by Michael E. Whitman and Herbert J. Mattord, Thomson Course Technology, 2003, ISBN: 0619063181
2. Handbook of Information Security Management, by Micki Krause and Harold F. Tipton, ISACA Publication, 1999.
3. Handbook of IT Auditing, D.Warren, L.Edelson, X.Parker, Coopers & Lybrand LLP, Warren, Gorham & Lamont. Boston, 1995 with 1999 supplement.
4. The information audit: an important management tool / Katherine Bertolucci. - Managing Information, June 1996, vol.3, no.6, p.34-35.
5. The value and impact of information / edited by M. Feeney and M. Grieves. - London: Bowker Saur, 1994. - ISBN 1 85739 084 9.
6. The value of information to the intelligent organisation. - Hatfield: University of Hertfordshire Press, 1994. - ISBN 0 900458 54 2.
7. Porter, M. E. (1985). Competitive Advantage: Creating and Sustaining Superior Performance. New York, N.Y.: Collier Macmillan.

Web Resources:

1. www.c3i.osd.mil/org/cio/i3/AWG_Digital_Library/index.htm
2. www.isaca.org
3. www.bsi.org
4. www.isaca.org/gir
5. www.isaca.org/cobit.htm

CSEL 446: INFORMATION SECURITY MANAGEMENT

L	T	P	C
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Prerequisites:
- Basic Understanding of Computer Networks.

Objectives:
- Review, Refresh and Expand the Information Security Knowledge (including information security concepts and industry best practices).

Outcomes:
- Ability to understand the processes involved in Information Security management.
- Ability to understand communication and network security, identity and access management.

Module-I: (9 hrs)

Security and Risk Management (Security, Risk, Compliance, Law, Regulations, and Business Continuity): Confidentiality, integrity, and availability concepts - Security governance principles – Compliance - Legal and regulatory issues - Professional ethic - Security policies, standards, procedures and guidelines

Module-II: (9 hrs)

Asset Security (Protecting Security of Assets): Information and asset classification - Ownership (e.g. data owners, system owners) - Protect privacy - Appropriate retention - Data security controls - Handling requirements (e.g. markings, labels, storage)

Module III: (9 hrs)

Security Engineering (Engineering and Management of Security) - Engineering processes using secure design principles - Security models fundamental concepts - Security evaluation models - Security capabilities of information systems - Security architectures, designs, and solution elements vulnerabilities – Web based systems vulnerabilities - Mobile systems vulnerabilities - Embedded devices and cyber physical systems vulnerabilities – Cryptography - Site and facility design secure principles – Physical Security

Module-IV: (9 hrs)

Communication and Network Security (Designing and Protecting Network Security): Secure network architecture design (e.g. IP & non - IP protocols, segmentation) - Secure network components - Secure communication channels - Network attacks

Module-V: (9 hrs)

Identity and Access Management (Controlling Access and Managing Identity) - Physical and logical assets control - Identification and authentication of people and devices - Identity as a service (e.g. cloud identity) – Third-party identity services (e.g. on- premise) - Access control attacks - Identity and access provisioning lifecycle (e.g. provisioning review)

References:
1. James M. Stewart, Ed Tittel, Mike Chapple 'CISSP: Certified Information Systems Security Professional Study Guide', Wiley 2008.

CSEL 447: CLOUD SECURITY

L	T	P	C
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Pre-requisite*:*
- *Security and methods to improve virtualization security are also dealt with in this course Cloud security introduces the basic concepts of security systems and cryptographic protocols, which are widely used in the design of cloud security. The issues related multi tenancy operation, virtualized infrastructure*

Objectives*:*
- *Compare modern security concepts as they are applied to cloud computing*
- *Assess the security of virtual systems*
- *Evaluate the security issues related to multi-tenancy*
- *Appraise compliance issues that arise from cloud computing*

Outcomes*:*

- *Ability to understand the processes involved in cloud security.*
- *Acquiring skills to implement virtualization systems and enhancing virtualization based security.*

Module-I: Security Concepts **(9 hrs)**
Confidentiality, privacy, integrity, authentication, non-repudiation, availability, access control, defense in depth, least privilege, how these concepts apply in the cloud, what these concepts mean and their importance in PaaS, IaaS and SaaS. e.g. User authentication in the cloud; Cryptographic Systems- Symmetric cryptography, stream ciphers, block ciphers, modes of operation, public-key cryptography, hashing, digital signatures, public-key infrastructures, key management, X.509 certificates, OpenSSL.

Module-II: Multi-Tenancy Issues **(9 hrs)**
Isolation of users/VMs from each other. How the cloud provider can provide this; Virtualization System Security Issues- e.g. ESX and ESXi Security, ESX file system security, storage considerations, backup and recovery; Virtualization System Vulnerabilities- Management console vulnerabilities, management server vulnerabilities, administrative VM vulnerabilities, guest VM vulnerabilities, hypervisor vulnerabilities, hypervisor escape vulnerabilities, configuration issues, malware (botnets etc).

Module-III: Virtualization System **(9 hrs)**
Specific Attacks: Guest hopping, attacks on the VM (delete the VM, attack on the control of the VM, code or file injection into the virtualized file structure), VM migration attack, hyper jacking. System attacks: Management Server attack, Administrative VM attack, Guest VM attacks, Hypervisor attacks.

Module-IV: Technologies for Virtualization-Based Security Enhancement   (9 hrs)
IBM security virtual server protection, virtualization-based sandboxing; Storage Security-HIDPS, log management, Data Loss Prevention. Location of the Perimeter.

Module-V: Legal and Compliance Issues   (9 hrs)
Responsibility, ownership of data, right to penetration test, local law where data is held, examination of modern Security Standards (eg PCIDSS), how standards deal with cloud services and virtualization, compliance for the cloud provider vs. compliance for the customer.

References:

1. Tim Mather, SubraKumaraswamy, ShahedLatif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance [ISBN: 0596802765]
2. Ronald L. Krutz, Russell Dean Vines, Cloud Security [ISBN: 0470589876]
3. John Rittinghouse, James Ransome, Cloud Computing [ISBN: 1439806802]
4. J.R. ("Vic") Winkler, Securing the Cloud [ISBN: 1597495921]
5. Cloud Security Alliance 2009, Security Guidance for Critical Areas of Focus in Cloud ComputingVMware Security Hardening Guide
6. Cloud Security Alliance 2010, Top Threats to Cloud Computing
7. NIST Guidelines on Security and Privacy in Public Cloud Computing
8. NIST Guide to Security for Full Virtualization Technologies
9. NIST The NIST Definition of Cloud Computing
10. William Hau, Rudolph Araujo et al How Virtualization Affects PCI DSS
   www.mcafee.com/us/resources/.../wp-how-virt-affect-pci-dss-part-1.pdf

CSEL 448: ETHICAL HACKING

L	T	P	C
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Prerequisites:
- Basic Understanding of Network Security & Threat Mechanisms

Objectives:
- To Understand the Ethical Hacking Process
- To Get familiarized with Tools and Techniques of Ethical Hacking

Outcomes:
- Ability to understand the processes involved in ethical hacking.
- Acquiring skills to analyse malware threats and developing solutions.

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

Introduction to Ethical Hacking: Information security overview – skills of an ethical hacker – Hacking concepts and phases - Types of attacks – Information Security threats, attack vectors, and controls – Information Assurance (IA) – Information Security Laws and Standards – Security Policies types, HR/legal implications – Physical Security – Threat Modelling – Enterprise Information Security Architecture (EISA) – Network Security Zoning.

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

Foot Printing & Reconnaissance: Foot printing concepts, threats, attack vectors and controls, Foot printing through Search Engines, Foot Printing through Social Networking sites, Website Foot printing, Competitive Intelligence, WHOIS Foot printing, Foot Printing tools. Scanning Networks: Scanning Methodology, techniques, and countermeasures - Techniques for IDS evasion, scanning, HTTP tunneling, and IP spoofing - Drawing network diagrams—latest network discovery and mapping tools, network discovery tools for mobile - Proxy chaining—latest proxy tools, proxy tools for mobile Enumeration: Protocols: NetBIOS, SNMP, LDAP, NTP, SMTP, DNS – Countermeasures - Techniques

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

System Hacking: Cracking passwords, escalating privileges, executing applications, hiding files and covering tracks – Steganography application and classification, tools, methods/attacks on Steganography, Steganography detection tools. Practical: Foot Printing & Reconnaissance, Scanning Networks, Enumeration, System Hacking

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

Malware Threats: Introduction to malware – Trojans attacks, how to infect a system, crypters, how to deploy, latest types, analysis, countermeasures - Viruses—stages, types, latest virus maker, analysis, countermeasures - Worms—types, makers, analysis, countermeasures - Malware analysis - Antivirus tools - Penetration testing.

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

Sniffing: Attacks: MAC, DHCP, and spoofing - Poisoning: ARP and DNS – Tools Social Engineering: Concepts, techniques, impersonation, identity theft, and Counter measures - Phases of an attack - Common targets of an attack - Impersonation scenario - Computer based, mobile based, social networking based Denial of Service: Concepts, case study, tools, attack techniques, and Countermeasures Botnet - Scanning methods for vulnerable machines - Detection Techniques and tools. Session Hijacking: Concepts, case study, tools, attack techniques, and Countermeasures - Five stages of a web malware attack - Application level session hijacking - Network level session hijacking - TCP/IP Hijacking. Practical: Trojans and Backdoors, Viruses and Worms, Sniffers, Social Engineering, Denial of Service, Session Hijacking

References:

1. Kimberly Graves, "CEH: Certified Ethical Hacker Study Guide", Wiley; 2010.

M.C.A.
STREAM 2:
SOFTWARE ENGINEERING

CSEL 451: OBJECT ORIENTED SYSTEM DESIGN

L	T	P	C
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Pre-requisite:

Nil

Objectives:

- To learn the fundamentals of OOSD
- To learn the various Object Oriented Design Models and Testing Objects

Outcomes:

- Ability to understand the fundamentals of object oriented system design.
- Acquiring skills to develop object oriented system design.

Module-I: Object Oriented Design Fundamentals **(9 hrs)**

Review of Object Oriented systems, Design objects, class hierarchy, Inheritance, Polymorphism, Object relationship, Association, Object persistence, metaclass - Object Oriented Systems development life cycle, Comparison of Object oriented methodologies over Traditional methodologies, Different methodologies for Object Oriented design (Rumbaugh, Booch, Jacobson)

Module-II: Object Oriented Analysis **(9 hrs)**

Different approaches for identifying classes, CRC , COAD Yourdon, Shellor mellor method, Identifying object relationships, attributes and methods. Aggregations, Use case analysis.

Module-III: Object Oriented Design and Development **(9 hrs)**

The Unified approach, UML History, Overview of UML, Different diagrams of UML, Capabilities Usage of UML. Architecture (4+1 view) OO Software Development Process – Different phases

Module-IV: Object Oriented Testing Maintenance **(9 hrs)**

Quality assurance Tests - Testing strategies - impact of object orientation on Testing - Test cases - Test Plan- Continuous Testing - Evaluation Testing, Coding, Maintenance, Metrics

Module-V: Case Studies **(9 hrs)**

Object oriented data model, query languages, storage organization and indexing techniques; object relational databases, ATM, Telecom and Different Case Studies.

Text Books:

1. Ali Bahrami, "Object Oriented System Development", Mc-Graw Hill International Edition, 1999.
2. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Language User Guide", Addison - Wesley Longman, 1999.

Reference Book:

1. The Unified Modeling Language User Guide. – Addison Wesley, Booch, Rambaush, Jacobson, 2000.

CSEL 452: SOFTWARE ARCHITECTURE

L	T	P	C
3	0	0	3

Pre-requisite:
- Basic Knowledge in Software Engineering

Objectives:
- Understand software Architectural Requirements and drivers.
- Be exposed to architectural styles and views.

Outcomes:
- Get familiarized with various software architectures and emerging technologies.

Module-I: Introduction and Architectural Drivers   **(9 hrs)**
Introduction – What is software architecture? – Standard Definitions – Architectural structures – Influence of software architecture on organization-both business and technical – Architecture Business Cycle- Introduction – Functional requirements – Technical constraints – Quality Attributes.

Module-II: Quality Attribute Workshop   **(9 hrs)**
Quality Attribute Workshop – Documenting Quality Attributes – Six-part scenarios – Case studies.

Module-III: Architectural Views   **(9 hrs)**
Introduction – Standard Definitions for views – Structures and views – Representing views-available notations – Standard views – 4+1 view of RUP, Siemens 4 views, SEI's perspectives and views – Case studies.

Module-IV: Architectural Styles   **(9 hrs)**
Introduction – Data flow styles – Call-return styles – Shared Information styles – Event styles – Case studies for each style.

Module-V: Documenting the Architecture   **(9 hrs)**
Good practices – Documenting the Views using UML – Merits and Demerits of using visual languages – Need for formal languages – Architectural Description Languages – ACME – Case studies. Special topics: SOA and Web services – Cloud Computing – Adaptive structures.

Text Books:
1. Len Bass, Paul Clements, and Rick Kazman, "Software Architectures Principles and Practices", 2nd Edition, Addison-Wesley, 2003.
2. Anthony J Lattanze, "Architecting Software Intensive System. A Practitioner's Guide", Auerbach Publications, 2010.

Reference Books:

1. Paul Clements, Felix Bachmann, Len Bass, David Garlan, James Ivers, Reed Little, Paulo Merson, Robert Nord, and Judith Stafford, "Documenting Software Architectures. Views and Beyond", 2nd Edition, Addison-Wesley, 2010.
2. Paul Clements, Rick Kazman, and Mark Klein, "Evaluating software architectures: Methods and case studies. Addison-Wesley, 2001.
3. Rajkumar Buyya, James Broberg, and Andrzej Goscinski, "Cloud Computing. Principles and Paradigms", John Wiley & Sons, 2011.
4. Mark Hansen, "SOA Using Java Web Services", Prentice Hall, 2007.

CSEL 453: SOFTWARE PROJECT MANAGEMENT

L	T	P	C
3	0	0	3

Pre-requisite:
- Software Engineering Principles.

Objectives:
- This Course is intended to provide the students with an overall view over Software Engineering Discipline and with insight into the processes of software development.
- To understand the various methods of Cost Estimation.
- To Study about Software Quality Management.
- To Study about Software Metrics

Outcomes:
- Ability to understand various software project management concepts.
- Ability to perform cost estimation and project evaluation.

Module-I: Project Concepts and Its Management   (9 hrs)
Project life cycle models-ISO 9001 model - Capability Maturity Model - Project, Planning-Project tracking-Project closure - Evolution of Software Economics –Software Management Process Framework: Phases, Artifacts, Workflows, Checkpoints – Software Management Disciplines: Planning / Project Organization and Responsibilities / Automation / Project Control – Modern Project.

Module-II: Cost Estimation   (9 hrs)
Problems in Software Estimation – Algorithmic Cost Estimation Process, Function, Points, SLIM (Software Life cycle Management), COCOMO II (Constructive Cost Model) – Estimating Web Application Development – Concepts of Finance, Activity Based Costing and Economic Value Added (EVA) – Balanced Score Card.

Module-III: Software Quality Management   (9 hrs)
Software Quality Factors – Software Quality Components – Software Quality Plan– Software Quality Metrics – Software Quality Costs – Software Quality Assurance-Standard – Certification – Assessment.

Module-IV: Software Management and Metrics   (9 hrs)
Software Configuration Management – Risk Management: Risk Assessment: Identification / Analysis / Prioritization – Risk Control: Planning / Resolution /Monitoring – Failure Mode and Effects Analysis (FMEA) –Defect Management-Cost Management. Software Metrics – Classification of Software Metrics: Product-Metrics: Size Metrics, Complexity Metrics, Halstead's Product Metrics, Quality, Metrics, and Process metrics.

Module-V: Project Evaluation and Emerging Trends   (9 hrs)
Strategic Assessment–Technical Assessment–Cost Benefit Analysis–Cash Flow Forecasting–Cost Benefit Evaluation Technique–Risk Evaluation–Software Effort Estimation. Emerging Trends: Import of the internet on project Management –people Focused Process Models.

Text Book:

1. Ramesh Gopalaswamy, "Managing and Global Software Projects", Tata McGraw Hill, 2017.
2. Neal Whitten, "Managing Software Development Projects", John Wiley & Sons, Inc., 2nd Ed., 1995.

Reference Book(s):

1. Demarco, T. and Lister, T. "Peopleware: Productive Projects and Teams, 2nd Ed.", Dorset House, 1999.
2. Royce, W. "Software Project Management: A Unified Framework", Addison-Wesley, 1998. Demarco, T. and Lister, T. "Peopleware: Productive Projects and Teams, 2ndEd.", Dorset House,1999.
3. Fenton, N.E., and Pfleeger, S.L. "Software Metrics: A Rigorous and Practical Approach, Revised" Brooks Cole, 1998.
4. Kaplan, R.S., Norton, D.P. "The Balanced Scorecard: Translating Strategy into Action", Harvard Business School Press, 1996.
5. Boehm, B. W. "Software Risk Management: Principles and Practices" in IEEE Software, January 1991, pp32-41.
6. Grant, J.L. "Foundations of Economic Value Added", John Wiley & Sons, 1997.
7. Cooper, R., "The Rise of Activity-Based Costing- PartOne: What is an Activity-Based Cost System" Journal of Cost Management, Vol.2, No.2.

CSEL 454: SOFTWARE TESTING

L	T	P	C
3	0	0	3

Pre-requisite:
- Basic Knowledge in Software Engineering

Objectives:
- To understand Standard Software Testing Principles .
- To learn the Functionality of Automated Testing tools.

Outcomes:
- Ability to understand various software testing techniques.
- Ability to incorporate specialize testing responsibilities

Module-I: Testing Environment and Test Processes   **(9 hrs)**
World-Class Software Testing Model – Building a Software Testing Environment – The Seven Step Testing process: Overview of Software Testing Process – Organizing for Testing – Developing the Test Plan – Verification Testing – Analyzing and Reporting Test Results – Acceptance Testing – Operational Testing – Post Implementation Analysis.

Module-II: Testing Techniques and Levels of Testing   **(9 hrs)**
Using White Box Approach to Test design - Static Testing Vs. Structural Testing – Code Functional Testing – Coverage and Control Flow Graphs –Using Black Box Approaches to Test Case Design – Random Testing – Requirements based testing –Decision tables –State-based testing – Cause-effect graphing – Error guessing – Compatibility testing – Levels of Testing - Unit Testing - Integration Testing - Defect Bash Elimination. System Testing - Usability and Accessibility Testing – Configuration Testing - Compatibility Testing - Case study for White box testing and Black box testing techniques.

Module-III: Incorporating Specialized Testing Responsibilities   **(9 hrs)**
Testing Client/Server Systems – Rapid Application Development Testing – Testing in a Multiplatform Environment – Testing Software System Security - Testing Object-Oriented Software – Object Oriented Testing – Testing Web based systems – Web based system – Web Technology Evolution – Traditional Software and Web based Software – Challenges in Testing for Web-based Software –Testing a Data Warehouse - Case Study for Web Application Testing.

Module-IV: Test Automation   **(9 hrs)**
Selecting and Installing Software Testing Tools - Software Test Automation – Skills needed for Automation – Scope of Automation – Design and Architecture for Automation – Requirements for a Test Tool – Challenges in Automation – Tracking the Bug – Debugging – Case study using Bug Tracking Tool.

Module-V: Software Testing and Quality Metrics   **(9 hrs)**
Testing Software System Security - Six-Sigma – TQM - Complexity Metrics and Models – Quality Management Metrics - Availability Metrics - Defect Removal Effectiveness - FMEA - Quality Function Deployment – Taguchi Quality Loss Function – Cost of Quality. Case Study for Complexity and Object-Oriented Metrics

Text Book(s):
1. William Perry, "Effective Methods of Software Testing", Third Edition, Wiley Publishing 2007
2. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson Education, 2007.

Reference Book(s):
1. Naresh Chauhan, "Software Testing Principles and Practices" Oxford University Press, New Delhi, 2010.
2. Dale H. Besterfiled et al., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint (2006).
3. Stephen Kan, "Metrics and Models in Software Quality", Addison – Wesley, Second Edition, 2004
4. Llene Burnstein, " Practical Software Testing", Springer International Edition, Chennai, 2003
5. Renu Rajani, Pradeep Oak, "Software Testing – Effective Methods, Tools and Techniques", Tata McGraw Hill,2004
6. Edward Kit, "Software Testing in the Real World – Improving the Process", Pearson Education, 1995.
7. Boris Beizer, " Software Testing Techniques" – 2nd Edition, Van Nostr and Reinhold, New York, 1990.

CSEL 455: SOFTWARE QUALITY ASSURANCE

L	T	P	C
3	0	0	3

Pre-requisite:
- Basic Knowledge in Software Design Process.

Objectives:
- To understand the basic tenets of Software Quality and quality factors.
- To Understand the SQA Components.

Outcomes:

- Ability to understand SQA components and project life cycle.
- Ability to understand software quality management and apply various metrics.

Module-I: Introduction to Software Quality & Architecture (9 hrs)
Need for Software quality – Quality challenges – Software quality assurance (SQA) – Definition and objectives – Software quality factors- McCall"s quality model – SQA system and architecture – Software Project life cycle Components – Pre project quality components – Development and quality plans.

Module-II: SQA Components and Project Life Cycle (9 hrs)
Software Development methodologies – Quality assurance activities in the development process - Verification & Validation – Reviews – Software Testing – Software Testing implementations – Quality of software maintenance – Pre-Maintenance of software quality components – Quality assurance tools – CASE tools for software quality – Software maintenance quality – Project Management

Module-III: Software Quality Infrastructure (9 hrs)
Procedures and work instructions - Templates - Checklists – 3S development team - Staff training and certification Corrective and preventive actions – Configuration management – Software change control – Configuration management audit -Documentation control – Storage and retrieval.

Module-IV: Software Quality Management & Metrics (9 hrs)
Project process control – Computerized tools - Software quality metrics – Objectives of quality measurement – Process metrics – Product metrics – Implementation – Limitations of software metrics – Cost of software quality – Classical quality cost model – Extended model – Application of Cost model

Module-V: Standards, Certifications & Assessments (9 hrs)
Quality management standards – ISO 9001 and ISO 9000-3 – capability Maturity Models – CMM and CMMI assessment methodologies - Bootstrap methodology – SPICE Project – SQA project process standards – IEEE st 1012 & 1028 – Organization of Quality Assurance – Department management responsibilities – Project management responsibilities – SQA units and other actors in SQA systems

Text Book(s):
1. Daniel Galin, "Software Quality Assurance", Pearson Publication, 2009.

Reference Book(s):
1. Alan C. Gillies, "Software Quality: Theory and Management", International Thomson Computer Press, 1997.
2. Mordechai Ben-Menachem "Software Quality: Producing Practical Consistent Software", International Thompson Computer Press, 1997.

CSEL 456: SOFTWARE RISK MANAGEMENT AND MAINTENANCE

L	T	P	C
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Pre-requisite:
- Basic Knowledge in Software Analysis & Design Process

Objectives:
- To understand the various Risk levels in software development.
- To understand the Risk plan, implementation and tracking Risks
- To realize the Software maintenance process, Measurement and benchmarking

Outcomes:
- Ability to understand the basics concepts of software risk management and maintenance.
- Ability to identify, asses, respond and track risk

Module-I: Risk Culture and Management Process   (9 hrs)

Risk- Basic Terms- Risk Vocabulary – Risk- Driven Project Management- Controlling the Process, Environment and Risk- Maturity in Risk Culture – Risk Scale – Preparing for Risk – Risk Management- Paradigms- Five Models of Risk Management – Thinking about Less Risky alternatives – Risk Management at Different Levels – Risk Escalation – Risk Models- Risk Intelligence - Software Risk Management steps.

Module-II: Discovering Risk and Assessment   (9 hrs)

Identifying software risk - Classification of Risks – Risk Taxonomy – Risk Mapping – Statements – Risk Reviews – Risk Ownership and stakeholder management – Risk Assessment Approach – Risk Assessment tools and techniques – Risk Probability, impact, exposure, matrix and Application Problem - Self - assessment checklist.

Module-III: Responding to Risks and Tracking   (9 hrs)

Special Treatment for Catastrophic risks- Constraint Risks – Risk Mitigation Plan Case Study – Contingency Plans- Implementing Risk Response- Tracking Risk Response and Hazards – Trigger Levels- Tracking Project Risks and Operational Risks- Learning by Tracking and Risk Tracker Tool.

Module-IV: Maintenance Process   (9 hrs)

Software Maintenance- Customer's Viewpoint- Economics of Maintenance- Issues in Maintenance- Software Maintenance Standard, Process, Activities and Categories – Maintenance Measurement – Service Measurement and Benchmarking – Problem Resolution – Reporting – Fix Distribution.

Module-V: Activities for Maintenance   (9 hrs)

Role of SQA for Support and Maintenance – SQA tools for Maintenance- Configuration Management and Maintenance – Maintenance of Mission Critical Systems – Global Maintenance Teams – Foundation of S3m Process Model- Exemplary Practices.

Text Book(s):

1. C. RavindranathPandian, "Applied Software Risk Management: A guide for Software Project Managers", Auerbach Publications, 2007.
2. John Mcmanus, "Risk Management in Software Development Projects", Elsevier Butterworth- Heinemann, First Edition, 2004.

Reference Book(s):

1. Alian April and Alain Abran, "Software Maintenance Management: Evaluation and Continuous Improvement", John Wiley & Sons Inc, 2008
2. Gopalaswamy Ramesh and Ramesh Bhattiprolu, "Software Maintenance: Effective Practices for Geographically Distributed Environments", Second Reprint, Tata McGraw Hill, 2009.

CSEL 457: AGILE SOFTWARE PROCESS

L	T	P	C
3	0	0	3

Pre-requisite:
- Basic Understanding of Software Design Process

Objectives:
- To Understand the basic concepts of Agile Software Process
- To gain knowledge in the area of various Agile Methodologies.
- To Understand the Principles of Agile Testing

Outcomes:
- Ability to understand basic agile and its significance.
- Ability to understand the methodology of agile through various case studies.

Module-I: Introduction   **(9 hrs)**
Software is new product development –Iterative development: Risk-Driven and Client-Driven iterative planning – Time boxed iterative development – During the iteration, No changes from external stakeholders – Evolutionary and adaptive development - Evolutionary requirements analysis – Early "Top Ten" high-level requirements and skillful analysis – Evolutionary and adaptive planning –Incremental delivery – Evolutionary delivery – The most common mistake –Specific iterative and Evolutionary methods.

Module-II: Agile and Its Significance   **(9 hrs)**
Agile development: Classification of methods – The agile manifesto and principles – Agile project management – Embrace communication and feedback –Simple practices and project tools – Empirical Vs defined and prescriptive process – Principle-based versus Rule-Based – Sustainable discipline: The human touch – Team as a complex adaptive system – Agile hype – Specific agile methods. Motivation: The facts of change on software projects – Key motivations for iterative development – Meeting the requirements challenge iteratively – Problems with the waterfall. Evidence: Research evidence – Early historical project evidence – Standards-Body evidence – Expert and thought leader evidence – A Business case for iterative development – The historical accident of waterfall validity.

Module-III: Agile Methodology   **(9 hrs)**
Scrum: Method overview – Lifecycle – Work products, Roles and Practices values –Common mistakes and misunderstandings – Sample projects – Process mixtures– Adoption strategies – Fact versus fantasy –Strengths versus "Other" history.

Module-IV: Case Study   **(9 hrs)**
Agile – Motivation – Evidence – Scrum – Extreme Programming – Unified Process –Evo– Practice Tips.

Module-V: Agile Practising and Testing   **(9 hrs)**
Practice: Project management – Environment – Requirements – Test – The agile alliances – The manifesto – Supporting the values – Agile testing: Nine principles and six concrete practices for testing on agile teams.

Text Book(s):

1. Craig Larman "Agile and Iterative Development – A Manager's Guide" Pearson Education – 2004.
2. Elisabeth Hendrickson, "Agile Testing" Quality Tree Software Inc 2008.

Reference Book(s):

1. Alistair Cockburn, "Agile Software Development Series", Addison-Wesley Professional, 2001.
2. Robert C. Martin, "Agile Software Development Principles, Patterns and Practices", Prentice Hall, 2002.

M.C.A.
STREAM 3:
HUMAN COMPUTER INTERACTION

CSEL 461: FOUNDATIONS OF HUMAN COMPUTER INTERACTION

L	T	P	C
3	0	0	3

Pre-requisites:
- Basic Understanding of Graphical User Interface.

Objectives:
- Understanding the Components of Human Computer Interaction
- Getting insights into the world of Universal Design

Outcomes:
- Ability to understand various components of Human Computer Interaction.
- Ability to understand the role of HCI in software process.

Module- I: Introduction   **(9 hrs)**
Computer: Text Entry Devices – Pointing Devices – Display Devices – Devices for Virtual Reality and 3D interaction – Physical Controls, Sensors and Special Devices – Memory – Processing and Networks.

Module-II: HCI Framework   **(9 hrs)**
Models of Interaction – HCI frameworks- Basics of Ergonomics – Interaction Styles – Interactivity – User Experience; Fundamentals of Interaction design : The process of Design – User Focus – Scenarios – Navigation Design – Iteration and prototyping.

Modul- III: HCI in the software process   **(9 hrs)**
The software life cycle – Iterative design and prototyping – Design rationale – HCI Patterns.

Module-IV: Dialog Notations and design   **(9 hrs)**
Dialog Notations and design – Dialog semantics – Modeling rich interaction – Cognitive models – Evaluation techniques.

Module-V: Universal Design   **(9 hrs)**
Introduction to Universal design – Benefits - design for diversity; User Support: requirements of user support – approaches to user support – adaptive help systems – designing user support systems.

Text Book:
1. Alan Dix, Janet Finaly, Gregory D. Abowd, Russell Beale., "Human Computer Interaction", 3rd Edition, Prentice Hall Publishers, 2003.

Reference Book:
1. Jonathan Lazar, "Research Methods in Human–Computer Interaction", John Wiley & Sons, 2009.

CSEL 462: INTRODUCTION TO WEB ACCESSIBILITY

L	T	P	C
3	0	0	3

Pre-requisites:
- Basic Understanding of Human Computer Interaction Concepts.

Objectives:
- Understanding the elements of Web accessibility
- Acquiring skills to Design accessible web pages

Outcomes:
- Ability to understand the processes involved in web accessibility.
- Ability to acquire skills to perform web accessibility analysis.

Module-I: **(9 hrs)**
Web accessibility - Definitions – Universal Design – Disabilities and Accessibility Requirements – Introduction to Accessible web design – Accessibility Myths – Assistive Technologies.

Module- II: **(9 hrs)**
Basics of Web Content Accessibility Guidelines – Principles : Perceivable – Operable – Understandable – Robust – Various Levels of Accessibility – WCAG standards evaluation tools and Comparative analysis.

Module-III: **(9 hrs)**
Accessibility of web page components: Images – Hyperlinks – Color contrast – Tables – Forms – Document Accessibility – Video accessibility – Audio accessibility – Static vs Dynamic page accessibility.

Module-IV: **(9 hrs)**
W3C Web Accessibility Initiatives (WAI) – Ajax applications accessibility – Features. Authoring tools accessibility guidelines – UAAG: User Agents Accessibility Guidelines – Accessibility regulations : Global and Indian context.

Module-V: **(9 hrs)**
Introduction to web accessibility analysis tools: Open Source vs. commercial – Features of accessibility analysis tools; Introduction to Mobile web accessibility – Tools and techniques.

Reference Book:
> 1. Simon Harper, Yeliz Yesilada (Editors) . Web Accessibility: A Foundation for Research – Springer Publications, 2010.

Web Resources:
1. W3C Resources on Web Accessibility
   https://www.w3.org/WAI/intro/accessibility.php
2. WebAIM(Web Accessibility in Mind) Resources : http://webaim.org

Online Courses:
1. Introduction to Web Accessibility by Google :
   https://webaccessibility.withgoogle.com/course

CSEL 463: INTRODUCTION TO MOBILE ACCESSIBILITY

L	T	P	C
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Pre-requisites:
- Basic Understanding of Human Computer Interaction.
- Basic Understanding of Web Accessibility.

Objectives:
- Introducing Android Mobile App development.
- Making the learner to understand the basics of Mobile accessibility.
- Acquiring skills in designing accessible mobile applications.

Outcomes:
- Ability to understand the processes involved in mobile accessibility.
- Ability to acquire skills to perform mobile accessibility analysis.

Module-I: (9 hrs)

Mobile Application types: Native, Mobile web and Hybrid apps – Standards and guidelines – The business case for accessibility – Legal and regulatory requirements. Introduction to Android – Versions – Features – The Android Studio – Architecture of Android – Creating and Publishing an application.

Module-II: (9 hrs)

Activities – Fragments – Intents – Layouts – Action Bar – UI Notifications – Building UI with Views – Images, Menus with views – Data Persistence : Files – Internal Storage – External Storage – Creating and using Databases.

Module-III: (9 hrs)

Accessible Design Principles – Color and Contrast – Sound and motion – Style – Hierarchy and focus – Implementation – Text accessibility.

Module-IV: (9 hrs)

Screen Reader Access: Talkback – Select to Speak ; Switch access – Voice commands. Accessibility Factors : Labeling UI Elements – Grouping Content – Touch target size – Color contrasts - Non-color cues- Media content accessibility.

Module-V: (9 hrs)

Accessibility analysis : Success criterion and components – Mapping WCAG to Mobile devices : Screen size factors – Contrast – Keyboard control for touchscreen devices – touch target size and spacing – device manipulation gestures – Tools for analyzing mobile accessibility.

Reference Books:
1. Colin Shanley. Cracking Accessibility on Mobile Devices: The definitive field guide to accessibility and digital inclusion for business managers and project teams. RS Books Publishers (2016).
2. J.F. DiMarzio. Beginning Android Programming with Android Studio, Fourth Edition – 2016 – Wiley Publications.

Web Resources:
1. https://developer.android.com/guide/topics/ui/accessibility/apps.html
2. https://material.io/guidelines/usability/accessibility.html

CSEL 464: FUNDAMENTALS OF CONTEXT AWARE COMPUTING

L	T	P	C
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Pre-requisites:
- Knowledge of Mobile computing and Distributed systems

Objectives:
- Understanding the Components of context awareness.
- Getting familiar with Context acquisition, interpretation and use.

Outcomes:
- Ability to understand the various components of context aware systems.
- Ability to analyse security of context aware systems.

Module-I: **(9 hrs)**
Basics of Context Awareness – Surrounding Context – User Attention in a Meeting - Activity context from multiple sensors.

Module-II: **(9 hrs)**
Distributed and Heterogeneous Context for Ambient Intelligence: Fundamental Concepts – Ontology Representation and Reasoning about Context – Ontology Alignment Approaches .

Module-III: **(9 hrs)**
Ubiquitous web – System Description – System Deployment – Collaborative Optimizations- Context Acquisition – Provisioning.

Module-IV: **(9 hrs)**
Elements of a context aware pervasive system- Architecture- Infrastructure, Middleware, Tool Kits – context for mobile device users – Location based Services – Ambient services – context aware mobile services – Mobile code and policy – Multi agent technology.

Module-V: **(9 hrs)**
Context Aware Security: Traditional Security issues – models – context aware security systems – context aware safety.

Reference Books:
1. Context aware pervasive systems-Architecture for a new breed of applications Sengloke, Auerbach publications, 2006.
2. Context Aware Computing and Self Managing systems ,Waltenegus Dargie,A chapman & Hall Book/CRC press, 2010.
3. Context-Aware Mobile and Ubiquitous Computing for Enhanced Usability: Adaptive Technologies and Applications: Dragan Stojanović, IGI Global Snippet, 2009.
4. Context Management for Distributed and Dynamic Context-Aware Computing, Rocha, RicardoCouto Antunes da, Endler, Markus,Springer,2012.
5. Context-Aware Computing: A Special Triple Issue of Human-Computer Interaction,Thomas P.Moran Paul Dourish, 2002.

CSEL 465: DIGITAL ACCESSIBILITY AUDIT

L	T	P	C
3	0	0	3

Pre-requisites:
- Basic Understanding of HCI
- Basic Understanding of Web Accessibility.

Objectives:
- Understanding the components of digital accessibility audit.
- Acquiring skills in Conducting the digital accessibility audit.

Outcomes:
- Ability to understand the processes involved in performing digital accessibility audit.
- Ability to carry out digital accessibility audit.

Module-I: Types of Disability and Special Needs   (9 hrs)
Visual conditions – Auditory conditions – Motor conditions – cognitive conditions – Legal and regulatory requirements.

Module-II: POUR Principles   (9 hrs)
Introduction - Perceivable: Text alternatives – Time Based media – adaptable – distinguishable; Operable: Keyboard accessibility – Time factor - Seizures – Navigable. Understandable principles: Readable – Language specific features – predictable – Input assistance; Robust – Compatible.

Module-III: (9 hrs)
Personas and Scenarios - Comprehensive Accessibility Evaluation – Standards Review – Heuristic Evaluation – Design Walkthroughs – Screening Techniques – Usability Testing.

Module-IV: Accessibility Analysis Tools   (9 hrs)
AChecker – Wave – Cynthia Says - Tenon – HERA – Comparative analysis.

Module-V: Accessibility Simulations   (9 hrs)
Screen reader simulations – Low vision simulation – dyslexia simulation. Building the accessibility evaluation reports : Components.

Reference Books:
1. Shawn Lawton Henry, "Just Ask – Integrating Accessibility Throughout Design" (Online Open Book : http://www.uiaccess.com/accessucd/), 2007.
2. Colin Shanley, "Cracking Accessibility on Mobile Devices: The definitive field guide to accessibility and digital inclusion for business managers and project teams", RS Books Publishers, 2016.

Web Resources:
1. https://www.w3.org/WAI/ER/tools/
2. https://www.w3.org/WAI/eval/preliminary.html
3. https://www.w3.org/WAI/eval/template

CSEL 466: USER INTERFACE ENGINEERING

L	T	P	C
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Pre-requisites:
- Basic Understanding of Human-Computer Interaction
- Basic Understanding of Graphical User Interfaces.

Objectives:
- Exploring the interaction design process.
- Explaining the role of interaction designers and the tools they use.

Outcomes:
- Ability to understand the principles of User interface design.
- Ability to develop effective user interface design.

Module-I: **(9 hrs)**
Introduction: Goals of User Interface Design – Motivations of Human factors in Design – High Level Theories – Three Principles – Guidelines for Data Display and Data Entry.

Module-II: **(9 hrs)**
The Three Pillars of Design Development Methodologies- Ethnographic Observation – Participating Design- Scenario Development- Social Impact Statement for Early Design – Legal Issues- Reviews.

Module-III: **(9 hrs)**
Usability Testing and laboratories- Surveys- Acceptance tests – Evaluation during Active use- Specification Methods- Interface – Building Tools- Evaluation and Critiquing tools. Visual Thinking and Icons – Direct manipulation Programming – Virtual Environments- Task-Related Organization – Item Presentation Sequence- Response Time and Display Rate – Fast Movement Through Menus- Menu Layouts- Form Filling – Dialog Box – Functionality to Support User's Tasks – Command Organization Strategies –Natural Language in Computing.

Module-IV: **(9 hrs)**
Interaction Devices: Introduction – Keyboards and Functions – Pointing Devices- Speech recognition ,Digitization and Generation – Image and Video Displays – Printers – User Productivity – Variability – Error messages – Non-anthropomorphic Design –Display Design – Color-Reading from Paper versus from Displays- Preparation of Printed Manuals- Preparation of Online Facilities.

Module-V: **(9 hrs)**
Windows Strategies and Information Search: Introduction- Individual Widow Design- Multiple Window Design- Coordination by Tightly –Coupled Widow- Image Browsing- Multimedia Documents Searches – Information Visualization – Advance Filtering Hypertext and Hypermedia – World Wide Web- Genres and Goals and Designers – Users and their tasks – Object Action Interface Model for Web site Design

Text book:
1. Ben Shneiderman, "Designing the User Interface", 5th Edition, Addison-Wesley, 2010.

Reference books:
1. Jacob Nielsen, "Usability Engineering ", Elsevier; First edition, 2015
2. Wilbert O. Galiz , "The Essential guide to User Interface Design", Wiley, 2002.
3. Barfied , Lon , "The User Interface : Concepts and Design", Addison Wesley, 1993.

CSEL 467: COMPUTER VISION AND APPLICATIONS

L	T	P	C
3	0	0	3

Pre-requisites:
- Basic Understanding of Image Processing
- Basic Understanding of Programming

Objectives:
- Understanding the Basics of Computer Vision
- Acquiring skills to develop computer vision based applications.

Outcomes:
- Ability to understand the computer vision pipeline.
- Ability to build solutions using computer vision algorithms.

Module-I: **(9 hrs)**
Basic Image Handling and Processing : Loading images – Converting image formats – Plotting images, points and lines – Image contours and histograms – Image resizing – Histogram equalization- PCA of Images – Image denoising.

Module-II: **(9 hrs)**
Local image descriptors – Harris corner detector – Scale Invariant Feature Transform - Matching geo-tagged images.

Module-III: **(9 hrs)**
Image to image mappings : Homo-graphics – warping images – creating panoramas; Camera models and augmented reality – Multiple view geometry.

Module-IV: **(9 hrs)**
Clustering images – Searching images: content based image retrieval – visual words – indexing images – searching the database for images – ranking with geometry.

Module-V: **(9 hrs)**
Classifying image content – Image segmentation: Graph cuts – Segmentation using clustering – OpenCV: Basics – processing video – tracking.

Text Book:

1. Jan Erik Solem. "Programming Computer Vision with Python". O'Reilly Publishers, 2012.

DATA ANALYTICS

CSEL 561: Big Data

L	T	P	C
3	0	0	3

Pre-requisite:

- *Data mining and InformationSystems.*

Objectives:

- *Thiscoursebringstogetherseveralkeybigdatatechnologiesusedforstorage,analysisandmanipulation ofdata.*
- *To recognize the key concepts of Hadoop framework, MapReduce, Pig, Hive, andNo-SQL.*

Outcomes:

- *Ability to do a sample project in HadoopAPI.*

Module - I: Introduction toBigData   *(9hrs)*

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: BigDataTechnologies   *(9hrs)*

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: ProcessingBigData   *(9hrs)*

Integrating disparate data stores - Mapping data to the programming framework - Connecting and extracting datafromstorage-Transformingdataforprocessing -SubdividingdatainpreparationforHadoopMapReduce.

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

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:AdvancedAnalyticsPlatform   *(9hrs)*

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 Book(s):

1. *MichaelMinelli,MicheheChambers,BigData,BigAnalytics:EmergingBusinessIntelligenceandAnalytic Trends for Today's Business, Ambiga Dhiraj, Wiely CIO Series, First Edition,2013.*
2. *ArvindSathi,BigDataAnalytics:DisruptiveTechnologiesforChangingtheGame,IBMCorporation,First Edition,2012.*
3. *BillFranks,TamingtheBigDataTidalWave:FindingOpportunitiesinHugeDataStreamswithAdvanced Analytics, Wiley and SAS Business Series, First Edition,2012.*

Reference Book(s):

1. *Tom White, Hadoop: The Definitive Guide, O'Reilly, Third Edition,2012.*

CSEL 562: Python Programming for Data Analytics

L	T	P	C
3	0	0	3

Pre-requisite:

- *Programming knowledge in any OOlanguage.*

Objectives:

- *Understanding the basic concepts ofPython.*
- *Preparing and pre-processingdata.*
- *Understanding the data aggregation and groupingconcepts.*
- *Leveraging webscraping.*
- *Visualizing the results of analyticseffectively.*

Outcomes:

- *Ability to do a data analytics using python programs.*

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

Interpreter – Program Execution – Statements – Expressions – Flow Controls – Functions - Numeric Types – Sequences-Strings,Tuples,Listsand-ClassDefinition–Constructors–Inheritance–Overloading–Text&Binary Files - Reading andWriting.

Module - II:DataWrangling   (9hrs)

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

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

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:WebScraping   (9hrs)

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

Module - V: VisualizationinPython   (9hrs)

Matplotlibpackage–PlottingGraphs–ControllingGraph–AddingText–MoreGraphTypes–Gettingandsetting values –Patches.

Text Book(s):

1. *Mark Lutz, Programming Python, O'Reilly Media, Fourth edition,2010.*
2. *Mark Lutz, Learning Python, O'Reilly Media, Fifth Edition,2013.*
3. *Tim Hall and J-P Stacey, Python 3 for Absolute Beginners, Apress, First Edition,2009.*
4. *Magnus Lie Hetland, Beginning Python: From Novice to Professional, Apress, SecondEdition, 2005.*
5. *Shai Vaingast, Beginning Python Visualization Crafting Visual Transformation Scripts, Apress, Second 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. *BrandonRhodesandJohnGoerzen,FoundationsofPythonNetworkProgramming:TheComprehensive 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/*

CSEL 563: Statistics for Business Analytics

L	T	P	C
3	0	0	3

Pre-requisite:

- *Data mining and itsconcepts.*

Objectives:

- *To identify the association between various types ofdata.*
- *To apply statistical inferencetechniques.*
- *To apply methods of inference to applied businesssituations.*
- *To identify, build and validate appropriate statistical regressionmodels.*

Outcomes:

- *Ability to do a business analytics using statistical models.*

Module -I:Introduction *(9hrs)*

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 - SummariesofNumericalVariables-HistogramsandtheDistributionof -NumericalData–Boxplot-Shapeofa Distribution.

Module - II: Association in Categorical andNumericalData: *(9hrs)*

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

Module -III:Probability *(9hrs)*

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

Module -IV:Inference *(9hrs)*

Samples and Surveys - Sampling Variation and Quality - Confidence Intervals- Hypothesis Tests - Alternative ApproachestoInference-DataforComparisons-Two-sampleT-test-ConfidenceIntervalfortheDifference-Rare Events -TestingAssociation.

Module - V: Regression Models–I *(9hrs)*

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

Text Book(s):

1. *Robert Stine, Dean Foster, Statistics for Business: Decision Making and Analysis, Pearson Education, Second Edition,2013.*
2. *Paul Newbold, William L. Carlson, Betty Thorne, Statistics for Business and Economics, Pearson Education, Sixth Edition,2007.*

Reference Book(s):

1. *Keller Gerald, Statistics for Management and Economics, South Western, Tenth Edition,2015.*

CSEL 564: Marketing Analytics

L	T	P	C
3	0	0	3

Pre-requisite:

- *Data mining withStatistics.*

Objectives:

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

Outcomes:

- *Ability to do a marketing analytics for business related applications.*

Module - I: MarketingDataSummarization   *(9hrs)*

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

Module - II:ForecastingTechniques   *(9hrs)*

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

Module - III:CustomerNeeds   *(9hrs)*

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

Module - IV:MarketSegmentation   *(9hrs)*

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

Module - V: Retailing and MarketResearchTools   *(9hrs)*

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

TextBook(s):

1. *Wayne. L. Winston, Marketing Analytics: Data driven techniques with MS-Excel, Wiley, First Edition, 2014.*

Reference Book(s):

1. *StephanSorger,MarketingAnalytics:Strategicmodelsandmetrics,CreateSpaceIndependentPublishing Platform, First Edition,2013.*

CSEL 565: Social Network Analytics

L	T	P	C
3	0	0	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.

Outcomes:

- Ability to do Online interactive demonstrations and hands-on analysis of real-world data sets.

Module -I: Introduction   (9hrs)

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   (9hrs)

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 WorldWideWeb   (9hrs)

TheStructureoftheWeb-WorldWideWeb-InformationNetworks,Hypertext,andAssociativeMemory-   Webas aDirectedGraph,Bow-TieStructureoftheWeb-LinkAnalysisandWeb SearchSearchingtheWeb:Ranking,Link Analysis using Hubs and Authorities- Page Rank- Link Analysis in Modern Web Search, Applications, Spectral Analysis, Random Walks, and WebSearch.

Module - IV: SocialNetworkMining   (9hrs)

ClusteringofSocialNetworkgraphs:Betweenness,Girvan NewmanAlgorithm-Discoveryofcommunities-Cliques and Bipartite Graphs-Graph Partitioning Methods-Matrices-Eigen valuesSim-rank.

Module - V: NetworkDynamics   (9hrs)

CascadingBehaviourinNetworks:DiffusioninNetworks,ModellingDiffusion-CascadesandCluster,Thresholds, Extensions of the Basic Cascade Model- Six Degrees of Separation-Structure and Randomness, Decentralized Search- Empirical Analysis and Generalized Models- Analysis of DecentralizedSearch.

Text Book(s):

1. Easley and Kleinberg, Networks, Crowds, and Markets: Reasoning about a highly connected world, Cambridge Univ. Press,2010.
2. RobertA.HannemanandMarkRiddle,Introductiontosocialnetworkmethods,Universityof California, 2005.
3. Jure Leskovec, Anand Rajaraman, Milliway Labs, Jeffrey D. Ullman, Mining of Massive Datasets, Cambridge University Press, Second Edition,2014.

Reference Book(s):

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

2. Borgatti, S. P., Everett, M. G., & Johnson, J. C., Analyzing social networks, SAGE Publications Ltd; First Edition,2013.

3. John Scott , Social Network Analysis: A Handbook , SAGE Publications Ltd; Second Edition,2000.

CSEL 566: Risk Analytics

L	T	P	C
3	0	0	3

Pre-requisite:

- *Nil.*

Objectives:

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

Outcomes:

- *Ability toanalyze impacts of risk on various sensitive applications.*

Module -I:Introduction   *(9hrs)*

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

Module - II: Risk Analytics forBankingDomain   *(9hrs)*

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 forInsuranceDomain   *(9hrs)*

IntroductiontoInsuranceSector;Property&CausalityInsuranceCompaniesandLifeInsuranceCompanies;Using Analytics for Customer Acquisition and Retention; Detecting, Preventing and Managing Fraud using Analytics; CaseStudies.

Module - IV: Risk Analytics forHealthcareDomain   *(9hrs)*

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:WorkforceAnalytics   *(9hrs)*

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

Text Book(s):

1. *Clark Abrahams and Mingyuan Zhang, Credit Risk Assessment: The New Lending System for Borrowers, Lenders, and Investors, John Wiley & Sons, First Edition,2009.*
2. *Naeem Siddiqi, Credit Risk Scorecards: Developing and Implementing Intelligent Credit Scoring, John Wiley & Sons,2005.*

Reference Book(s):

1. *Laura B. Madsen, Data-Driven Healthcare: How Analytics and BI are Transforming the Industry, John Wiley & Sons, First Edition,2014.*
2. *Jason Burke, Health Analytics: Gaining the Insights to Transform Health Care, John Wiley & Sons,2013.*
3. *Jac Fitz-Enz , John R. Mattox II, Predictive Analytics for Human Resources, Wiley,2014.*
4. *James C. Sesil, Applying Advanced Analytics to HR Management Decisions: Methods for Selection, Developing Incentives, and Improving Collaboration, Pearson Education,2017.*

CSEL 567: Database Systems in Big Data

L	T	P	C
3	0	0	3

Pre-requisite:

- *Nil.*

Objectives:

- *To understand the design of database in BigData.*

Outcomes:

- *Ability touse the datdbase with big data.*

Module - I: Getting StartedWithCassandra   (9hrs)

Introduction of NoSQL Database concepts: -: ACID Vs. BASE, Advantages, Where Applicable, Schema, Two Phase Commit, Sharing 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(EventualConsistency),ColumnOrientation,SchemaFree,HighPerformance,Featuresandcomparisonsof few NOSQL Databases (Cassandra, Mongo, Cloudera, CouchDB,HBase.

Module - II: Understanding CassandraDataModel   (9hrs)

USE Cases for Cassandra, Cassandra Installation: Installing Cassandra, Running the CommandLine Client Interface,BasicCLICommands,Help,ConnectingtoaServer,DescribingtheEnvironment,CreatingandKeyspace 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, MaterializedViews.

Module - III: UnderstandingCassandraArchitecture   (9hrs)

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: CreatingSampleApplication   (9hrs)

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 Datain Cassandra   (9hrs)

Key spaces, Replicas, Replica Placement Strategy, Replication Factor, Partitioner, Snitches, Creating Clusters, DynamicRingParticipation,Security,MiscellaneousSettings,AdditionalTools,QuerydifferencesbetweenRDBMS andCassandra,BasicWriteProperties,ConsistencyLevel,BasicReadProperties,API's,SetUpandInsertingData, 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 modifyUsers,Userpermission,CaptureCQLoutputtoafile,Importandexportdata,CQLscriptsfromwithinCQL, CQL Scripts from the commandprompt.

Text Book(s):
1. *Tom Plunkett, Brian Macdonald, Bruce Nelson, Oracle Big Data Handbook, (Oracle Press),Fujitsu*
2. *Madhu Jagadeesh, Soumendra Mohanty, Harsha Srivatsa, Big Data Imperatives: Enterprise Big Data Warehouse, BI Implementations and Analytics, Apress, First Edition,2013.*
3. *Frank J. Ohlhorst, Big Data Analytics: Turning Big Data into Big Money, Wiley Publishers,2012.*

Reference Book(s):
1. *CristianMolaro,SurekhaParekh,TerryPurcell,DB211:TheDatabaseforBigData&Analytics,MCPress, 2013.*

CSEL 568: Streaming Analytics

L	T	P	C
3	0	0	3

Pre-requisite:

- *Nil.*

Objectives:

- *Understanding the need for streamcomputing.*
- *Comprehend the architecture of streamanalytics.*
- *Building data flow management pipelines forstreams.*
- *Processing streamingdata.*
- *Delivering the results of streaminganalytics.*

Outcomes:

- *Ability todo streaming analytics.*

Module - I: Introduction toStreamComputing   (9hrs)

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

Module - II: StreamingAnalyticsArchitecture   (9hrs)

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

Module - III:DataFlowManagement   (9hrs)

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

Module - IV: Processing & StoringStreamingData   (9hrs)

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: DeliveringStreamingMetrics   (9hrs)

VisualizingData–MobileStreamingApps–TimesCountingandSummation–StochasticOptimization–Delivering Time SeriesData.

Text Book(s):

1. *ByronEllis,Real-TimeAnalytics:TechniquestoAnalyzeandVisualizeStreamingData,Wiley,FirstEdition, 2014.*
2. *Sherif Sakr, Large Scale and Big Data: Processing and Management, CRC Press,2014.*
3. *BillFranks,TamingTheBigDataTidalWaveFindingOpportunitiesInHugeDataStreamsWithAdvanced Analytics, Wiley,2012.*
4. *JureLeskovec,AnandRajaraman,JeffreyD.Ullman,MiningofMassiveDatasets,CambridgeUniversity Press,2014.*

ReferenceBook(s):

1. *Paul C Zikopoulos, Chris Eaton, Paul Zikopoulos, Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGraw-Hil, First Edition,2011.*
2. *kafka.apache.org*
3. *flume.apache.org*
4. *zookeeper.apache.org*

CSEL 569: Video Processing and Analytics

L	T	P	C
3	0	0	3

Pre-requisite:

- *Image processing and it'sworking.*

Objectives:

- *To have a better knowledge aboutvideos.*
- *To enrich students with dataanalytics.*
- *To understand the video content analysis.*

Outcomes:

- *Ability to expose various applications and case studies of Video analytics.*

Module - I:VideoFundamentals   *(9hrs)*

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 andVideoFeatures   *(9hrs)*

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

Module - III: IntroductiontoAnalytics   *(9hrs)*

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 AnalysisandAnalytics   *(9hrs)*

Introduction-DetectingShotBoundariesinVideo–ParsingaVideointoSemanticSegments–VideoIndexingand Abstraction for Retrievals – Affective Video Content Analysis – Automatic Video Trailer Generation - Video database - Video categorization - Video querycategorization.

Module - V:EmergingTrends   *(9hrs)*

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

Text Book(s):

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

CSEL 571: Principles of Distributed Computing

L	T	P	C
3	0	0	3

Pre-requisite:

- *Basic knowledge in Operating System and ComputerNetworks.*

Objectives:

- *To learn the principles, architectures, algorithms and programming models used in distributedsystems.*
- *To examine state-of-the-art distributed systems, such asJINI.*

Outcomes:

- *Ability to design and implement sample distributed systems.*

Module -I:Introduction (**9hrs)**

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

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

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

Module - III: Synchronization andDistributedTransactions **(9hrs)**

Synchronization – Clock Synchronization – Logical Clocks – Global States – Election Algorithms – Mutual Exclusion – DistributedTransactionConsistenceandReplication–Introduction–DataCentricConsistence–FaultTolerance – Reliable Client/Server Communication – Distributed Commit –Recovery.

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

Distributed Object Database System: CORBA – DCOM – GLOBE.

Module - V:DistributedFileSystem **(9hrs)**

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

Text Book(s):

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

ReferenceBook(s):

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

CSEL 571: Introduction to Parallel Computing

L	T	P	C
3	0	0	3

Pre-requisite:

- *Basic knowledge in computer architecture and computernetworks.*

Objectives:

- *To study various types of parallel computers and theirarchitectures.*
- *Todescribetheconceptsunderlyingthedesign,implementation,anduseofmessage-passingcomputing and shared-memorycomputing.*
- *To set up cluster computing systems, code and evaluate the performance of parallelprograms.*

Outcomes:

- *Ability to choose suitable programming strategies in parallelizing computational tasks.*

Module -I:Introduction   *(9hrs)*

Introduction–Motivation–Scope-ParallelProgrammingPlatforms:ImplicitParallelism–LimitationsofMemory System Performance - Dichotomy of Parallel Computing Platforms – Communication cost in Parallel Machines – Routing Mechanism for InterconnectionNetworks.

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

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 communicationOperations.

Module - III: Analytical Modelling ofParallelprograms   *(9hrs)*

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 MessagePassingParadigm   *(9hrs)*

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

Module - V: Parallel AlgorithmsandApplications   *(9hrs)*

DenseMatrixAlgorithms:Matrix-VectorMultiplication-Matrix-MatrixMultiplication-SolvingaSystemofLinear Equations. Sorting: Issues in Sorting on Parallel Computers - Sorting Networks - Bubble Sort and its Variants – Quick sort - Bucket and Sample Sort - Other SortingAlgorithms.

Text Book(s):

1. *Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing, , Pearson, Second Edition,2003.*

Reference Book(s):

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

CSEL 573: Network Design and Management

L	T	P	C
3	0	0	3

Pre-requisite:

● *Basic knowledge in computernetworks.*

Objectives:

● *Learn design considerations for Layer 2 and Layer 3 components and networkidentity.*
● *Understand design considerations for common applications such as DNS, mail, andweb.*
● *Identify the key roles and placement issues for network elements such as firewalls, intrusion detection systems, VPNgateways.*

Outcomes:

• *Ability to choose the various testing and optimizations strategies to select the technologies and devices for current network design.*

Module -I:Introduction   (9hrs)

Basic Networking Concepts: Network – Telephone Network - Network Architecture Types - Network Services – LANs,MANsandWANs–OSIModelandIEEEStandards:ProtocolsforDataTransmission–ProtocolStacks–OSI Management – Layering Concepts – IEEE 802Standards.

Module - II: Protocols, ServicesandInterfaces   (9hrs)

Definition – The X.25 Protocol – Routable Protocols – Non-Routable Protocols – Connectionless and Connection OrientedProtocols–TCP/IPProtocolSuite–IPAddressing–Sub-netting–IPX/SPXProtocolSuite–OtherProtocols within the TCP/IP Suite: Microsoft Protocol Suite - AppleTalk ProtocolSuite.

Module - III: Network Designs andEthernetNetworking   (9hrs)

PhysicalTopologies–Bus,Star,Ring,Mesh -NetworkTypes–ARCNet–TheEthernet–FastEthernetNetworks – Token Ring Networks – FDDI – Settings in NetworkAdapters.

Module - IV: Wired andWirelessMedia   (9hrs)

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: SNMPandRMON   (9hrs)

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 RMONDevices.

Text Book(s):

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

Reference Book(s):

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

CSEL 574: Web Services Computing

L	T	P	C
3	0	0	3

Pre-requisite:

- *Basic knowledge in Web Technology and ComputerNetworks.*

Objectives:

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

Outcomes:

- *Ability to develop small applications using web services.*

Module - I: Fundamental ConceptsandTheories   *(9hrs)*

IntroductiontoWebServices—Thedefinitionofwebservices,basicoperationalmodelofwebservices,toolsand technologies enabling web services, benefits and challenges of using webservices.
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: ServiceOrientedArchitecture   *(9hrs)*

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 ServicesusingSOAP   *(9hrs)*

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: ToolsandTechnologies   *(9hrs)*

DescribingWebServices—WSDL—WSDLintheworldofWebServices,WebServiceslifecycle,anatomyofWSDL definition document, WSDL bindings, WSDL Tools, limitations ofWSDL.
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: WebServicesInteroperability   *(9hrs)*

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 ServicesSecurity—XMLsecurityframework,GoalsofCryptography,HashCipher,SymmetricCipher,Asymmetric Cipher, XML encryption, Digital signature, Digital Certificate, XML Encryption, SAML,structure.

Text Book(s):
1. *R. Nagappan, R. Skoczylas, R.P. Sriganesh, Developing Java Web Services, , Wiley India,2008.*
2. *Eric Newcomer and Greg Lomow, Understanding SQA with Web Services, Pearson,2009*
3. *James McGovern, Sameer Tyagi et.al., Java Web Service Architecture, Elsevier,2009.*

Reference Book(s):
1. *S. Graham, Building Web Services with Java, Pearson, Second Edition,2008.*
2. *D.A. Chappell & T. Jewell, Java Web Services, O'Reilly,SPD.*
3. *McGovern, et al., Java Neb Services Architecture, Morgan Kaufmann Publishers,2005.*

CSEL 575: Pervasive and Ubiquitous Computing

L	T	P	C
3	0	0	3

Pre-requisite:

- *Basic knowledge in Distributedsystems.*

Objectives:

- *to acquire a conceptual foundation in the area of Pervasive Computingaspects.*
- *to provide a balanced treatment of the mechanisms and environments of pervasivecomputing.*

Outcomes:

- *Ability to use the concepts in developing new applications.*

Module - I: Fundamental ConceptsandTheories   (9hrs)

Introduction to ubiquitous Computing – History – Development – The Ubiquitous Portal – Grid, RFID Technologies – AmbientIntelligence.

Module - II: Development andDesignMethodologies   (9hrs)

Ubiquitous and Pervasive Application Design – Designing Pervasive and Multimodal Interactive System – pervasive computing: A Conceptual Framework – Deploying User Interfaces for workflow information systems – Ubiquitous and Pervasive case study Applications.

Module - III: ToolsandTechnologies   (9hrs)

DeployingPervasiveTechnologies–EmbeddingubiquitousTechnologies–UbiquitousComputingTechnologiesin Education – Potential and possibilities – problem andpitfalls.

Module - IV: UtilizationandApplication   (9hrs)

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 andEmergingTrends   (9hrs)

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(s):

1. *Symonds,Judith,ed.UbiquitousandPervasiveComputing: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.*

CSEL 576: Cloud Computing

L	T	P	C
3	0	0	3

Pre-requisite:

- Basic knowledge in distributedsystems.

Objectives:
- To analyze the components of cloud computing and its businessperspective.
- To evaluate the various cloud developmenttools.
- To collaborate with real time cloudservices.

Outcomes:

- Ability to use the concepts in developing new applications.

Module -I:Introduction   (9hrs)

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-ProsandConsofCloudComputing,Cloudcomputingvs.Clustercomputingvs.Gridcomputing - Role of Open Standards - Cloud Computing Architecture - Cloud computing stack - Service Models (XaaS) - Deployment Models.

Module - II: Infrastructure as aService(IaaS)   (9hrs)

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.

Module - III: Platform asa Service(PaaS)   (9hrs)

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.complatform-SoftwareasaService(PaaS)-IntroductiontoSaaS-Webservices-Web2.0- WebOS-Case Study onSaaS.

Module - IV: Service Management inCloudComputing   (9hrs)

Service Management in Cloud Computing - Service Level Agreements(SLAs) - Billing & Accounting - Comparing ScalingHardware:Traditionalvs.Cloud-Economicsofscaling:Benefittingenormously-ManagingData-Looking atData,Scalability&CloudServices, Database&DataStoresinCloud,LargeScaleDataProcessing.

Module - V:CloudSecurity   (9hrs)

Cloud Security - Infrastructure Security - Network level security, Host level security, Application level security - DatasecurityandStorage-DataprivacyandsecurityIssues,JurisdictionalissuesraisedbyDatalocation-Identity &AccessManagement-AccessControl-Trust,Reputation,Risk-Authenticationincloudcomputing,Clientaccess   in cloud, Cloud contracting Model, Commercial and businessconsiderations.

Text Book(s):

1. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 2011.
2. RonaldL.Krutz,RussellDeanVines,CloudSecurity:AComprehensiveGuidetoSecureCloudComputing, Wiley-India,2010.

Reference Book(s):

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing, Mc Graw Hill Education,2013.
2. NikosAntonopoulos,LeeGillam,CloudComputing:Principles,Systemsand Applications,Springer, 2012.
3. Barrie Sosinsky,Cloud Computing Bible, Wiley-India,2010.

CSEL 577: Internet of Things

L	T	P	C
3	0	0	3

Pre-requisite:

- *Basic knowledge in computer networks and working ofsensors.*

Objectives:

- *To understand IoT Marketperspective.*
- *To understand State of the Art – IoTArchitecture.*
- *To understand Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation inIoT.*

Outcomes:

- *Ability to develop small applications using IoT.*

Module - I: M2M andIoT-Introduction   (9hrs)

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

Module - II: M2M and IoT-AMarketPerspective   (9hrs)

Introduction – Some Definitions – M2M Value Chains – IoT Value Chains – An emerging industrial structure for IoT – 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 IoTTechnologyFundamentals   (9hrs)

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 oftheArt   (9hrs)

Introduction – State of the art – Architecture Reference Model – Introduction – Reference Model and architecture – IoT reference Model.

Module - V: IoTReferenceArchitecture   (9hrs)

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 deviceintegration.

Text Book(s):

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, Academic Press, First Edition,2014.*

Reference Book(s):

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

ARTIFICIAL INTELLIGENCE

CSEL 581: Introduction to Artificial Intelligence and Expert Systems

L	T	P	C
3	0	0	3

Pre-requisite:

- *Exposure to Algorithms, Data structure and MathematicalLogic.*

Objectives:

- *Explore basic concepts of AI and expertsystems.*

Outcomes:

- *Ability to explore logic for solving various AI problems.*

Module -I:Introduction   (9hrs)

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

Module - II:Problemsolving   (9hrs)

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

Module - III:SearchAlgorithms   (9hrs)

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

Module - IV:Expertsystems   (9hrs)

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: LanguagesandTools   (9hrs)

Working with LISP, Prolog – Apache Spark.

Text Book(s):

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

Reference Book:

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

CSEL 582: Neural Networks

L	T	P	C
3	0	0	3

Pre-requisite:

- *Knowledge in ArtificialIntelligence.*

Objectives:

- *Develop the skill in basic understanding on neuralnetwork.*
- *Explore the Advanced methods of representing information inANN.*
- *Exposure to many real-world controlproblems.*

Outcomes:

- *Ability to use in various AI problems.*

Module -I:Introduction   *(9hrs)*

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:ANNArchitectures   *(9hrs)*

Associativememory–exponentialBAM–Associativememoryforrealcodedpatternpairs–Applicationsadaptive resonance theory – introduction – ART 1 – ART2 –Applications.

Module - III: Selforganizingmaps   *(9hrs)*

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

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

Fundamentals of genetic algorithms – genetic modelling – hybrid systems – integration of fuzzy logic, neural networksandgeneticalgorithms–non-traditionaloptimizationtechniqueslikeantcolonyoptimization–Particle swarm optimization and artificial immunesystems.

Module -V:Applications   *(9hrs)*

Pattern Recognition-Prediction-Robotics-Case study.

Text Book(s):

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, Prenticehall.*
3. *C.M.Bishop, Neural networks and Pattern recognition, 2003, OxfordUniversity*
4. *Mitchell Melanie, An Introduction to Genetic Algorithm,1996, MITPress.*

CSEL 583: Fuzzy Logic

L	T	P	C
3	0	0	3

Pre-requisites:

- *Mathematical Foundation of Computer Science and probabilitytheory.*

- *Knowledge in programminglanguages.*

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 FuzzyLogic.*

Outcomes:

- *Ability to explore the concepts in various AI problems.*

Module - I: FuzzySetTheory   (9hrs)

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 fuzzyevents,fuzzyexpectedvalue,fuzzyinferenceprinciple,Examplesofuseoffuzzylogicincontrolofreal-world systems.

Module - II: Neural Networks and FuzzyLogicFundamentals   (9hrs)

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

Module - III: NeuroFuzzyModelling   (9hrs)

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

Module - IV:FuzzinessMeasures   (9hrs)

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:CaseStudy   (9hrs)

FuzzygeometryApplicationstosomeselectedtopicslikepatternrecognition,imageprocessing,computervision, optimization, control, data mining, Integration with other computingparadigm.

Reference Book(s):

1. *G.J.KlirandT.A.Folger:FuzzySets,Uncertainty,andInformation,PrenticeHall,EnglewoodCliffs,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.*

CSEL 584: Decision Support Systems

L	T	P	C
3	0	0	3

Pre-requisite:

- *Exposure to AI and MathematicalLogic*

Objectives:

- *Explore basic concepts ofDSS*

Outcomes:

- *Ability to explore the concepts in various AI problems.*

Module - I: Decisionmakingsystems   *(9hrs)*

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: DecisionSupportsystem   *(9hrs)*

Overview–DSSconfigurations–CharacteristicsandcapabilitiesofDSS–ComponentsofDSS–DataManagement Subsystem – Model management subsystems- Knowledge management subsystem – User- hardware- Classifications- Casestudy.
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 andDSSDevelopment   *(9hrs)*

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.
IntroductiontoDSSdevelopment-Changemanagement–Technologylevelsandtools-Platforms-Toolselections-Team developed and End user developedDSS.

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

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: LanguagesandTools   *(9hrs)*

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

Text Book(s):

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

CSEL 585: Introduction to Machine Learning

L	T	P	C
3	0	0	3

Pre-requisite:

- *Basic knowledge in artificial intelligence, learningactivities.*

Objectives:

- *To understand the concepts of machinelearning.*
- *To appreciate supervised and unsupervised learning and theirapplications.*
- *To appreciate the concepts and algorithms oflearning.*

Outcomes:

- *Ability to explore logic for solving various AI problems.*

Module -I:Introduction   (9hrs)

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: Regressionandclassification   (9hrs)

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

Module - III: ClusteringandLearning   (9hrs)

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

Module - IV: Probabilisticgraphicalmodels   (9hrs)

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: Machinelearningexperiments   (9hrs)

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

Text Book(s):

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

CSEL 586: Introduction to Robotics

L	T	P	C
3	0	0	3

Pre-requisites:

- *Mathematical Foundation of ComputerScience*
- *MachineLearning*
- *Natural LanguageProcessing*

Objectives:

- *To understand the different robotic configurations and theirsubsystems*

Outcomes:

- *Ability to use the concepts in various AI problems.*

Module -I:Introduction   (9hrs)

Introduction to Robotics: Robot Anatomy - Coordinate 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:Drivesystems   (9hrs)

TypesofRobotDrives:Mechanical–Magnetic–Vacuum,Robotarmkinematics,World,Tool,DHtransformation   and Inverse Kinematics. Fundamentals of Closed loop control, PWM amplifiers, PIDcontrol.

Module - III: Sensors andMachineVision   (9hrs)

Robotics sensors: Range, Proximity, Touch, Force and Torque Sensing, uses of sensors in Robotics, Applications- Inspection – Identification - Visual Serving and Navigation, 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:RobotProgramming   (9hrs)

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 andCaseStudies   (9hrs)

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 Book(s):

1. *Deb,S.R.,RoboticsTechnologyandFlexibleAutomation,TataMcGrawHillpublishingcompanylimited, 1994.*
2. *Richard David Klafter, Thomas A. Chmielewski, Michael Negin, Robot Engineering: An integrated Approach, Prentice Hall of India Pvt. Ltd,1994.*

Reference Book(s):

1. *King Sun Fu, Rafael C. González, C. S. George Lee, Robotics: control, sensing, vision, and intelligence, McGraw-Hill, 1987.*
2. *Craig, J. J, Introduction to Robotics: Mechanics and Control, Addison-Wesley, London, Third Edition, 2004.*
3. *M.P.Groover, M. Weins, R.N.Nage, N.C.Odrey, Industrial Robotics, McGrawHill*
4. *K.D. Richard, Chmielewski T.A and Michael, Robotic Engineering, PHILearning.*
5. *K.S. Fu Gonzalez, Lee, Robotics Control, Sensing, Vision andintelligence.*

CSEL 587: Soft Computing

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Pre-requisites:

- *Linear Algebra, Multivariate Calculus, ProbabilityTheory*
- *Knowledge in programminglanguages*

Objectives:

- *To provide a strong foundation of fundamental concepts in ArtificialIntelligence.*
- *To provide a basic exposition to the goals and methods of ArtificialIntelligence.*

Outcomes:

- *Ability to apply these techniques in applications which involve perception, reasoning and learning.*

Module -I:Introduction   (9hrs)

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:NeuralNetworks   (9hrs)

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

Module - III:FuzzySets   (9hrs)

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   (9hrs)

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 ofcomputationalintelligence   (9hrs)

AISearchAlgorithm-Predicatecalculus-rulesofinterface-Semanticnetworks–frames–objects-Hybridmodels, Applications -Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Colour RecipePrediction

ReferenceBook(s):

1. *JangJ.S.R.,SunC.TandMizutamiE-NeuroFuzzyandSoftComputingPrenticehall,New Jersey,1998.*
2. *Munakata, T.: Fundamentals of the New Artificial Intelligence, Springer-Verlag New York, Inc.,1998.*
3. *Goldberg, Introduction to GeneticAlgorithms.*
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.*
6. *Kecman, V.: Learning and Soft Computing, The MIT Press,2001.*
7. *Nih.J.Ndssen Artificial Intelligence, Harcourt Asia Ltd.,1998.*