

Scheme of Teaching
&
Detailed Syllabus
For
Master of Computer Application
MCA
(Two Year Program)
(w.e.f. Academic Session 2021–22)



School of Engineering & Technology
Shobhit Institute of Engineering & Technology
(Deemed to-be University)
NH-58, Modipuram, Meerut (U.P.) – 250110

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Shobhit Institute of Engg. & Tech.
(Deemed to-Be University)
NH-58, Modipuram, Meerut-250110

Scheme of Teaching

M.C.A. 1st Year

SEMESTER-I			
Subject Code	Subject Name	L-T-P	Cr
CSCA 501	Operating Systems	3-1-0	4
CSCA 503	Database Management System	3-1-0	4
CSCA 505	Analysis and Design of Algorithms	3-1-0	4
CSCA 507	Intelligent Systems	3-1-0	4
CSCA 509	Software Engineering	3-1-0	4
CSCA 551	DBMS Lab.	0-0-2	1
CSCA 553	Operating System Lab.	0-0-4	2
TOTAL		15-5-6	23
SEMESTER-II			
Subject Code	Subject Name	L-T-P	Cr
CSCA 502	Data Warehousing and Data Mining	3-1-0	4
CSCA 504	Linux and X – Windows Programming	3-1-0	4
CSCA 506	Java Programming and Website Design	4-0-0	4
CSCA 508	Computer Networks	3-1-0	4
..CA	Elective I	3-0-0	3
--CA	Elective II	3-0-0	3
CSCA 552	Java Programming Lab.	0-0-2	1
CSCA 554	Linux And Network Admin. Lab.	0-0-2	1
CSCA 572	Project I	0-0-4	2
TOTAL		19-3-8	26

Scheme of Teaching

M.C.A. 2nd Year

SEMESTER-III			
Subject Code	Subject Name	L-T-P	Cr
CSCA 601	Object Oriented Software Engineering	3-1-0	4
CSCA 603	Distributed Operating System	3-1-0	4
CSCA 605	Advanced DBMS	3-1-0	4
.....CA	Elective III	3-0-0	3
....CA	Elective IV	3-0-0	3
CSCA 651	Object Oriented System Design Lab.	0-0-2	1
UHV-111	Universal Human Values and Professional Ethics	3-0-0	3
CSCA 671	Project II	0-0-6	3
TOTAL		18-3-6	25
SEMESTER-IV			
Subject Code	Subject Name	L-T-P	Cr
CSCA 682	Dissertation	0-0-40	20
CSCA 684	Seminar and Progress Reports	0-0-20	10
TOTAL		0-0-60	30

MCA Specializations Courses (Elective Courses)

1. AI and Machine Learning
2. Cyber Security
3. Data Science
4. Cloud Computing
5. Full stack development

Name of Specialization	Subject Code	Subjects (II Semester onwards)
Artificial Intelligence and Machine Learning	AMCA-510	Application based Programming in Python
	AMCA-512	Introduction to Deep Learning
	AMCA-607	Fuzzy Logic and Neural Network
	AMCA-609	Digital Image Processing
Cyber Security	CSCA-510	Foundation of Cyber Security
	CSCA-512	Cyber Law and Ethics
	CSCA-607	Ethical Hacking
	CSCA-609	Intrusion Detection and Internet Security
Data Science	DSCA-510	Python for Data Science
	DSCA-512	R for data science
	DSCA-607	Big Data Analytics
	DSCA-609	Information Visualization
Cloud Computing	CCCA-510	Introduction to Virtualization & Cloud Computing
	CCCA-512	Cloud Computing Architecture
	CCCA-607	Storage Technology Foundation
	CCCA-609	Security in Cloud
Full Stack Development	FDCA-510	Introduction to HTML, Bootstrap and CSS
	FDCA-512	Programming with JavaScript
	FDCA-607	Node JS and Mongo DB Development
	FDCA-609	Angular JS Development

Programme Outcomes (POs)

PO1. Will demonstrate basic knowledge in computing discipline.

PO2. Will demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results.

PO3. Will demonstrate the ability to design and develop software that meets the Software industry demands.

PO4. Capacity to analyze a problem, and identify and formulate the computing requirements appropriate to its solution.

PO5. Capacity to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations.

PO6. Will demonstrate an understanding of their professional and ethical responsibilities.

PO7. Will be able to communicate effectively in both verbal and written forms.

PO8. Will have the confidence to apply engineering solutions in global and societal contexts.

PO9. Should be capable of self-education and clearly understand the value of lifelong learning.

PO10. Awareness of the need for and an ability to engage in continuing professional development.

PO11. An skill of engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects.

Programme Educational Objectives (PEOs):

1. To prepare students for successful careers in Industry that meets the needs of Indian and multinational Companies.
2. To develop the ability among students to synthesize data and technical concept for application to project design.
3. To provide opportunity for students to work as part of teams on multidisciplinary projects.
4. To provide students with a sound foundation in the mathematical, scientific and technical foundations necessary to formulate, solve and analyze real life problems.

Programme Specific Outcomes (PSO)

PSO 1. Ability to pursue careers in IT industry/ consultancy/ research and development, teaching and allied areas related to computer science.

PSO 2. Comprehend, explore and build up computer programs in the areas allied to Algorithms, System Software, Multimedia, Web Design and Big Data Analytics for efficient design of computer-based systems of varying complexity.

Operating Systems

CSCA 501

Cr	L	T	P
4	3	1	0

Course Objectives

1. Recognize the concepts and principles of operating systems.
2. Provide comprehensive introduction to understand the underlying principles, techniques and approaches which constitute a coherent body of knowledge in operating systems.
3. To teach understanding how the various elements that underlie operating system interact and provides services for execution of application software.

Course Outcomes

CO1 Understand the basics of operating systems like kernel, shell, types and views of operating systems

CO2 Describe the various CPU scheduling algorithms and remove deadlocks.

CO3 Explain various memory management techniques and concept of thrashing

CO4 Use disk management and disk scheduling algorithms for better utilization of external memory

CO5 Recognize file system interface, protection and security mechanisms.

CO6 Explain the various features of distributed OS like UNIX, Linux, windows etc.

Course Content

Unit-I

Introduction, What is an Operating System, Simple Batch Systems, Multiprogrammed Batches systems, Time-Sharing Systems, Personal-computer systems, Parallel systems, Distributed Systems, Real-Time Systems Memory Management: Background, Logical versus Physical Address space, swapping, Contiguous allocation, Paging, Segmentation, Segmentation with Paging Virtual Memory: Demand Paging, Page Replacement, Page-replacement Algorithms, Performance of Demand Paging, Allocation of Frames, Thrashing, Other Considerations, Demand Segmentation

Unit-II

Processes: Process Concept, Process Scheduling, Operation on Processes, Cooperating Processes, Interprocess Communication CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple- Processor Scheduling, Real-Time Scheduling, Algorithm Evaluation Process Synchronization: Background, The Critical-Section Problem, Synchronization Hardware, Semaphores, Classical Problems of Synchronization, Critical Regions, Monitors, Synchronization in Solaris 2, Atomic Transactions

Unit-III

Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined Approach to Deadlock Handling. Device Management: Techniques for Device Management, Dedicated Devices, Shared

Unit-IV

Devices, Virtual Devices; Device Characteristics-Hardware Consideration, Input or Output Devices, Storage Devices, Channels and Control Units, Independent Device Operation, Buffering, Multiple Paths, Block Multiplexing, Device Allocation Consideration, Secondary-

Storage Structure: Disk Structure, Disk Scheduling, Disk Management, Swap- Space Management, Disk Reliability, Stable-Storage Implementation

Unit-V

Information Management: Introduction, A Simple File System, General Model of a File System, Symbolic File System, Basic File System, Access Control Verification, Logical File System, Physical File System File-System Interface: File Concept, Access Methods, Directory Structure, Protection, Consistency Semantics File-System Implementation: File- System Structure, Allocation Methods, Free-Space Management, Directory Implementation, Efficiency and Performance, Recovery.

Reference Books:

1. Silberschatz and Galvin, "*Operating System Concepts*", Pearson, 5th Ed., 2001
2. Madnick E., Donovan J., "*Operating Systems*", Tata McGraw Hill, 2001
3. Tannenbaum, "*Operating Systems*", PHI, 4th Edition, 2000

Database Management System

CSCA 503

Cr	L	T	P
4	3	1	0

Course Objectives:

The objective of the course is to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively - information from a DBMS.

Course Outcomes:

Upon successful completion of this course, students should be able to:

CO1: Describe the fundamental elements of relational database management systems

CO2: Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.

CO3: Design ER-models to represent simple database application scenarios

CO4: Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.

CO5: Improve the database design by normalization.

CO6: Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.

Course Content

Unit-I

Introduction: Concept & Overview of Database management system(DBMS), Comparison of DBMS with file processing system, Data Models- Entity-Relationship, Network, Relational and Object Oriented Data Models, Database Languages, Database Users, Three Schema architecture of DBMS, overall structure of DBMS. Entity-Relationship (ER) Model: Basic concepts, Design Issues, Mapping Constraints, Keys, Entity-Relationship Diagram, Weak Entity Sets, Extended E-R features.

Unit-II

Relational Database Design: Basic terminologies, integrity constraints, Functional Dependency, Different anomalies in designing a Database, Decomposition and its properties, Normalization using functional dependencies (1NF, 2NF, 3NF,BCNF), Normalization using multi-valued dependencies(4NF, 5NF).

Unit-III

Query Languages: Relational Algebra, characteristics and various operations, **Structured Query Language(SQL):** Characteristics of SQL, SQL data types and literals. Concept of Data definition language, Data manipulation language, Data Control Language. Basic Structure, Set operations, Aggregate Functions, Null Values, views, Sub-queries. Introduction to Tuple Calculus.

Unit-IV

Transaction Processing: Transaction system, Testing of serializability, recoverable schedule, Concurrency control, Locking techniques for concurrency control, Time stamping protocols for concurrency control, Validation based protocol, Recovery from transaction failures, log based recovery, checkpoints, shadow paging, deadlock handling.

Unit-V

File Organization & Data warehousing: File & Record Concept, Fixed and Variable sized Records, Types of Single-Level Index. Data warehousing: Introduction, basic concepts, data warehouse architecture, various models, basic operations.

Reference Books:

1. Henry F. Korth and Silberschatz Abraham, "*Database System Concepts*", Mc.Graw Hill.5th edition, 2006.
2. Elmasri Ramez and Novathe Shamkant, "*Fundamentals of Database Systems*", Addison Wesley Publishing Company, 6th edition, 2010.
3. Ramakrishnan: "*Database Management System*", McGraw-Hill, 3rd edition, 2007.
4. Date C J, "*An Introduction to Database System*", Addison Wesley, 8th edition, 2004.
5. Ivan Bayross, "*SQL, PL/SQL: The programming language with oracle*" BPB

Analysis and Design of Algorithms

CSCA 505

Cr	L	T	P
4	3	1	0

Course Objectives

1. Analyze the asymptotic performance of algorithms.
2. Write rigorous correctness proofs for algorithms.
3. Demonstrate a familiarity with major algorithms and data structures.
4. Apply important algorithmic design paradigms and methods of analysis.
5. Synthesize efficient algorithms in common engineering design situations.

Course Outcomes

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

1. Explain the time and space complexity of the algorithm.
2. Describe elementary data structure like binary search tree, Red Black tree, binomial, B tree and Fibonacci heap.
3. Compare between design techniques of algorithm like Divide and Conquer, Dynamic algorithm, Greedy algorithm, backtracking and Amortized algorithm.
4. Demonstrate different graph traversal algorithm like BFS, DFS, Prim's, Kruskal's, single source shortest path and all pair shortest path.
5. Examine different string-matching algorithm like naïve string matching, robin-karp algorithm, kurth-morrispratt algorithm.
6. Distinguish between NP-hard and NP-completeness problem.

Course Content

Unit-I

Preliminaries: Review of growth of functions, Recurrences: The substitution method, The iteration method, The master method, Data Structures for Disjoint Sets.

Divide and Conquer Approach: Merge Sort, Quick sort, Medians and Order statistics, Strassen's algorithm for Matrix Multiplications.

Unit-II

Dynamic Programming: Elements of Dynamic Programming, Matrix Chain Multiplication, Longest common subsequence and optimal binary search trees problems.

Greedy Algorithms: Elements of Greedy strategy, An activity selection problem, Huffman Codes, A task scheduling problem.

Unit-III

Graph Algorithms: Representation of Graphs, Breadth First Search, Depth First Search, Topological Sort, Strongly Connected Components, Algorithm for Kruskal's and Prim's for finding Minimum cost Spanning Trees, Dijkstra's and Bellman Fort Algorithm for finding Single source shortest paths. All pair shortest paths and matrix multiplication, Floyd – Warshall algorithm for all pair shortest paths.

Unit-IV

String matching: The naïve String Matching algorithm, The Rabin-Karp Algorithm, String Matching with finite automata, The Knuth-Morris Pratt algorithm.

Unit-V

NP-Complete Problem: Polynomial-time verification, NP-Completeness and Reducibility, NP-Completeness Proof, NP-Complete problems.

Reference Books:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, Clifford Stein, "*Introduction to Algorithms*", 2nd Ed., PHI, 2004.
2. A. V. Aho, J. E. Hopcroft, J. D. Ullman, "*The Design and Analysis of Computer Algorithms*", Addison Wesley, 1998.
3. Ellis Horowitz and Sartaz Sahani, "*Computer Algorithms*", Galgotia Publications, 1999.
4. D. E. Knuth, "*The Art of Computer Programming*", 2nd Ed., Addison Wesley, 1998

Intelligent Systems

CSCA 507

Cr	L	T	P
4	3	1	0

Course Objective

To provide a strong foundation of fundamental concepts in Artificial Intelligence². To provide a basic exposition to the goals and methods of Artificial Intelligence³. To enable the student to apply these techniques in applications which involve perception, reasoning and learning

Course Outcomes

At the end of the course students will be able to

CO1: Define the various searching techniques, constraint satisfaction problem and example problems- game playing techniques.

CO2: Classify AI techniques in applications which involve perception, reasoning and learning.

CO3: Demonstrate about AI techniques for knowledge representation, planning, uncertainty management and exploration methods.

CO4: Distinguish the knowledge of real world Knowledge representation, the modern view of AI as the study of agents that receive precepts from the environment and perform actions

CO5: Defend a real world problem for implementation and understand the dynamic behavior of a system.

CO6: Formulate the machine learning techniques to design AI machine and enveloping applications for real world problems.

Course Content

Unit-I

Foundational issues in intelligent systems: Foundation and history of AI, AI problems and techniques, problem spaces and searches, Search algorithms: Informed search, Uninformed search, Hill Climbing, Depth first search, Best first search, And or graph.

Unit-II

Knowledge Representation: Graphs, Frames structures and related structures, Semantic Nets and Partitioned Nets, Scripts, AI programming languages, Introduction to PROLOG, Production Rules, Knowledge Based systems, Inference engine, Forward deductions and backward deductions, Matching production rules against working memory.

Unit-III

Processing and understanding Natural Languages: Understanding Natural Languages: Applications of Natural Languages, Natural Language processing, Parsing techniques: Rules of parsing, Top down parsing, Bottom up parsing, Transformational grammars, Context free grammar, Transition networks, Fillmore's grammars, Shanks Conceptual Dependency.

Unit-IV

Expert System: Existing Expert Systems (DENDRAL, MYCIN), Architecture of expert system, Features of Expert system, Genetic algorithm, Fuzzy logic, Neural Networks, Intelligent Agents, Meta Knowledge, Expertise Transfer, Self Explaining System, User and expert systems.

Unit-V

Pattern Recognition: Introduction to Pattern Recognition, Structured Description, Symbolic Description, Machine perception, Line Finding, Interception, Semantic & Model, Object Identification, Speech Recognition.

Reference Books:

1. Elaine Rich, Kevin Knight and Shivashankar B. Nair, "*Artificial Intelligence*", Tata McGraw-Hill, Third edition, 2009.
2. Char Nick, "*Introduction to Artificial Intelligence*", Addison Wesley, 2007.
3. Stuart Russell and Peter Norvig, "*Artificial Intelligence: A Modern Approach*", Prentice Hall, Third Edition, 2010.
4. Patrick Henry Winston and Berthold Horn, "*LISP*", Addison Wesley, Third Edition, 2010.
5. Marcellous, "*Expert Systems Programming*", Prentice Hall Inc., Third Edition, 2009.
6. Elamie, "*Artificial Intelligence*", Academic Press, Third Edition, 2007.
7. Dan W. Patterson, "*Artificial Intelligence and Expert Systems*", PHI Learning Private Limited, Third Edition, 2009.

Software Engineering

CSCA 509

Cr	L	T	P
4	3	1	0

Course Objectives

The program will prepare our students to be successful professionals in the field with solid fundamental knowledge of software engineering.

1. Be successful professionals in the field with solid fundamental knowledge of software engineering
2. Utilize and exhibit strong communication and interpersonal skills, as well as professional and ethical principles when functioning as members and leaders of multi-disciplinary teams
3. Apply their foundations in software engineering to adapt to readily changing environments using the appropriate theory, principles and processes

Course Outcomes

CO1: How to apply the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment

CO2: An ability to work in one or more significant application domains

CO3: Work as an individual and as part of a multidisciplinary team to develop and deliver quality software

CO4: Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle

CO5: Demonstrate an ability to use the techniques and tools necessary for engineering practice

Course Content

Unit-I

Introduction: Software Crisis, Software Processes & Characteristics, Software life cycle models, Waterfall, Prototype, Evolutionary and Spiral Models.

Software Requirements analysis & specifications: Requirement engineering, requirement elicitation techniques like FAST, QFD & Use case approach, requirements analysis using DFD, Data dictionaries & ER Diagrams, Requirements documentation, Nature of SRS, Characteristics & organization of SRS.

Unit-II

Software Project Planning: Size Estimation like lines of Code & Function Count, Cost Estimation Models, COCOMO, COCOMO-II, Putnam resource allocation model, Risk Management.

Software Design: Cohesion & Coupling, Classification of Cohesiveness & Coupling, Function Oriented Design, Object Oriented Design.

Unit-III

Software Metrics: Software measurements: What & Why, Token Count, Halstead Software Science Measures, Design Metrics, Data Structure Metrics, Information Flow Metrics.

Software Reliability: Importance, Hardware Reliability & Software Reliability, Failure and Faults, Reliability Models, Basic Model, Logarithmic Poisson Model, Software Quality Models, CMM & ISO 9001.

Unit-IV

Software Testing: Testing process, Design of test cases, functional testing: Boundary value analysis, Equivalence class testing, Decision table testing, Cause effect graphing, Structural testing, Path Testing, Data flow and mutation testing, Unit Testing, Integration and System Testing, Debugging, Alpha & Beta Testing, Testing Tools & Standards.

Unit-V

Software Maintenance: Management of Maintenance, Maintenance Process, Maintenance Models, Regression Testing, Reverse Engineering, Software Re-engineering, Configuration Management, Documentation.

Reference Books:

1. K. K. Aggarwal & Yogesh Singh, “*Software Engineering*”, 2nd Ed., New Age International, 2005.
2. R. S. Pressman, “*Software Engineering – A practitioner’s approach*”, 5th Ed., McGraw Hill Int. Ed., 2001.
3. Stephen R. Schach, “*Classical & Object Oriented Software Engineering*”, IRWIN, 1996.
4. James Peter, W. Pedrycz, “*Software Engineering: An Engineering Approach*”, John Wiley & Sons.
5. I. Sommerville, “*Software Engineering*”, Addison Wesley, 2002.

DBMS Lab.

CSCA 551

Cr	L	T	P
1	0	0	2

1. Create a database and write the programs to carry out the following operation
2. Add a record in the database,
3. Delete a record in the database,
4. Modify the record in the database
5. Generate queries, Generate the report, List all the records of database in ascending order.
6. PL/SQL
7. Procedure & Functions
8. Cursor & Trigger
9. Views
10. Develop a menu driven project for management of database system (on any one of the following):
 - (i) Library information system
 - (ii) Inventory control system
 - (iii) Student information system or
 - (iv) Any Other of your choice

Operating System Lab.

CSCA 553

Cr	L	T	P
2	0	0	4

1. Study of WINDOWS 2000 Operating System.
2. Administration of WINDOWS 2000 (including DNS, LDAP, Directory Services)
3. Study of LINUX Operating System (Linux kernel, shell, basic commands, pipe & filter commands).
4. Administration of LINUX Operating System. Writing of Shell Scripts (Shell programming). Programming for CPU Scheduling algorithms

Note: At least 5 to 10 more exercises to be given by the teacher concerned.

Data Warehousing and Data Mining

CSCA 502	Cr	L	T	P
	4	3	1	0

Course objective:

1. To understand data mining principles and techniques.
2. To introduce DM as a cutting edge business intelligence method and acquaint the students with the DM techniques for building competitive advantage through proactive analysis, predictive modeling, and identifying application and new trends in data mining.

Course outcomes (CO):

At the end of course, Students will be able to

CO1: Describe the basic concepts and techniques of Data Warehouse and Data Mining.

CO2: Demonstrate the gathering and analysis of large sets of data to gain useful business understanding.

CO3: Differentiate the data generalization and frequent pattern mining that can be discovered by association rule mining,

CO4: Explain the classification, clustering and prediction in Data mining.

CO5: Identify business applications and trends of data mining.

Unit-I

Introduction: Data-ware housing: Definition, Delivery Process, Difference between Database System and Data Warehouse, Multi Dimensional Data Model, Stars, Snow Flakes, Fact Constellations, Data marts, 3 Tier Architecture of Data Warehouse, OLAP Servers: ROLAP, MOLAP, HOLAP.

Unit-II

Data Mining: Motivation (for Data Mining), Definition & Functionalities, knowledge discovery steps, Architecture, Statistical measures in large Databases. Measuring Central Tendency, Measuring Dispersion of Data, Graph Displays of Basic Statistical class Description.

Data Processing: Requirement for pre processing, Data Cleaning and its various techniques, Data Integration and Transformation, Data Reduction:- Data Cube Aggregation, attribute subset selection, Numerosity Reduction, Concept hierarchy generation. Attribute oriented induction Concept Description and Data Generalization, implementation of AOI, Mining Class comparisons. Mining frequent patterns, A priori Algorithm, F P Growth, Mining various kind of Association rule: correlation analysis,.

Unit-III

Classification and Predictions: Basics and issues regarding Classification & Prediction, Classification by Decision tree induction, Bayesian Classification, Rule- based Classification, Classification by Back propagation; Multilayer feed-forward Neural Network, Back-propagation Algorithm, Classification methods K-nearest neighbor classifiers, Genetic Algorithm, constraints based mining, accuracy and error measure.

Unit-IV

Cluster analysis: Requirement of clustering in data mining, Data types in cluster analysis, Categories of clustering methods, partitioning methods: K-mean and K- mediods. Hierarchical Clustering: agglomerative and divisive clustering, BIRCH, and Chameleon. Density Based Methods-DBSCAN, OPTICS. Grid Based Methods- STING, CLIQUE. Model Based Method –

expectation- maximization, Outlier Analysis: statistical distribution method, distance based method.

Unit-V

Applications and Trends in data mining: Benefits of data mining, Data Mining Applications:in retail industry banking and finance, and telecommunication industry Social impact on data mining,, data mining interfaces.

Reference Books:

1. Jiawei Han, Micheline Kamber, ”*Data Mining Concepts & Techniques*” Elsevier, 2nd edition 2010.
2. M.H. Dunham, “*Data Mining: Introductory and Advanced Topics*”, Pearson Education,1stedition ,2007.
3. Sam Anahory, Dennis Murray, “*Data Warehousing in the Real World : A Practical Guide for Building Decision Support Systems* “, Pearson Education, 1st edition, 2008.
4. Pieter Adriaans, Dolf Zantinge, “*Data Mining*”, Pearson Education, 4th edition,2009.

Linux and X-Windows Programming

CSCA 504

Cr	L	T	P
4	3	1	0

Course Objectives

1. To understand and make effective use of linux utilities and shell scripting language to solve problems
2. To implement in C some standard linux utilities like mv,cp,ls etc.
3. To Develop the skills the necessary for systems programming including file system programming, process and signal management and interprocess communication

Course Outcomes

CO1:Students will be able to understand the basic commands of linux operating system and can write shell scripts

CO2:Students will be able to create file systems and directories and operate them

CO3:Students will be able to create processes background and fore ground etc. by fork() system calls

CO4:Students will be create shared memory segments, pipes ,message queues and can exercise interprocess communication

Course Content

Unit-I

Linux – The Operating System: Linux history, Linux features, Linux distributions, Linux’s relationship to Unix, Overview of Linux architecture, Installation, Booting, Login and Shutdown Process, Start up scripts, controlling processes, system processes (an overview), Linux Security, Networking on Linux: Preparing Linux for Networking, Network Installation, configuring network setting after installation.

Unit-II

User Management: Types of users, The powers of Root, managing users (adding and deleting): using the command line, shell scripts and GUI tools. The Linux File System: Basic Principles, Pathnames, Mounting and Unmounting File Systems, Different File Types, File Permissions, Disk Usage Limits, Directory Structure, The Ext2 and Ext3 File Systems, Check and Repair File Systems.

Unit-III

Shell in Linux: Available shells under Linux (viz. Bash, TCSH, Korn or so on), different shell features, editors, shell commands, shell scripts: shell variables, environmental variables, purpose of shell scripts, writing, storing and executing scripts, Filters- The grep family, advanced filters- sed and awk.

Unit-IV

Using the X-Windows System: What is X clients, servers and Windows Management, Exploring X Applications X – Lib Programming Model, creating and managing windows,

Unit-V

Handling events: key board and mouse management, an overview of drawing graphics, text handling colormap and manipulation.

Reference Books:

1. Barkakati N. “X-Windows System Programming”, PHI, 2001
2. Cox K, “Red Hat Linux Administrator’s Guide”, PHI, 2001

3. Peterson Richard, "*The Complete References Linux*", 2nd Ed., Tata McGraw Hill, 2000
4. O'Reilly and Associates Vol. 0: *Protocol Reference Manual*, 1992
5. O'Reilly and Associates Vol. 1: *Xlib Programming Manual*, 1992
6. O'Reilly and Associates Vol. 2: *Xlib Programming Manual*, 1992
7. Bach, "*The Design of the Unix Kernel*", PHI, 2000 32 w.e.f. session 2004-2005

Java Programming and Website Design

CSCA 506

Cr	L	T	P
4	4	0	0

Course Objectives:

- 1: Gain knowledge about basic Java language syntax and semantics to write Java programs and use concepts such as variables, conditional and iterative execution methods etc.
- 2: Understand the fundamentals of object-oriented programming in Java, including defining classes, objects, invoking methods etc and exception handling mechanisms.
- 3: Understand the principles of inheritance, packages and interfaces.

Course Outcome

- CO1: Identify classes, objects, members of a class and relationships among them needed for a specific problem
- CO2: Write Java application programs using OOP principles and proper program structuring
- CO3: Demonstrate the concepts of polymorphism and inheritance
- CO4: Write Java programs to implement error handling techniques using exception handling

Course Content

Unit-I

Introduction to Java: Importance and features of Java, Keywords, constants, variables and Data Types, Operators and Expressions, Decision Making, Branching and Looping: if-else, switch,?: operator, while, do, for statements, labeled loops, jump statements: break, continue, return. Introducing classes, objects and methods: defining a class, adding variables and methods, creating objects, constructors, class inheritance.

Arrays and String: Creating an array, one and two dimensional arrays, string array and methods, Classes: String and String Buffer classes, Wrapper classes: Basics types, using super, Multilevel hierarchy abstract and final classes, Object class, Packages and interfaces, Access protection, Extending Interfaces, packages.

Unit-II

Exception Handling: Fundamentals exception types, uncaught exceptions, throw, throw, final, built in exception, creating your own exceptions, Multithreaded Programming: Fundamentals, Java thread model: priorities, synchronization, messaging, thread classes, Run able interface, inter thread Communication, suspending, resuming and stopping threads.

Unit-III

Input/Output Programming: Basics, Streams, Byte and Character Stream, predefined streams, Reading and writing from console and files. Using Standard Java Packages (lang, util, io,net). Networking: Basics, networking classes and interfaces, using java.net package, doing TCP/IP and Data-gram Programming

Unit-IV

Event Handling: Different Mechanism, the Delegation Event Model, Event Classes, Listener Interfaces, Adapter and Inner Classes, Working with windows, Graphics and Text, using AWT controls, Layout managers and menus, handling Image, animation, sound and video, Java Applet. Beans: Introduction to Java Beans and Swings, Servlets.

Unit-V

Website Designing: Overview of Internet and Intranet Services, HTML Tags, Tables, Frames,

Graphical and animation techniques, Static & Dynamic Web Pages, DHTML, ASP, Javascript

Reference Books:

1. Patrick Naughton and Herbertz Schildt, "*Java-2 The Complete Reference*", TMH, 1999.
2. Rick Dranell, "*HTML 4 unleashed*", Techmedia Publication, 2000
3. Shelley Powers, "*Dynamic Web Publishing*", 2nd Ed., Techmedia, 1998.
4. E. Balaguruswamy, "*Programming with Java: A Primer*", TMH, 1998.
5. Horstmann, "*Computing Concepts with Java 2 Essentials*", John Wiley
6. Decker & Hirshfield, "*Programming Java: A introduction to programming using JAVA*", Vikas Publication, 2000.

Computer Networks

CSCA 508

Cr	L	T	P
4	3	1	0

Course Objectives

1. To develop an understanding of computer networking basics
2. To develop an understanding of different components of computer networks, various protocols, modern technologies and their applications

Course Outcomes

CO1: Recognize the technological trends of Computer Networking.

CO2: Discuss the key technological components of the Network.

CO3: Evaluate the challenges in building networks and solutions to those.

Course Content

Unit-I

Introduction and The Physical Layer: Uses of Computer Networks, Network Hardware, Network Software, Reference Model (OSI, TCP/IP Overview), The Physical Layer, Theoretical Basis for Data communication, Guided Transmission Media, Wireless Transmission, Communication Satellites, Digital Signal Encoding Formats – NRZ-L, NRZI, Bipolar-AMI, Manchester, Differential Manchester, Digital Modulation – ASK, FSK, PSK, QPSK, Digitization – Sampling Theorem, PCM, DM, Analog Modulation – Introducing AM, FM, PM, The Public Switched Telephone Network, The Mobile Telephone System.

Unit-II

The Data Link Layer: Data Link Layer Design Issues, Error Detection and Correlation, Flow Control Protocols, Stop-and-wait Flow Control, Sliding – Window Flow Control, Error Control, Stop-and-wait ARQ, Go-back-N, Selective-repeat, Example of Data Link Protocols- HDLC.

Unit-III

The Medium Access Control Sub Layer: The Channel Allocation Problem, Multiple Access, Protocols, Ethernet, wireless LANs, Blue Tooth, Data Link Layer Switching.

Unit-IV

The Network Layer: Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms, Quality of Service, Internetworking, The Network Layer in the Internet.

Unit-V

The Transport Layer and Network Security: The Transport Service, Elements of Transport Protocols, A Simple Transport Protocol, The Internet Transport Protocols; UDP, TCP, Performance Issues.

Reference Books:

1. S. Tananbaum, “Computer Networks”, 4th Ed., Pearson, 2003
2. W. Stallings, “Data and Computer Communications”, 7th Ed., Pearson, 2002.
3. Black U, “Computer Networks-Protocols, Standards and Interfaces”, PHI 1996
4. Comer E. Douglas, “Computer Networks and Internets”, 2nd Ed., Pearson, 2000
5. Comer E. Douglas, “Internetworking with TCP/IP, Vol. 1, PHI, 2000
6. Laura Chappell (Ed), “Introduction to Cisco Router Configuration”, Techmedia, 99.

Java Programming Lab.

CSCA 552

Cr	L	T	P
2	0	0	4

Development following programs:

- Servlets ,
- Networking,
- I/O ,
- JDBC,
- Beans
- RMI

You may use Visual Age or equivalent software.

Linux and Network Admin. Lab.

CSCA 554

Cr	L	T	P
1	0	0	2

1. Basic Commands of Linux operating system.
2. Command line arguments
3. Local and Environmental Variable
4. Arithmetic Operators (+,-,*,/,**,%)
5. Logical Operators (AND, OR NOT)
6. Conditional Statement
7. Shell Parameters
8. Case Statement
9. Iteration Statement (For loop, While Loop etc.)
10. Function
11. File System
12. Grep Family

Object Oriented Software Engineering

CSCA 601

Cr	L	T	P
4	3	1	0

Course Objectives

In this course students will learn how to:

- Develop models using the UML notation;
- Apply an iterative, agile process;
- Analyze requirements with use cases;
- Create domain models;
- Relate analysis and design artifacts;

Course Outcomes

CO1: Interact with a “client” to elicit project requirements by developing and refining scenarios and use cases.

CO2: Extract an Object Model and Dynamic Model of system functionality and performance from the requirements.

CO3: Design and implement structured, robust, maintainable object-oriented systems across multiple platforms and appropriate programming languages from the specifications developed.

CO4: Develop teamwork and management skills to divide tasks and effectively develop projects in large software teams.

CO5: Research, evaluate and use various CASE tools for object-oriented software engineering

Course Content

Unit-I

Object modeling: Objects and classes, links and associations, generalization and inheritance, grouping constructs, aggregations, generalization as extension and restrictions, multiple inheritance, meta data, candidate keys, dynamic modeling: events and states nesting, concurrency,

Unit-II

Functional modeling: data flow diagrams, specifying operations. Analysis: Object modeling, dynamic modeling, functional modeling, adding operations, iteration. System design: Subsystems, concurrency, allocation to processors and tasks, management of data stores,

Unit-III

Control implementation boundary condition, architectural frameworks, object design, optimization, implementation of control,

Unit-IV

Adjustment of inheritance, design of associations, documentation, comparison of methodologies. Implementation: Using a programming language databases system,

Unit-V

Programming styles, reusability, extensibility, robustness, programming in the large, and case study.

Reference Books:

1. Booch, G., *Object oriented analysis and design*, Benjamin Cummins Publishing Co., 2nd edition, 1991.
2. Rebecca Wires Bracket, *Designing object oriented software*, Prentice Hall of India, New Delhi, 2nd edition, 1998.
3. Rumbaugh, J., *Object oriented modeling and design*, Prentice Hall of India, New Delhi, 2nd Edition, 1991.

Distributed Operating System

CSCA 603

Cr	L	T	P
4	3	1	0

Course Objectives

1. To introduce concepts related to distributed computing systems
2. To get knowledge in distributed architecture, naming, synchronization, consistency and Replication, fault tolerance, security, and distributed file systems
3. To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed

Course Outcomes

CO1: Understand the principles and desired properties of distributed systems on which the Internet and other distributed systems are based

CO2: Understand and apply the basic theoretical concepts and algorithms of distributed systems in problem solving

CO3: Recognize the inherent difficulties that arise due to distributed-ness of computing resources

CO4: Identify the challenges in developing distributed applications

CO5: Design a distributed system that fulfills requirements with regards to key distributed systems properties

Course Content

Unit-I

Introduction: Introduction to Distributed System, Goals of Distributed system, Hardware and Software concepts, Design issues. Communication in distributed system: Layered protocols, ATM networks, Client – Server model, Remote Procedure Calls and Group Communication.

Unit-II

Synchronization in Distributed System: Clock synchronization, Mutual Exclusion, Election algorithm, the Bully algorithm, a Ring algorithm, Atomic Transactions, Deadlock in Distributed Systems, Distributed Deadlock Prevention, Distributed Deadlock Detection.

Unit-III

Processes and Processors in distributed systems: Threads, System models, Processors Allocation, Scheduling in Distributed System, Real Time Distributed Systems.

Unit-IV

Distributed file systems: Distributed file system Design, Distributed file system Implementation, Trends in Distributed file systems.

Distributed Shared Memory: What is shared memory, Consistency models, Page based distributed shared memory, shared variables distributed shared memory.

Unit-V

Case study MACH: Introduction to MACH, process management in MACH, communication in MACH, UNIX emulation in MACH.

Reference Books:

1. *Distributed Operating System* – Andrew S. Tanenbaum, PHI.

Advanced DBMS

CSCA 605

Cr	L	T	P
4	3	1	0

Course Objective

The course should enable the student to present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively information from a DBMS.

Course Outcomes:

Upon successful completion of this course, students should be able to:

CO1: Describe the fundamental elements of relational database management systems

CO2: Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.

CO3: Design ER-models to represent simple database application scenarios

CO4: Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.

Course Content

Unit-I

Distributed DBMS features and needs, Reference Architecture, Levels of Distribution Transparency, Replication, Distributed database design – Fragmentation, allocation criteria, Storage mechanisms, Translation of Global Queries / Global Query Optimisation, Query Execution and access plan.

Unit-II

Concurrency control – 2 phase locks, distributed deadlocks, time based and quorum based protocols, comparison reliability – non-blocking commitment protocols, Partitioned networks, Check points and Cold starts.

Unit-III

Management of Distributed Transactions – 2 phase unit protocols, Architectural aspects, Node and link failure recoveries, Distributed data dictionary management, Distributed database administration.

Unit-IV

Heterogeneous database-federated database, reference architecture, loosely and tightly coupled, Alternative architectures, Development tasks, operation – global task management,

Unit-V

Client server databases – SQL server, Open database connectivity, Constructing an Application.

Reference Books:

1. S. Ceri, G. Pelagatti, "*Distributed Database: Principles and Systems*", McGraw Hill, New York, 1985.
2. Lin Wujuan, Veeravalli Bhardwaj, "*Object Management in distributed database systems*", Kluwer Academic Publishers, UK, 2003.
3. V. K. Jain, "*Advanced DBMS*", Cyber Tech Publications, 2001.
4. Mario Piattini, "*Advanced Database Technology and Design*", Artech House, UK, 2000.

Object Oriented System Design Lab.

CSCA 651

Cr	L	T	P
1	0	0	2

Practical will be based on following Paper:

Object Oriented Software Engineering and other electives subjects with, which lab can be associated

1. SRS (System Requirement Specification)
2. DFD (Data Flow Diagram)
3. ERD (E-R Diagram)
4. LOC (Line of Code)
5. Test Plan & Test Cases

Detail Syllabus of Specialization Courses

Artificial Intelligence and Machine Learning

AMCA-510	Application based Programming in Python	L-4	T-0	P-0	CR4
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CO	COURSE OUTCOMES	Bloom's Knowledge Level (KL)
Upon completion of this course, the students will be able to		
CO1	Solve basic problems using Python built-in data types and their methods.	K1, K3
CO2	Design an application with user-defined modules and packages using OOP concept	K2, K3
CO3	Employ efficient storage and data operations using NumPy arrays.	K3
CO 4	Apply powerful data manipulations using Pandas.	K3
CO 5	Do data preprocessing and visualization using Pandas	K3, K4

Detail Content

Unit 1

Introduction: Introduction to Python and Installation, Python IDE, Interacting with Python Programs, Elements of Python, Expressions, Assignment Statement, Arithmetic Operators.

Conditionals: Conditional statement in Python (if-else statement, its working and execution), Nested-if statement and Elif statement in Python.

Unit 2

Loops: Purpose and working of loops, While loop including its working, For Loop, Nested Loops.

Function: Functions in Python.

Unit 3

Python Data Structure: Strings, Tuples, Lists, Sets, Dictionaries.

Classes: Class definition and other operations in the classes, Special Methods.

Unit 4

Python Pandas: Series, Data Frame, Pandas Read CSV, Data Frames, Data Cleaning.

Unit 5

Python NumPy: Creating Arrays, data types, copy, shape, reshape, iterating arrays, concatenate, split, search, sort, filter.

Reference Books:

1. Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Allen B. Downey, ``Shroff/O'Reilly Publishers, 2016.
2. An Introduction to Python – Revised and updated for Python 3.2, Guido van Rossum and Fred L. Drake Jr, Network Theory Ltd., 2011.
3. Introduction to Computation and Programming Using Python'', Revised and expanded Edition, John V Guttag, MIT Press , 2013.

AMCA-512	Introduction to Deep Learning	L-4	T-0	P-0	CR4
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Course Objectives

After the completion of course the students will

- Get the exposure to Artificial Neural Networks & Fuzzy Logic.
- Understand the importance of tolerance of imprecision and uncertainty for design of robust & low cost intelligent machines.

Course Outcomes

On completion of this course, the students will be able to

1. Identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines
2. Apply Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems.
3. Recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem

Course Content

Unit I

INTRODUCTION: Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates

Unit II

DEEP NETWORKS: History of Deep Learning- A Probabilistic Theory of Deep Learning Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks-Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning

Unit III

DIMENSIONALITY REDUCTION:

Linear (PCA, LDA) and manifolds, metric learning – Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures –Alex-Net, VGG, Inception, Res-Net - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization

Unit IV

OPTIMIZATION AND GENERALIZATION: Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience.

Unit V

CASE STUDY AND APPLICATIONS : Processing Word2Vec - Joint Detection-Bioinformatics- Face Recognition- Scene Understanding Gathering Image Captions

Text books:

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View,2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
4. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

AMCA-607	Fuzzy Logic and Neural Network	L-4	T-0	P-0		CR4
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Course Outcome

CO1: Comprehend the concept of feed forward neural network

CO2: Analyze the various feedback network

CO3: Understand the concept of fuzziness involved in various systems and fuzzy set theory

Unit I

Fuzzy Logic: Basic concepts of fuzzy logic, Fuzzy vs. Crisp set, Linguistic variables, Membership functions, Operations of fuzzy sets, Fuzzy IF- THEN rules, Variable inference techniques, De-Fuzzification, Basic fuzzy inference algorithm, Fuzzy system design, FKBC& PID control, Antilock Breaking system (ABS), Industrial applications.

Unit II

Neural networks characteristics, History of development in neural networks principles, Artificial neural net terminology, Model of a neuron, Topology, Learning, types of learning, Supervised, Unsupervised, Re-inforcement learning. Knowledge representation and acquisition.

Unit III

Basic Hop field model, Basic learning laws, Unsupervised learning, Competitive learning, K-means clustering algorithm, Kohonen`s feature maps.

Unit IV

Radial basis function neural networks, Basic learning laws in RBF nets, Recurrent back propagation, Introduction to counter propagation networks, CMAC network, and ART networks.

Unit V

Applications of neural nets such as pattern recognition, Optimization, Associative memories, speech and decision-making. VLSI implementation of neural networks.

Reference Book:

1. Neural Networks - by Simon Haykin
2. Fuzzy logic with engineering application - by ROSS J.T (Tata Mc)
3. Neural Networks & Fuzzy Logic - by Bart Kosko
4. Neural computing theory & practice - by P.D. wasserman (ANZA PUB).
5. Introduction to applied Fuzzy Electronics-Ahmad M.Ibrahim (PHI)
6. Introduction to artificial neural systems - by J.M. Zurada.(Jaico Pub)

AMCA-609	Digital Image Processing	L-4	T-0	P-0	CR4
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Course Outcomes:

After undergoing this course, the students will be able to:

CO1: Understand the basic concepts of DIP.

CO2: Improve the quality of digital images.

CO3: Understand and De-noise Digital Images

CO4: Segment digital images and extract various features from digital images

CO5: Understand various image compression techniques and apply such techniques to compress digital images for reducing the sizes of digital images.

Detailed Contents:

UNIT I

Introduction of Digital Image Processing (DIP)

Introduction to the DIP areas and applications; Components of Digital Image Processing; Elements of Visual Perception; Image Sensing and Acquisition; Image Sampling and Quantization; Relationships between pixels; color models. [7hrs] (CO 1)

UNIT II

Image Enhancement

Spatial Domain: Gray level transformations; Histogram processing; Basics of Spatial Filtering; Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform; Smoothing and Sharpening frequency domain filters; Ideal, Butterworth and Gaussian filters [10hrs] (CO 2)

UNIT III

Image Restoration

Noise models; Mean Filters; Order Statistics; Adaptive filters; Band reject Filters; Band pass Filters; Notch Filters; Optimum Notch Filtering; Inverse Filtering; Wiener filtering [8hrs] (CO 3)

UNIT IV

Feature Extraction and Image Segmentation

Feature Extraction: Contour and shape dependent feature extraction, Extraction of textural features Segmentation: Detection of Discontinuities; Edge Linking and Boundary detection; Region based segmentation; Morphological processing- erosion and dilation. [10hrs] (CO 4)

UNIT V

Image Compression and Encoding

Entropy-based schemes, Transform-based encoding, Predictive encoding and DPCM, Vector quantization, Huffman coding. [10hrs](CO 5)

Suggested Readings/ Books:

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
3. William K Pratt, "Digital Image Processing", John Willey, 2002.
4. Nick Efford, "Digital Image Processing a practical introduction using Java", Third Edition, Pearson Education, 2004.
5. R.C. Gonzalez, R.E. Woods, and S. L. Eddins "Digital Image Processing using MATLAB", Pearson Prentice-Hall, 2004.
6. Sandipan Dey, "Hands-On Image Processing with Python", Packt, 2018

Cyber Security

CSCA-510	Foundation of Cyber Security	L-4	T-0	P-0	CR4
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Course outcomes:

Upon successful completion of the course, the students will have:

1. Reasonable understanding of the fundamentals of the cybersecurity domain and related issues
2. Practical knowledge of various tools, processes and methods to ensure security of systems through a minimum of two hands-on assignments involving attack and protection in a virtual environment
3. An understanding of the inter-disciplinary nature of cyber security domain
4. Adequate level of cross-disciplinary knowledge of design, implementation, evaluation and testing of secure protocols, systems or applications

Unit I

Introduction, Psychology, Usability, Thinking like a Hacker, CIA Triad, Security Terminologies, Security Protocols, 3. Security Policies and Management, Multilevel and multilateral Policies, Security Mechanisms

Unit II

Security Design Principles, Threat Analysis and Risk Assessment, Securing a System, Cryptography, Basic Techniques, Digital Signatures, Cryptanalysis 6. Software Security, Low-level attacks, Code Review and Testing, Defenses.

Unit III

Fall-Break, Student Project Idea Discussion, 8. Network Security, Vulnerabilities, Attacks, Defenses Internet and Smartphone Security, Anonymous vs Secure Browsing

Unit IV

Information Economics, Economics of Security, Physical Protection, Biometrics, Banking Security, Cyber Forensics, Cyber Warfare, Surveillance and Privacy

Unit V

Incident Response and Mitigation, Business Continuity, Legal issues and Ethics

Text Books:

1. Fundamentals of Cyber Security (Principles Theory & Practices), Bhushan Mayank, Publisher: BPB Publications, 2020.
2. Cyber Security Fundamentals, Rajesh Kumar Gautam, BPB Publications, 2019.

CSCA-512	Cyber Law and Ethics	L-4	T-0	P-0	CR4
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Course Outcome: After learning the course the students should be able to:

1. To identify and describe the major types of cyber crime.
2. To identify cyber crime vulnerabilities and exploitations of the Internet.
3. To identify the four major cyber crimes vulnerability areas: a. physical security, personal security, communications security, and operations security.
4. Distinguish between various types of cybercrimes with respect to the motivations and methods of operation of offenders, the types of victims or targets, and the spatial, temporal, and legal domains in which they are carried out.
5. Identify various classifications of cybercrimes and cyber-criminals.

Unit I

Cyber Crime : Definition and Origin of the Word, Cyber Crime and Information Security, Who are Cyber Criminals, Classification of Cyber crimes, E-mail Spoofing, Spam ming, Cyber Defamation, Internet Time Theft, Salami Attack, Salami technique Data Diddling, Frogery, Web Jacking, Newsgroup Spam, Industrial Spying,, Hacking, Online Fruads, Pornographic Offenders, Software Piracy, Computer Sabotage Email Bombing, Computer Network Intrusion, Password Sniffing, Credit Card Frauds, Identity Theft

Unit II

Cyber Crime : The Legal Perspectives, The Cyber Crime Indian Perspectives, The Cyber Crime And Indian ITA 2000/2001, Hacking and Indian Laws, Global Perspective on Cyber Crime , Cyber Crime and extended Enterprise, Cyber Crime Era : Survival Mantra for Netizens.

Cyber Offenses: How Criminals plan them, Categories of Cyber Crimes, How Criminal Plans the Attack .

Cybercrime: Mobile and Wireless Devices, Credit card Frauds in Mobile and wireless devices, Authentication Service Security, Attacks on Mobile/Cellphones, Tools and Methods used in Cybercrime, phising.

Unit III

Cybercrimes and Cyber security: The legal perspectives: Cybercrimes and the legal Landscape around the world, why do we need cyberlaws: The Indian context, The Indian IT ACT: Admissibility of Electronic records, Amendments made in Indian ITA 2000, Psitive Aspects and weak areas of ITA 2000, Challenges to Indian law and cybercrime scenario in India, Digital signatures and the Indian ITA act, Cybercrime and punishment, Cyber law Technology and students: Indian Scenario

Unit IV

Understanding Computer Forensics: Digital forensic Science, Need for Computer Foransic, Cyber Forensic and digital Evidence and rules of Evidence, Forensics Analysis of E-Mail, DigitalForensic Life Cycle,

Unit V

Cyber Security: Organizational Implications: Web Threats for Organization , Security and Privacy Implications, Social Media Marketing: Security risk for organizations, Incident handling: An Essential Component of Cyber Security, Intellectual Property in the Cyberspace, The Ethical Dimensions of Cybercrime, The Psychology, Mindset and skills of Hackers and the Other criminals

Reference Books:

1. Cyber Security : Understanding Cyber Crimes , Computer Forensics and Legal Perspectives By Nina Godbole, Sunit Belapur , Wiley
2. UNDERSTANDING CYBERCRIME: P H E N O M E N A , A N D L E G A L C H A L L E N G E S R E S P O N S E, ITU 2012

CSCA-607	Ethical Hacking	L-4	T-0	P-0	CR4
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Objectives:

- Introduces the concepts of Ethical Hacking
- Gives the students the opportunity to learn about different tools and techniques in Ethical hacking and security Practically
- Apply Ethical hacking tools to perform various activities.

Course Outcomes: After completion of course, students would be able to:

- 1.Understand the concepts of ethical hacking
2. Understand the concepts of System hacking
- 3 Perform TCP/IP and Port scanning
- 4 Identify desktop and server OS vulnerabilities
- 5 Describe on network protection systems

Unit I

Ethical hacking process, Hackers behaviour & mindset, Maintaining Anonymity, Hacking Methodology, Information Gathering, Active and Passive Sniffing, Physical security vulnerabilities and countermeasures. Internal and External testing. Preparation of Ethical Hacking and Penetration Test Reports and Documents.

Unit II

Social Engineering attacks and countermeasures. Password attacks, Privilege Escalation and Executing Applications, Network Infrastructure Vulnerabilities, IP spoofing, DNS spoofing, Wireless Hacking: Wireless footprint, Wireless scanning and enumeration, Gaining access (hacking 802.11), WEP, WPA, WPA2.

Unit III

DoS attacks. Web server and application vulnerabilities, SQL injection attacks, Vulnerability Analysis and Reverse Engineering, Buffer overflow attacks. Client-side browser exploits, Exploiting Windows Access Control Model for Local Elevation Privilege. Exploiting vulnerabilities in Mobile Application

Unit IV

Introduction to Metasploit: Metasploit framework, Metasploit Console, Payloads, Metrprieter, Introduction to Armitage, Installing and using Kali Linux Distribution, Introduction to penetration testing tools in Kali Linux. Case Studies of recent vulnerabilities and attacks.

References: 1. Baloch, R., Ethical Hacking and Penetration Testing Guide, CRC Press, 2015.
 2. Beaver, K., Hacking for Dummies, 3rded. John Wiley & sons., 2013.
 3. Council, Ec. , Computer Forensics: Investigating Network Intrusions and Cybercrime, Cengage Learning, Second Edition, 2010
 4. McClure S., Scambray J., and Kurtz G, Hacking Exposed. Tata McGraw-Hill Education, 6th Edition, 2009
 5.International Council of E-Commerce Consultants by Learning, Penetration Testing Network and Perimeter Testing Ec-Council/ Certified Security Analyst Vol. 3 of Penetration Testing, Cenage Learning, 2010

CSCA-609	Intrusion Detection and Internet Security	L-4	T-0	P-0	CR4
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Objectives:

- 1.To familiarize the intrusion detection and prevention basics and approaches.
- 2.To introduce the taxonomy of anomaly detection system
3. To learn the architecture and justification of intrusion detection.
4. To learn the applications and tools for intrusion detection
- 5.To learn the legal issues and organizations standards

Course Outcomes: After completion of course, students would be able to:

- 1.Understand the intrusion detection and prevention basics and approaches.
- 2.Understand the taxonomy of anomaly detection system
3. Understand the architecture and justification of intrusion detection.
- 4.Apply the intrusion detection applications.
5. Understand the legal issues and organizations standards

Unit I

The state of threats against computers, and networked Systems-Overview of computer security solutions and why they Fail-Vulnerability assessment, firewalls, VPN's –Overview of Intrusion Detection and Intrusion Prevention Network and Host-based IDS

Unit II

Classes of attacks – Network layer: scans, denial of service, penetration – Application layer: software exploits, code Injection-Human layer: identity theft, root access-Classes of attackers-Kids/hackers/sop Hesitated groups-Automated: Drones, Worms, Viruses

Unit III

A General IDS model and taxonomy, Signature-based Solutions, Snort, Snort rules, Evaluation of IDS, Cost sensitive IDS Anomaly Detection Systems and Algorithms-Network Behavior Based Anomaly Detectors (rate based)-Host-based Anomaly Detectors-Software VulnerabilitiesState transition, Immunology, Payload Anomaly Detection

Unit IV

Attack trees and Correlation of Alerts-Autopsy of Worms and Botnets-Malware Detection-Obfuscation, Polymorphism-Document vectors Email/IM security Issues-Viruses/Spam-From signatures to thumbprints to zero day Detection-Insider Threat Issues-Taxonomy-Masquerade and Impersonation Traitors, Decoys and Deception-Future: Collaborative Security

- References:** 1. Peter Szor , The Art of Computer Virus Research and Defense, Symantec Press, 2010, ISBN 0- 321-30545-3.
2. Markus Jakobsson and Zulfikar Ramzan, Crimeware, Understanding New Attacks and Defenses, Symantec Press, 2008, ISBN: 978-0-321-50195-0.

Data Science

DSCA-510	Python for Data Science	L-4	T-0	P-0	CR4
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CO	COURSE OUTCOMES	Bloom's Knowledge Level (KL)
Upon completion of this course, the students will be able to		
CO1	Identify the need for data science and solve basic problems using Python built-in data types and their methods.	K1, K3
CO2	Design an application with user-defined modules and packages using OOP concept	K2, K3
CO3	Employ efficient storage and data operations using NumPy arrays.	K3
CO 4	Apply powerful data manipulations using Pandas.	K3
CO 5	Do data preprocessing and visualization using Pandas	K3, K4

DETAILED SYLLABUS

UNIT-I: Introduction to Data Science - Why Python? - Essential Python libraries - Python Introduction- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Set - Type Conversion- Operators. Decision Making- Looping- Loop Control statement- Math and Random number functions. User defined functions - function arguments & its types.

UNIT 2: FILE, EXCEPTION HANDLING AND OOP- User defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods. Python Exception Handling. OOPs Concepts -Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance.

UNIT 3: INTRODUCTION TO NUMPY- NumPy Basics: Arrays and Vectorized Computation- The NumPy ndarray- Creating ndarrays- Data Types for ndarrays- Arithmetic with NumPy Arrays- Basic Indexing and Slicing - Boolean Indexing-Transposing Arrays and Swapping Axes. Universal Functions: Fast Element-Wise Array Functions- Mathematical and Statistical Methods-Sorting- Unique and Other Set Logic

UNIT 4: DATA MANIPULATION WITH PANDAS- Introduction to pandas Data Structures: Series, DataFrame, Essential Functionality: Dropping Entries- Indexing, Selection, and Filtering- Function Application and Mapping- Sorting and Ranking. Summarizing and Computing Descriptive Statistics- Unique Values, Value Counts, and Membership. Reading and Writing Data in Text Format.

UNIT 5: DATA CLEANING, PREPARATION AND VISUALIZATION- Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers- String Manipulation: Vectorized String Functions in pandas. Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots.

TEXT BOOKS and REFERENCES

1. Y. Daniel Liang, “Introduction to Programming using Python”, Pearson, 2012.
2. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly, 2nd Edition, 2018.
3. Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, O’Reilly, 2017.
4. Wesley J. Chun, “Core Python Programming”, Prentice Hall, 2006.
5. Mark Lutz, “Learning Python”, O’Reilly, 4th Edition, 2009.

MOOC

<https://www.edx.org/course/python-basics-for-data-science>

<https://www.edx.org/course/analyzing-data-with-python>

DSCA-512	R for data science	L-4	T-0	P-0	CR4
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CO	COURSE OUTCOMES	Bloom's Knowledge Level (KL)
Upon completion of this course, the students will be able to		
CO1	Understand the basics of Fundamentals of R.	K1
CO2	Apply the loading, retrieval techniques of data.	K2
CO3	Analysis of data through visualization	K3

DETAILED SYLLABUS

UNIT-I: Overview of R- History and Overview of R- Basic Features of R-Design of the R System- Installation of R- Console and Editor Panes- Comments- Installing and Loading R Packages- Help Files and Function Documentation- Saving Work and Exiting R- Conventions- R for Basic Math- Arithmetic- Logarithms and Exponentials- E-Notation- Assigning Objects- Vectors- Creating a Vector- Sequences, Repetition, Sorting, and Lengths- Subsetting and Element Extraction- Vector-Oriented Behaviour.

UNIT-II: MATRICES AND ARRAYS- Defining a Matrix – Defining a Matrix- Filling Direction- Row and Column Bindings- Matrix Dimensions- Subsetting- Row, Column, and Diagonal Extractions- Omitting and Overwriting- Matrix Operations and Algebra- Matrix Transpose- Identity Matrix- Matrix Addition and Subtraction- Matrix Multiplication- Matrix Inversion-Multidimensional Arrays- Subsets, Extractions, and Replacements

UNIT-III: NON-NUMERIC VALUES- Logical Values- Relational Operators- Characters- Creating a String- Concatenation- Escape Sequences- Substrings and Matching- Factors- Identifying Categories- Defining and Ordering Levels- Combining and Cutting

UNIT IV: LISTS AND DATA FRAMES- Lists of Objects-Component Access-Naming- Nesting-Data Frames-Adding Data Columns and Combining Data Frames-Logical Record Subsets-Some Special Values-Infinity-NaN-NA-NULL- Attributes-Object-Class-Is-Dot Object-Checking Functions-As-Dot Coercion Functions.

UNIT V: BASIC PLOTTING- Using plot with Coordinate Vectors-Graphical Parameters- Automatic Plot Types-Title and Axis Labels- Color-Line and Point Appearances-Plotting Region Limits-Adding Points, Lines, and Text to an Existing Plot-ggplot2 Package-Quick Plot with qplot- Setting Appearance Constants with Geoms- **READING AND WRITING FILES-** R-Ready Data Sets- Contributed Data Sets- Reading in External Data Files- Writing Out Data Files and Plots- Ad Hoc Object Read/Write Operations

Text books and References:

1. Tilman M. Davies, "THE BOOK OF R - A FIRST PROGRAMMING AND STATISTICS", Library of Congress Cataloging-in-Publication Data, 2016.
2. Roger D. Peng, "R Programming for Data Science", Lean Publishing, 2016.
3. Hadley Wickham, Garrett Grolemund, "R for Data Science", OREILLY Publication, 2017
4. Steven Keller, "R Programming for Beginners", CreateSpace Independent Publishing Platform, 2016.
5. Kun Ren, "Learning R Programming", Packt Publishing, 2016

MOOC

<https://online-learning.harvard.edu/subject/r>
<https://www.udemy.com/course/r-basics/>

DSCA-607	Big Data Analytics	L-4	T-0	P-0	CR4
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CO	COURSE OUTCOMES	Bloom's Knowledge Level (KL)
Upon completion of this course, the students will be able to		
CO1	Describe the life cycle phases of Data Analytics through discovery, planning and building.	K1,K2
CO2	Understand and apply Data Analysis Techniques.	K2, K3
CO3	Implement various Data streams.	K3
CO 4	Understand item sets, Clustering, frame works & Visualizations	K2
CO 5	Apply R tool for developing and evaluating real time applications.	K3,K5,K6

DETAILED SYLLABUS

UNIT-I: Introduction to Data Analytics: Sources and nature of data, classification of data (structured, semi-structured, unstructured), characteristics of data, introduction to Big Data platform, need of data analytics, evolution of analytic scalability, analytic process and tools, analysis vs reporting, modern data analytic tools, applications of data analytics. **Data Analytics Lifecycle:** Need, key roles for successful analytic projects, various phases of data analytics lifecycle – discovery, data preparation, model planning, model building, communicating results, operationalization.

UNIT-II: Data Analysis: Regression modeling, multivariate analysis, Bayesian modeling, inference and Bayesian networks, support vector and kernel methods, analysis of time series: linear systems analysis & nonlinear dynamics, rule induction, neural networks: learning and generalisation, competitive learning, principal component analysis and neural networks, fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, stochastic search methods.

UNIT-III: Mining Data Streams: Introduction to streams concepts, stream data model and architecture, stream computing, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, decaying window, Real-time Analytics Platform (RTAP) applications, Case studies – real time sentiment analysis, stock market predictions.

UNIT-IV: Frequent Itemsets and Clustering: Mining frequent itemsets, market based modelling, Apriori algorithm, handling large data sets in main memory, limited pass algorithm, counting frequent itemsets in a stream, clustering techniques: hierarchical, K-means, clustering high dimensional data, CLIQUE and ProCLUS, frequent pattern based clustering methods, clustering in non-euclidean space, clustering for streams and parallelism.

UNIT-V: Frame Works and Visualization: MapReduce, Hadoop, Pig, Hive, HBase, MapR, Sharding, NoSQL Databases, S3, Hadoop Distributed File Systems, Visualization: visual data analysis techniques, interaction techniques, systems and applications. **Introduction to R - R** graphical user interfaces, data import and export, attribute and data types, descriptive statistics, exploratory data analysis, visualization before analysis, analytics for unstructured data.

Text books and References:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer
2. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press.
3. Bill Franks, "Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & Sons.

4. John Garrett, “Data Analytics for IT Networks : Developing Innovative Use Cases”, Pearson Education
5. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses”, Wiley
6. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big Data Analytics”, EMC Education Series, John Wiley
7. Frank J Ohlhorst, “Big Data Analytics: Turning Big Data into Big Money”, Wiley and SAS Business Series
8. Colleen Mccue, “Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis”, Elsevier
9. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer
10. Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGraw Hill
11. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, Springer
12. Mark Gardner, “Beginning R: The Statistical Programming Language”, Wrox Publication
13. Pete Warden, “Big Data Glossary”, O’Reilly
14. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons
15. Pete Warden, “Big Data Glossary”, O’Reilly.
16. Peter Bühlmann, Petros Drineas, Michael Kane, Mark van der Laan, “Handbook of Big Data”, CRC Press
17. Jiawei Han, Micheline Kamber “Data Mining Concepts and Techniques”, Second Edition, Elsevier

MOOC

<https://www.edx.org/course/big-data-analytics-2>

<http://nptel.ac.in/courses/110106072/>

DSCA-609	Information Visualization	L-4	T-0	P-0	CR4
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CO	COURSE OUTCOMES	Bloom's Knowledge Level (KL)
Upon completion of this course, the students will be able to		
CO1	Understand basics of Data Visualization	K2, K3
CO2	Implement visualization of distributions	K2, K3
CO3	Write programs on visualization of time series, proportions & associations	K3
CO4	Apply visualization on Trends and uncertainty	K3
CO5	Explain principles of proportions	K3, K4

DETAILED SYLLABUS

UNIT 1: INTRODUCTION TO VISUALIZATION- Visualizing Data-Mapping Data onto Aesthetics, Aesthetics and Types of Data, Scales Map Data Values onto Aesthetics, Coordinate Systems and Axes- Cartesian Coordinates, Nonlinear Axes, Coordinate Systems with Curved Axes, Color Scales-Color as a Tool to Distinguish, Color to Represent Data Values, Color as a Tool to Highlight, Directory of Visualizations- Amounts, Distributions, Proportions, x–y relationships, Geospatial Data

UNIT 2: VISUALIZING DISTRIBUTIONS- Visualizing Amounts-Bar Plots, Grouped and Stacked Bars, Dot Plots and Heatmaps, Visualizing Distributions: Histograms and Density Plots- Visualizing a Single Distribution, Visualizing Multiple Distributions at the Same Time, Visualizing Distributions: Empirical Cumulative Distribution Functions and Q-Q Plots-Empirical Cumulative Distribution Functions, Highly Skewed Distributions, Quantile- Quantile Plots, Visualizing Many Distributions at Once-Visualizing Distributions Along the Vertical Axis, Visualizing Distributions Along the Horizontal Axis.

UNIT 3: VISUALIZING ASSOCIATIONS & TIME SERIES- Visualizing Proportions-A Case for Pie Charts, A Case for Side-by-Side Bars, A Case for Stacked Bars and Stacked Densities, Visualizing Proportions Separately as Parts of the Total, Visualizing Nested Proportions- Nested Proportions Gone Wrong, Mosaic Plots and Treemaps, Nested Pies , ParallelSets. Visualizing Associations Among Two or More Quantitative Variables-Scatterplots, Correlograms, Dimension Reduction, Paired Data. Visualizing Time Series and Other Functions of an Independent Variable- Individual Time Series, Multiple Time Series and Dose–Response Curves, Time Series of Two or More Response Variables.

UNIT 4: VISUALIZING UNCERTIANITY- Visualizing Trends-Smoothing, Showing Trends with a Defined Functional Form, Detrending and Time-Series Decomposition, Visualizing Geospatial Data-Projections, Layers, Choropleth Mapping, Cartograms, Visualizing Uncertainty-Framing Probabilities as Frequencies, Visualizing the Uncertainty of Point Estimates, Visualizing the Uncertainty of Curve Fits, Hypothetical Outcome Plots.

UNIT 5: PRINCIPLE OF PROPORTIONAL INK- The Principle of Proportional Ink- Visualizations Along Linear Axes, Visualizations Along Logarithmic Axes, Direct Area Visualizations, Handling Overlapping Points-Partial Transparency and Jittering, 2D Histograms, Contour Lines, Common Pitfalls of Color Use-Encoding Too Much or Irrelevant Information, Using Nonmonotonic Color Scales to Encode Data Values, Not Designing for Color-Vision

Deficiency.

TEXT BOOKS and REFERENCES:

1. Claus Wilke, “Fundamentals of Data Visualization: A Primer on Making Informative and Compelling Figures”, 1st edition, O’Reilly Media Inc, 2019.
2. Tony Fischetti, Brett Lantz, R: Data Analysis and Visualization,O’Reilly, 2016.
3. Ossama Embarak, Data Analysis and Visualization Using Python: Analyze Data to Create Visualizations for BI Systems, Apress, 2018

Cloud Computing

CCCA-510	Introduction to Virtualization & Cloud Computing	L-4	T-0	P-0	CR4
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Course Objectives:

- Apply Cloud Computing and Related Technologies
- Applying virtualization concept in reality

Course Outcome:

1. Understanding of Cloud Computing and Related Technologies
2. Appreciate the requirements of various service paradigms in Cloud Computing

Unit 1

Introduction to Cloud Computing, Definition, Characteristics, Components, Cloud provider, SLA, Virtualization, Types of virtualization, Server virtualization, storage virtualization, Network Virtualization and application virtualization, Importance of virtualization in cloud, Study of hypervisors.

Unit 2

Cloud deployment models: Public cloud, Private cloud and Hybrid cloud- Organizational scenarios of clouds, , Deploy application over cloud-Workload distribution, Resource pooling, dynamic scalability,elasticity, Service load balancing, Cloud bursting, Service Technology: SOAP and REST Web services, AJAX and mashups Web services, Service Middleware.

Unit 3

Overview, Infrastructure as a Service (IaaS) Cloud Delivery Model, Platform as a Service (PaaS) Cloud Delivery Model, Software as a Service (SaaS) Cloud Delivery Model- Administering & Monitoring cloud services, benefits and limitations- Cloud computing platforms: Infrastructure as a service: Amazon EC2, Platform as a Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing.

Unit 4

GFS and HDFS, BigTable, HBase and Dynamo, Map-Reduce: The Map-Reduce model- Cloud Workload Overview, Workloads most suitable for Cloud, Workloads not suitable for Cloud Unit 5 Tools and Technologies for Cloud, Cloud Computing Platform: Eucalyptus, Nimbus, OpenNebula, Cloud Mashups, Cloud Tools: VMWare, Eucalyptus, CloudSim, Implementing real time application over cloud platform, QOS Issues in Cloud, data migration, streaming in Cloud, Concepts in Mobile Cloud Computing, Fog Computing, Dockers, Green Cloud, Cloud Computing, IoT Cloud.

Text Books

1. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, "Cloud Computing Concepts, Technology & Architecture", Prentice Hall, 2013.
2. A.Srinivasan, J.Suresh, "Cloud Computing, A practical approach for learning and implementation", Pearson, 2014.

Reference Books

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

CCCA-512	Cloud Computing Architecture	L-4	T-0	P-0	CR4
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Course Objectives:

1. To provide students with the fundamentals and essentials of Cloud Computing.
2. To provide students a sound foundation of the Cloud Computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.
3. To impart knowledge in applications of cloud computing

Course Outcome:

1. Design, Develop & Demonstrate real-world applications from the Cloud Computing
2. Understand the subtle architectural difference in Public and Private Clouds.
3. Appreciate the requirements of various service paradigms in Cloud Computing.
4. Describe the methods of processing multimedia elements and other information presentation concepts during multimedia communications.

Unit 1

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

Unit 2

Web Service Architecture – Web Service APIs – Web service Authentication - Web service authentication methods - Technologies and the processes required when deploying web services; Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages

Unit 3

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

Unit 4

Programming Models for Cloud Computing - Software Development in Cloud - Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

Unit 5

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

Text Books

1. Gautam Shroff, “Enterprise Cloud Computing Technology Architecture Applications”, Cambridge University Press; 1 edition, *ISBN: 978-0521137355], 2010
2. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach” McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009.

Reference Book

1. Dimitris N. Chorafas, “Cloud Computing Strategies” CRC Press; 1 edition 2010.

CCCA-607	Storage Technology Foundation	L-4	T-0	P-0	CR4
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Course Objectives:

The objective of this course is to discuss storage systems, their design and analysis from both hardware (architectural features) and system software (operating systems, networking, run-time systems) point of view.

Course Outcome:

1. The evolution of storage and implementation models
2. Storage devices principles including structure.
3. Storage network design principles.

Unit 1

Importance of data storage - Business issues and IT challenges - Business and IT opportunities - opportunity for Cloud, Virtualization and Data Storage Networking - Server and Storage I/O Fundamentals - I/O connectivity and Networking Fundamentals - IT Clouds - Virtualization - Virtualization and Storage Services - Data and Storage Access

Unit 2

Managing Data Infrastructures for Cloud and Virtual Environments - Introduction to Infrastructure resource management - understanding and managing IT Resources - Service offerings - Categories -and Technology Alignment - Gaining Situational Awareness and control - From SRM - E2E SRA - Search and eDiscovery - Performance and Capacity Planning - Data Movement and Migration

Unit 3

Being Secure without Being Scared - Eliminating Blind Spots, Gaps in Coverage, or Dark Territories - Security Threat Risks Challenges - Taking Action to resources - Securing Networks- Securing Storage -Virtual Servers, Physical Servers and Desktops - Security Clouds - Disposing of Digital Assets and Technology - Security Checklist

Unit 4

Tiered Storage - Storage Reliability - Availability - Serviceability (RAS) - Storage Services and Functionalities - Storage System Architectures - Storage Virtualization and Virtual Storage.

Unit 5

Virtual Servers - Inside Virtual Servers and Virtual Machines - Virtual Desktop Infrastructures - Cloud and Virtual Servers - Networking Challenges - I/O and Networking Bits and Bytes, Decoding Encoding, I/O and Networking Fundamentals - Virtual Servers - I/O Networking Devices - Converged and Unified Networking - Local Networking - Enabling Distance - Cloud virtualization and management topics - Configuring for reliability, availability and Serviceability (RAS).

CCCA-609	Security in Cloud	L-4	T-0	P-0	CR-4
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Course Objectives:

Cloud security entails securing cloud environments against unauthorized use/access, distributed denial of service (DDOS) attacks, hackers, malware, and other risks.

Course Outcome:

1. Describe cloud security architectures from the perspectives of: providers, brokers, carriers, and auditors.
2. Describe a methodology for orchestrating a cloud ecosystem.
3. Understand how cloud computing changes the traditional enterprise security considerations compared to on-premise.

Unit 1

Introduction to Cloud Computing and Security: Understanding Cloud Computing - The IT Foundation for Cloud- overview of Security Architecture, Cloud Computing Architecture: Cloud Reference Architecture-Control over Security in the Cloud Model- Cloud Deployment & Services Models- Key Examples.

Unit 2

Cloud Computing: Security Concerns- Risk Tolerance- Legal and Regulatory Issues, Security Requirements for the Architecture-Security Patterns and Architectural Elements-Cloud Security Architecture-Key Strategies for Secure Operation

Unit 3

Overview of Data Security in Cloud Computing-Common Risks with Cloud Data Security- Data Encryption: Applications and Limits- Errors with Data Encryption- Cloud Data Security: Sensitive Data Categorization, Cloud Data Storage-Roach Motel Syndrome, Overall Strategy: Effectively Managing Risk, Overview of Security Controls, Overview of Security Controls, The Limits of Security Controls, Best Practices, Security Monitoring

Unit 4

Private Clouds: Motivation and Overview-Security Implications: Shared versus Dedicated Resources, Security Criteria for Ensuring a Private Cloud - Network Considerations- Data Center Considerations- Operational Security Considerations- Regulation, Selecting a CSP: Overview of Assurance, Overview of Risks, Security Criteria- Revisiting Defense-in-depth- Additional Security- relevant Criteria

Unit 5

Evaluating Cloud Security, Checklists for Evaluating Cloud Security- Foundational Security-Business Considerations- Defense-in-depth- Operational Security, Operating a Cloud: From Architecture to Efficient and Secure Operations, Bootstrapping Secure Operations, Security Operations Activities- Business Continuity, Backup, and Recovery- Managing Changes in Operational Environments - Information Security Management - Vulnerability and Penetration Testing, Security Monitoring and Response

Text Books

1. Vic (J.R.) Winkler, "Securing the Cloud: Cloud Computer Security Techniques and Tactics", Elsevier, 2011
2. Sushil Jajodia, Krishna Kant, "Secure Cloud Computing", Elsevier, 2014
3. Curtis Franklin, Jr. ,Brian J. S. Chee, "Securing the Cloud: Security Strategies for the Ubiquitous Data Center", CRC Press, 2019.

Full Stack Development

FDCA-510	Introduction to HTML, Bootstrap and CSS	L-4	T-0	P-0	CR-4
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Course Objectives:

After completion of this course the learners will be able to understand, design and develop the web applications in a well-defined manner. It will enable the students to create their own web pages and websites.

Course Outcomes:

- Building Strong expertise to develop front end application using HTML and CSS
- To become proficient in Bootstrap concepts
- To develop web pages based on Bootstrap
- Create webpages that function using external data
- Create visualizations in accordance with UI/UX theories.

Module 1: Introduction to HTML and CSS: HTML and CSS syntax, HTML Elements, HTML Document Structure, CSS Selectors, Property and Values, Code Editors, Code Commenting, Building a Web page

Module 2: HTML Fundamentals: Semantics of HTML, Block and inline elements, Nesting of elements, Text elements, Structure elements, Hyperlinks, Lists, Image, video, audio elements, I frame elements, Tables, Forms, Create a basic multi page website

Module 3: CSS Fundamentals: Cascading effect, Specificity - CSS selectors, Combining and layering selectors, advanced selectors, Colors, Lengths, Typography, Backgrounds and gradients, CSS resets

Module 4: Introduction to Bootstrap, Bootstrap Basics, Bootstrap Grid, Bootstrap themes, Bootstrap CSS, Bootstrap JS

Module 5: HTML Form Elements: Get and Post Communications, Validating input Values in a Form, Form Action and Type.

1. Ivan Bayross, “*HTML, DHTML, Java Script, Perl cgi*”, BPB publication,
2. James Godwill, “*Pure JSP*”, Sams publications, edition-2000
3. Bryan Basham, “*Head First in Servlets and Jsp*”, O’Rielly publications, March 2008.

FDCA-512	Programming with JavaScript	L-4	T-0	P-0	CR-4
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Course Objectives:

- Understand the JavaScript language & the Document Object Model.
- Alter, show, hide and move objects on a web page.
- Check information inputted into a form.

Course Outcomes:

- To structure and implement HTML and CSS
- To understand Client Server Technology
- To analyse the web development practices
- Create webpages that function using external data

Module 1: Introduction to JavaScript : Values and Types, Operators, Variables, Math and String Manipulation, Applying JavaScript (internal and external), Understanding JS Syntax, Introduction to Document and Window Object

Module 2: Expressions and Operators, Flow Control, Objects and Arrays, Defining Functions and Methods, Constructors and Inheritance Control Statements, Error Handling, Understanding arrays, Function Declaration, Dialog Boxes

Module 3: Working with objects and classes, HTML Document Object Model, Working with HTML Form and its elements

Module 4: JavaScript Error Handling, Validation, Animation, Multimedia, Image Map, Browsers

Module 5: JavaScript Events, JavaScript Cookies, Internal and External JavaScript, JavaScript vs. PHP, JavaScript vs. Angular JS.

1. „JavaScript from Beginner to Professional, Packt Publishing Limited, 2021.
2. JavaScript: Functional Programming for JavaScript Developers, Packt Publishing Limited, 2016

FDCA-607	Node JS and MongoDB Development	L-4	T-0	P-0	CR-4
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Course Objective: This course will enable the students to develop their own Node.JS live projects and acquire the programming skills for various trending JavaScript frameworks.

Course Outcome: On completion of this course the students will:

- Clearly understand the platform design choices that led to Node.js choosing an event loop and what this means for applications built on that foundation.
- Understand the unique trade-offs present in event-driven programming.
- Create Node.js modules and express code modularity in an application.
- Understand the core flow control patterns in Node.js and know when it is appropriate to use callbacks, event emitters or streams.
- To create and design database using Mongo DB
- To analyze data deployed on Mongo DB database servers

Module 1: Introduction to Node JS, Environment Setup, REPL Terminal, Package Manager, Console, Install Node.js in Linux and Windows

Module 2: Node.js Globals, OS, Node.js Timers, DNS, Node.js Net, Crypto, TLS/SSL, Debugger, Process, Child Process, Buffer

Module 3: Node.js File System, Path, String Decoder, Query String, Callbacks, Events in Node.js, Node.js Web Modules

Module 4: Node.js and MySQL Create Connection, Create Database, Table, Insert, Update and Delete Records, Select Records and Drop Tables.

Module 5: Mongo DB Introduction, Advantages, Environment, Modelling Data, Create Database, Drop Database, Create Connection, Drop Connection, Data types, Insert Document, Query Document, Update Document, Delete Document, Sorting Records, Indexing, Aggregation, Replication, Sharding, Deployment, Create Backup.

Text Books:

1. Node.js, MongoDB and Angular Web Development, Caleb Dayley Brad Dayley, Brendan Dayley, Second Edition, Second Edition, 2019.

FDCA-609	Angular JS Development	L-4	T-0	P-0	CR-4
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Course Objectives: The main objective of Angular JS is to reduce the code to build user interface applications. The students will learn to create single page applications, to restore data from back-end server and manipulate it easily. Also they will learn to build Responsive Web application using Angular JS

Course Outcomes: After completing this course, students will be able to:

- Get familiar with client-side Angular framework.
- Use various Angular features including directives, components, and services.
- Implement a functional front-end web application using Angular.
- Boost your hire ability through innovative and independent learning.

Detail Content

Unit 1

Introduction to AngularJS , MVC Architecture , Conceptual Overview , Setting up theEnvironment, First Application ,Understanding ng attributes.

Unit 2

Number and String Expressions, Object Binding and Expressions, Working withArrays, Forgiving Behavior, Understanding Data binding.

Unit 3

Conditional Directives, Styles Directives, Mouse and Keyboard Events Directives

Unit 4

Understanding Controllers, Programming Controllers & \$scope object, Adding Behavior to a Scope Object, Passing Parameters to the Methods, Having Array asmembers in Controller Scope, Nested Controllers and Scope Inheritance, MultipleControllers and their scopes.

Unit 5

Built-In Filters, Uppercase and Lowercase Filters, Currency and Number Formatting Filters, OrderBy Filter, Creating Custom Filter, Understanding Services, Developing Creating Services, Using a Service, InjectingDependencies in a Service

Text Book:

1. ng-book: The Complete Guide to Angular, Felipe Coury, Ari Lerner & Carlos Taborda, 2018.
2. Angular 8 for Enterprise-Ready Web Applications, Doguhan Uluca, Packt Publishing Limited, 2020,

Course Objectives

This introductory course input is intended

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature

Course Contents

UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self Exploration—what is it? its content and process; 'Natural Acceptance' and Experiential Validation—as the mechanism for self exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Swasthya
7. Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

1. Understanding Harmony in the family – the basic unit of human interaction
2. Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhaytripty;
3. Trust (Vishwas) and Respect (Samman) as the foundational values of relationship
4. Understanding the meaning of Vishwas; Difference between intention and competence
5. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship
6. Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sahastitva as comprehensive Human Goals
7. Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha) from family to world family
8. Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

1. Understanding the harmony in the Nature

2. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature
3. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space
4. Holistic perception of harmony at all levels of existence
5. Practice Exercises and Case Studies will be taken up in Practice Sessions

UNIT 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
 2. Definitiveness of Ethical Human Conduct
 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
 4. Competence in professional ethics: Ability to utilize the professional competence for augmenting universal human order; Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems; Ability to identify and develop appropriate technologies and management patterns for above production systems.
 5. Case studies of typical holistic technologies, management models and production systems
 6. Strategy for transition from the present state to Universal Human Order: At the level of individual: as socially and ecologically responsible engineers, technologists and managers; At the level of society: as mutually enriching institutions and organizations
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COs Mapping with POs & PSOs (Three Level : 3-Strongly Related , 2-Moderate, 1-Slightly)

CSCA-501 Operating Systems

Course Outcomes

CO1 Understand the basics of operating systems like kernel, shell, types and views of operating systems

CO2 Describe the various CPU scheduling algorithms and remove deadlocks.

CO3 Explain various memory management techniques and concept of thrashing

CO4 Use disk management and disk scheduling algorithms for better utilization of external memory

CO5 Recognize file system interface, protection and security mechanisms.

CO6 Explain the various features of distributed OS like UNIX, Linux, windows etc.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1													
CO 2			1				3				3		
CO 3	2					1						1	
CO 4		3											
CO 5												2	
CO 6			3		3					1			2
Average	2.0	3.0	2.0	-	3.0	1.0	3.0	-	-	1.0	3.0	1.5	2.0

CSCA 503 Database Management System

Course Outcomes:

CO1: Describe the fundamental elements of relational database management systems

CO2: Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.

CO3: Design ER-models to represent simple database application scenarios

CO4: Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.

CO5: Improve the database design by normalization.

CO6: Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	1	1	1	1	-	1	1	1	-	2	2
CO 2	2	2	2	1	2	1	1	1	2	1	1	2	2
CO 3	2	2	2	1	2	1	1	1	2	1	1	2	2
CO 4	2	2	2	2	2	1	1	2	2	2	1	2	2
CO 5	2	3	2	2	2	1	2	2	2	2	2	2	2
CO 6	1	2	2	1	1	1	1	1	1	1	1	1	1
Average	1.66	2.0	1.8	1.33	1.66	1.0	1.0	1.33	1.66	1.33	1.0	1.83	1.83

CSCA-505 Analysis and Design of Algorithms

CO1 Explain the time and space complexity of the algorithm.

CO2 Describe elementary data structure like binary search tree, Red Black tree, binomial, B tree and Fibonacci heap.

CO3 Compare between design techniques of algorithm like Divide and Conquer, Dynamic algorithm, Greedy algorithm, backtracking and Amortized algorithm.

CO4 Demonstrate different graph traversal algorithm like BFS, DFS, Prim's, Kruskal's, single source shortest path and

all pair shortest path .

CO5 Examine different string matching algorithm like naïve string matching, robin-karp algorithm, kurth-morrispratt algorithm.

CO6 Distinguish between NP-hard and NP-completeness problem

	PO 1-	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	3	1	1	2	-	-	-	-	-	-	1	-	1
CO 2	3	1	2	1	1	-	-	1	-	-	2	-	2
CO 3	3	2	2	3	2	-	-	-	1	2	2	1	3
CO 4	3	2	2	2	1	-	-	-	-	1	1	1	2
CO 5	1	1	-	-	-	-	-	-	-	1	-	2	-
CO 6	1	-	-	-	-	-	-	-	-	1	-	1	-
Average	2.3	1.4	1.7	2.0	1.3	-	-	1.0	1.0	1.25	1.5	1.25	2.0

.CSCA 507 Intelligent Systems

Course Outcome

CO1: Define the various searching techniques, constraint satisfaction problem and example problems- game playing techniques.

CO2: Classify AI techniques in applications which involve perception, reasoning and learning

CO3: Demonstrate about AI techniques for knowledge representation, planning, uncertainty management and exploration methods.

CO4: Distinguish the knowledge of real world Knowledge representation, the modern view of AI as the study of agents that receive precepts from the environment and perform actions

CO5: Defend a real world problem for implementation and understand the dynamic behavior of a system.

CO6: Formulate the machine learning techniques to design AI machine and enveloping applications for real world problems.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	3	1	2	2	1	-	-	-	-	1	1	1	1
CO 2	3	2	1	2	1	-	-	-	-	-	3	1	1
CO 3	2	1	1	1	1	-	-	-	1	1	1	1	1
CO 4	1	2	-	1	1	-	-	-	-	1	1	1	1
CO 5	2	1	-	1	1	-	-	-	-	1	-	2	1
CO 6	2	1	2	1	1	-	-	-	-	1	-	1	2
Average	2.16	1.33	1.5	1.33	1.0	-	-	-	1.0	1.0	1.5	1.16	1.16

CSCA-509 Software Engineering

Course Outcome

CO1: How to apply the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment

CO2: An ability to work in one or more significant application domains

CO3: Work as an individual and as part of a multidisciplinary team to develop and deliver quality software

CO4: Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle

CO5: Demonstrate an ability to use the techniques and tools necessary for engineering practice

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	3	1	1	2	-	-	-	-	1	2	1	-	1
CO 2	3	1	2	1	1	-	-	1	-	-	2	-	2
CO 3	1	2	2	3	2	-	-	-	1	2	2	1	3
CO 4	3	2	2	2	1	-	-	-	-	1	1	1	2
CO 5	1	-	-	2	-	-	-	-	-	1	-	2	-
Average	2.2	1.5	1.75	2.0	1.33	-	-	1.0	1.0	1.5	1.5	1.33	2.0

CSCA 551 DBMS Lab.

Course Outcome

CO1: Infer database language commands to create simple database

CO2: Analyze the database using queries to retrieve records.

CO3: Applying PL/SQL for processing database.

CO4: Develop solutions for database applications.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	2	-	-	1	-	-	-	-	-	-	-	-
CO 2	2	2	1	2	2	2	-	-	-	-	-	1	2
CO 3	2	2	1	2	2	2	-	-	-	-	-	1	2
CO 4	2	2	3	2	2	2	-	1	1	-	2	3	2
Average	2.0	2.0	1.66	2.0	1.75	2.0	-	1.0	1.0	-	2.0	1.66	2.0

CSCA 553 Operating System Lab

Course Outcome

CO1: To apply the basic LINUX commands, process concepts and system calls.

CO2: To implement various CPU scheduling algorithm for a given problem

CO3: To implement the concepts of deadlock and multiprogramming system

CO4: To implement various page replacement algorithms.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	1	1	-	2	-	1	-	-	1	2	2	1
CO 2	2	1	2	-	-	1	-	-	1	-	-	3	-
CO 3	3	-	1	-	-	-	-	-	-	-	-	3	1
CO 4	3	2	1	-	-	3	-	1	2	1	1	2	2
Average	2.5	1.33	1.25	-	2.0	2.0	1.0	1.0	1.5	1.0	1.5	2.5	1.33

CSCA-502 Data Warehousing and Data Mining

CO1: Describe the basic concepts and techniques of Data Warehouse and Data Mining.

CO2: Demonstrate the gathering and analysis of large sets of data to gain useful business understanding.

CO3: Differentiate the data generalization and frequent pattern mining that can be discovered by association rule mining.

CO4: Explain the classification, clustering and prediction in Data mining.

CO5: Identify business applications and trends of data mining

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	1	1	–	–	1	–	–	2	1	–	1	1
CO 2	2	1	2	2	–	2	–	–	1	1	2	2	1
CO 3	2	2	1	2	2	1	–	–	1	1	2	2	2
CO 4	1	2	1	2	–	1	–	–	1	1	1	1	2
CO 5	2	2	2	1	–	1	–	–	1	1	1	2	1
Average	1.8	1.6	1.4	1.75	2.0	1.2	–	–	1.2	1.0	1.5	1.33	1.4

CSCA-504 Linux and X-Windows Programming

Course Outcomes

CO1: Students will be able to understand the basic commands of linux operating system and canwrite shell scripts

CO2: Students will be able to create file systems and directories and operate them

CO3: Students will be able to create processes background and fore ground etc. by fork() systemcalls

CO4: Students will be create shared memory segments, pipes, message queues and can exerciseinter-process communication

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	1	1	–	2	-	1	-	-	1	2	2	1
CO 2	2	1	2	-	1	1	-	-	1	-	-	3	–
CO 3	3	1	1	-	1	-	-	-	-	-	–	3	1
CO 4	3	2	1	–	1	3	-	1	2	1	1	2	2
Average	2.5	1.25	1.25	–	1.25	2.	1.0	1.0	1.5	1.0	1.5	2.5	1.33

CSCA 506 Java Programming and Website Design

Course Outcome

CO1: Identify classes, objects, members of a class and relationships among them needed for aspecific problem

CO2: Write Java application programs using OOP principles and proper program structuringCO3: Demonstrate the concepts of polymorphism and inheritance

CO4: Write Java programs to implement error handling techniques using exception handling

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	2											1	2	2
CO 2	1	2	1	1		2	1	2	2			1	1	2
CO 3	1	1	1	1		1	1	1	1			2	1	-
CO 4	2	2	2	2		1	2	1	2			2	2	2
Average	1.5	1.66	1.33	1.33	–	1.33	1.33	1.33	1.66	–	–	1.5	1.5	2.0

CSCA 508 Computer Networks

Course Outcomes

CO1: Recognize the technological trends of Computer Networking.

CO2: Discuss the key technological components of the Network.

CO3:Evaluate the challenges in building networks and solutions to those

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO 1	1	1	1	1	1	-	-	1	-	-	1	1	1	1
CO 2	1	2	1	2	2	-	-	1	-	-	1	2	1	2
CO 3	1	1	1	1	1	-	-	1	-	-	1	1	1	1
Average	1.0	1.33	1.0	1.33	1.33	-	-	1.0	-	-	1.0	1.33	1.0	1.33

CSCA 552 Java Programming Lab

Course Outcome

CO1: Identify classes, objects, members of a class and relationships among them needed for a specific problem

CO2: Write Java application programs using OOP principles and proper program structuring
CO3: Demonstrate the concepts of polymorphism and inheritance

CO4: Write Java programs to implement error handling techniques using exception handling

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	2											1	2	2
CO 2	1	2	1	1		2	1	2	2			1	1	2
CO 3	1	1	1	1		1	1	1	1			2	1	-
CO 4	2	2	2	2		1	2	1	2			2	2	2
Average	1.5	1.66	1.33	1.33	-	1.33	1.33	1.33	1.66	-	-	1.5	1.5	2.0

CSCA 554 Linux and Network Admin. Lab`

Course Outcome

CO1. Students will be able to understand the basic commands of Linux operating system and can write shell scripts

CO2 Students will be able to create file systems and directories and operate them

CO3 Students will be able to create processes background and fore ground etc...By fork () system calls SIS

CO4 Students will be create shared memory segments, pipes, message queues and can exercise interprocess communication

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	1	1	-	2	-	1	-	-	1	2	2	1
CO 2	2	1	2	-	1	1	-	-	1	-	-	3	-
CO 3	3	1	1	-	1	-	-	-	-	-	-	3	1
CO 4	3	2	1	-	1	3	-	1	2	1	1	2	2
Average	2.5	1.25	1.25	-	1.25	2.	1.0	1.0	1.5	1.0	1.5	2.5	1.33

CSCA-572 Project I

Course Outcome

CO1: Identify the topic in the relevant area of computer engineering.

CO2: Apply appropriate methodology to provide a solution to the chosen problem

CO3: Prepare a technical report effectively using modern tools.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	–	2	2	1	–	–	3	–	–	2	2
CO 2	1	1	–	2	2	1	–	–	2	–	–	2	2
CO3	1	1	–	2	2	1	–	–	2	–	–	2	2
Average	1.0	1.0	–	2.0	2.0	1.0	–	–	2.3	–	–	2.0	2.0

CSCA 601 Object Oriented Software Engineering

Course Outcomes

CO1: Interact with a “client” to elicit project requirements by developing and refining scenarios and use cases.

CO2: Extract an Object Model and Dynamic Model of system functionality and performance from the requirements.

CO3: Design and implement structured, robust, maintainable object-oriented systems across multiple platforms and appropriate programming languages from the specifications developed.

CO4: Develop teamwork and management skills to divide tasks and effectively develop projects in large software teams.

CO5: Research, evaluate and use various CASE tools for object-oriented software engineering

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	1	1	2	2	–	–	2	1	–	2	1	2
CO 2	2	1	2	2	1	–	–	2	1	–	1	1	2
CO 3	2	1	1	1	2	–	–	1	1	–	2	1	1
CO 4	2	1	2	1	1	–	–	2	1	–	1	2	2
CO5	2	2	2	1	2	–	–	1	1	–	2	1	1
Average	2.0	1.2	1.6	1.4	1.6	–	–	1.6	1.0	–	1.6	1.2	1.6

CSCA 603 Distributed Operating System

Course Outcomes

CO1: Understand the principles and desired properties of distributed systems on which the Internet and other distributed systems are based

CO2: Understand and apply the basic theoretical concepts and algorithms of distributed systems in problem solving

CO3: Recognize the inherent difficulties that arise due to distributed-ness of computing resources

CO4: Identify the challenges in developing distributed applications

CO5: Design a distributed system that fulfills requirements with regards to key distributed systems properties

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	1	-	-	-	-	-	1	1	1	-	1
CO 2	1	-	2	1	1	-	-	1	-	-	2	-	2
CO 3	1	2	2	3	2	-	-	-	-	2	2	1	3
CO 4	-	1	-	2	1	-	-	-	-	1	1	1	2
CO 5	-	-	2	-	-	-	-	-	-	1	-	2	-
Average	1.0	1.33	1.75	2.0	1.33	-	-	1.0	1.0	1.25	1.5	1.33	2.0

CSCA 605 Advanced DBMS

Course Outcome

CO1: Describe the fundamental elements of relational database management systems

CO2: Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.

CO3: Design ER-models to represent simple database application scenarios

CO4: Convert the ER-model to relational tables, populate relational database and formulate SQLqueries on data.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	1	-	1	-	1	-	-	1	1	1	1	2	2	2
CO 2	1	-	1	-	1	-	-	2	2	2	1	1	1	1
CO 3	1	-	1	-	2	-	-	1	1	1	2	1	1	-
CO 4	1	-	1	-	2	-	-	2	2	2	2	1	2	-
Average	1.0	-	1.0	-	1.5	-	-	1.5	1.5	1.5	1.5	1.25	1.5	1.5

CSCA 651 Object Oriented System Design Lab.

Course Outcome

CO1: To understand the basic concepts of the programming

CO2: To identify the principles of object-oriented problem solving and programming

CO3: Outline the essential features and elements of the C++ programming language.

CO4: The students will gain knowledge about Object Oriented Programming through C++.

CO5: Analyze, write, debug, and test basic C++ codes using the approaches introduced in the course.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	-	-	2	-	-	-	-	-	-	-	1
CO 2	1	-	-	-	-	-	-	-	-	-	1	1	1
CO 3	1	2	1	1	2	1	1	1	1	1	2	2	1
CO 4	1	1	1	1	1	1	2	2	2	2	2	2	-
CO 5	1	1	1	1	-	1	-	-	-	-	1	1	-
Average	1.0	1.25	1.0	1.0	1.66	1.0	1.5	1.5	1.5	1.5	1.5	1.5	1.0

UHV-111 Universal Human Values and Professional Ethics

Course Outcome:

On completion of this course, the students will be able to

CO1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society

CO2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.

CO3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society

CO4. Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.

CO5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	-	-	-	-	-	1	1	-	1	2	-	-	-
CO 2	-	-	-	-	-	2	2	-	1	2	-	-	-
CO 3	-	-	-	-	-	1	2	-	1	2	-	-	-
CO 4	-	-	-	-	-	1	2	-	1	2	-	-	-
CO 5	-	-	-	-	-	1	2	-	1	2	-	-	-
Average	-	-	-	-	-	1.2	1.8	-	1.0	2.0	-	-	-

CSCA 671 Project II

Course Outcome

CO1: Identify the topic in the relevant area of computer engineering.

CO2: Apply appropriate methodology to provide a solution to the chosen problem

CO3: Prepare a technical report effectively using modern tools.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	3	2	2	1	-	-	3	1	1	2	2
CO 2	1	1	3	2	2	1	-	-	2	1	1	2	2
CO3	1	1	3	2	2	1	-	-	2	1	1	2	2
Average	1.0	1.0	3.0	2.0	2.0	1.0	-	-	2.3	1.0	1.0	2.0	2.0

CSCA 604 Seminar and Progress Reports

Course Outcome:

CO1: Collect , Organize & Analyze information about emerging technologies /market demands /current trends.

CO2: Exhibit effective communication skills, stage courage, and confidence.

CO3 : Awareness & in keeping with new innovations and inventions.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	-	1	1	1	1	1	1	-	1	1	1
CO 2	1	1	-	-	1	1	3	-	1	1	1	-	-
CO 3	1	1	-	1	1	1	1	1	1	1	1	1	1
Average	1.0	1.0	-	1.0	1.0	1.0	1.6	1.0	1.0	1.0	1.0	1.0	1.0

AMCA-510 Application based Programming in Python

Course Outcome

CO1: Solve basic problems using Python built-in data types and their methods

CO2: Design an application with user-defined modules and packages using OOP concept

CO3: Employ efficient storage and data operations using NumPy arrays.

CO4: Apply powerful data manipulations using Pandas.

CO5: Do data preprocessing and visualization using Pandas

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	2	2	2	2	-	-	2	-	-	2	2	2
CO 2	2	2	2	2	2	-	-	1	-	-	1	1	1
CO 3	1	1	1	1	1	-	-	1	-	-	1	2	2
CO 4	2	2	2	2	2	-	-	2	-	-	2	1	1
CO 5	2	2	1	1	2	-	-	2	-	-	2	2	2
Average	1.8	1.8	1.6	1.6	1.8	-	-	1.6	-	-	1.6	1.6	1.6

AMCA-512 Introduction to Deep Learning

Course Outcome

CO1: Identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines

CO2: Apply Artificial Neural Network & Fuzzy Logic models to handle uncertainty and solve engineering problems.

CO3: Recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	2	2	2	2	–	–	2	–	–	2	2	2
CO 2	2	2	2	2	2	–	–	1	–	–	1	1	1
CO 3	1	1	1	1	1	–	–	1	–	–	1	2	2
Average	1.6	1.6	1.6	1.6	1.6	–	–	1.3	–	–	1.3	1.6	1.6

AMCA-607 Fuzzy Logic and Neural Network

Course Outcome

CO1: Comprehend the concept of feed forward neural network

CO2: Analyze the various feedback network

CO3: Understand the concept of fuzziness involved in various systems and fuzzy set theory

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	3	1	2	2	2	–	–	1	–	–	1	2	2
CO 2	2	2	1	2	2	–	–	1	–	–	1	1	1
CO 3	1	1	1	1	1	–	–	1	–	–	1	2	2
Average	2.0	1.3	1.3	1.6	1.6	–	–	1.0	–	–	1.0	1.6	1.6

AMCA-609 Digital Image Processing

Course Outcomes:

CO1: Understand the basic concepts of DIP.

CO2: Improve the quality of digital images.

CO3: Understand and De-noise Digital Images

CO4: Segment digital images and extract various features from digital images

CO5: Understand various image compression techniques and apply such techniques to compress digital images for reducing the sizes of digital images.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	1	1	1	–	–	2	–	–	1	1	1
CO 2	1	1	1	1	2	–	–	1	–	–	1	1	1
CO 3	1	1	1	1	1	–	–	1	–	–	1	2	2
CO 4	1	1	2	2	1	–	–	1	–	–	1	1	1
CO 5	2	2	1	1	2	–	–	1	–	–	2	1	1
Average	1.2	1.2	1.6	1.2	1.4	–	–	1.2	–	–	1.2	1.2	1.2

CSCA-510 Foundation of Cyber Security

Course outcomes:

Upon successful completion of the course, the students will have:

CO1 Reasonable understanding of the fundamentals of the cybersecurity domain and related issues

CO2 Practical knowledge of various tools, processes and methods to ensure security of systems through a minimum

of two hands-on assignments involving attack and protection in a virtual environment

CO3. An understanding of the inter-disciplinary nature of cyber security domain

CO4 Adequate level of cross-disciplinary knowledge of design, implementation, evaluation and testing of secure protocols, systems or applications

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	1	1	1	2	–	2	1	–	1	1	1
CO 2	1	1	1	1	1	2	–	1	1	–	1	1	1
CO 3	1	1	1	1	1	2	–	1	1	–	1	2	2
CO 4	1	1	1	2	1	–	–	1	1	–	1	1	1
Average	1.0	1.0	1.0	1.26	1.0	2.0	–	1.2	1.0	–	1.2	1.2	1.2

CSCA-512 Cyber Law and Ethics

Course Outcome:

CO1: To identify and describe the major types of cyber crime.

CO2: To identify cyber crime vulnerabilities and exploitations of the Internet.

CO3: To identify the four major cyber crimes vulnerability areas: a. physical security, personal security, communications security, and operations security.

CO4: Distinguish between various types of cybercrimes with respect to the motivations and methods of operation of offenders, the types of victims or targets, and the spatial, temporal, and legal domains in which they are carried out.

CO5: Identify various classifications of cybercrimes and cyber-criminals.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	1	1	1	2		2	1		1	1	1
CO 2	1	1	1	1	1	2		1	1		1	1	1
CO 3	1	1	1	1	1	2		1	1		1	2	2
CO 4	1	1	1	2	1			1	1		1	1	1
CO 5	1	1	1	1	1	1		–	1		1	1	1
Average	1.0	1.0	1.0	1.2	1.0	1.75		1.25	1.0		1.0	1.2	1.2

CSCA-607 Ethical Hacking

Course Outcomes:

CO 1. Understand the concepts of ethical hacking

CO 2. Understand the concepts of System hacking

CO 3 Perform TCP/IP and Port scanning

CO 4 Identify desktop and server OS vulnerabilities

CO 5 Describe on network protection systems

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	1	1	1	1	–	1	1	–	1	1	1
CO 2	1	1	1	1	1	1	–	1	1	–	1	1	1
CO 3	1	1	1	1	1	1	–	1	1	–	1	2	2
CO 4	1	1	1	–	1		–	2	1	–	1	1	1
CO 5	1	–	1	1	1	1	–	2	1	–	1	1	1
Average	1.0	1.0	1.0	1.0	1.0	1.0	–	1.4	1.0	–	1.0	1.2	1.2

CSCA-609 Intrusion Detection and Internet Security

Course Outcomes:

CO1: Understand the intrusion detection and prevention basics and approaches.

CO2: Understand the taxonomy of anomaly detection system

CO3: Understand the architecture and justification of intrusion detection.

CO4: Apply the intrusion detection applications.

CO5 Understand the legal issues and organizations standards

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	1	1	1	–	–	1	1	–	1	1	1
CO 2	1	1	1	1	1	–	–	1	1	–	1	1	1
CO 3	1	1	1	1	1	–	–	1	1	–	1	2	2
CO 4	1	1	1		1	–	–	2	1	–	1	1	1
CO 5	1	–	1	1	1	–	–	2	1	–	1	1	1
Average	1.0	1.0	1.0	1.0	1.0	–	–	1.4	1.0	–	1.0	1.2	1.2

DSCA-510 Python for Data Science

Course Outcome

CO1: Identify the need for data science and solve basic problems using Python built-in data types and their methods.

CO2: Design an application with user-defined modules and packages using OOP concept

CO3: Employ efficient storage and data operations using NumPy arrays.

CO4: Apply powerful data manipulations using Pandas

CO5: Do data preprocessing and visualization using Pandas

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	2	2	2	2	1	1	2	1	1	2	1	1
CO 2	2	2	2	2	2	1	1	1	1	1	1	1	1
CO 3	1	1	1	1	1	1	1	1	1	1	1	1	1
CO 4	2	2	2	2	2	1	1	2	1	1	2	1	1
CO 5	2	2	1	1	2	1	1	2	1	1	2	1	1
Average	1.8	1.8	1.8	1.6	1.8	1.0	1.0	1.6	1.0	1.0	1.6	1.0	1.0

DSCA-512 R for data science

Course Outcome

CO1. Understand the basics of Fundamentals of R.

CO2. Apply the loading, retrieval techniques of data.

CO3. Analysis of data through visualization

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	1	1	1	1	1	-	1	1	1	1	2	2
CO 2	2	2	2	1	2	1	1	1	2	1	1	2	2
CO 3	2	2	2	1	2	1	1	1	2	1	1	2	2
Average	2.0	1.66	1.66	1.0	1.66	1.0	1.0	1.0	1.66	1.0	1.0	2.0	2.0

DSCA-607 Big Data Analytics

Course Outcome

CO1: Describe the life cycle phases of Data Analytics through discovery, planning and building

CO2: Understand and apply Data Analysis Techniques.

CO3: Implement various Data streams.

CO4: Understand item sets, Clustering, frame works & Visualizations

CO5: Apply R tool for developing and evaluating real time applications

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	1	1	-	-	-	1	-	-	1	2	2
CO 2	2	2	2	1	-	-	-	1	-	-	1	2	2
CO 3	2	2	2	1	-	-	-	1	1	-	1	2	2
CO 4	2	2	2	2	-	-	-	2	1	-	2	2	2
CO 5	2	3	2	2	2	-	-	2	1	-	2	2	2
Average	1.8	2.0	1.8	1.4	2.0	-	-	1.4	1.0	-	1.4	2.0	2.0

DSCA-609 Information Visualization

Course Outcome

CO1: Understand basics of Data Visualization

CO2: Implement visualization of distributions

CO3: Write programs on visualization of time series, proportions & associations

CO4: Apply visualization on Trends and uncertainty

CO5: Explain principles of proportions

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	1	1	1	1	1	1	-	-	1	2	1
CO 2			1	1	1	1	1	1	-	-	1	2	1
CO 3	1	1	1		1	1	1	1	-	-	1	1	1
CO 4	2	2	1	2	1	1	1	2	-	1	1	1	1
CO 5	2	2	1	2	1	1	1	2	-	1	1	1	1
Average	1.2	1.2	1.0	1.2	1.0	1.0	1.0	1.4	-	1.0	1.0	1.4	1.0

CCCA-510 Introduction to Virtualization & Cloud Computing

Course Outcome

CO1: Understanding of Cloud Computing and Related Technologies

CO2: Appreciate the requirements of various service paradigms in Cloud Computing

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	1	1	1	-	-	1	-	1	1	2	2
CO 2			1	1	1	-	-	1	-	1	1	2	2
Average	1.0	1.0	1.0	1.0	1.0	-	-	1.0	-	1.0	1.0	2.0	2.0

CCCA-512 Cloud Computing Architecture

Course Outcome:

CO1: Design, Develop & Demonstrate real-world applications from the Cloud Computing

CO2: Understand the subtle architectural difference in Public and Private Clouds.

CO3: Appreciate the requirements of various service paradigms in Cloud Computing.

CO4: Describe the methods of processing multimedia elements and other information presentation concepts during multimedia communications.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	1	1	1	-	-	1	1	1	1	2	2
CO 2	-	-	1	1	1	-	-	1	-	-	1	1	2
CO 3	1	1	1	-	1	-	-	1	1	-	1	1	2
CO 4	2	2	1	2	1	-	-	2	1	-	1	2	2
Average	1.33	1.33	1.0	1.33	1.0	-	-	1.25	1.0	1.0	1.0	1.5	2.0

CCCA-607 Storage Technology Foundation

Course Outcome:

CO1: The evolution of storage and implementation models

CO2: Storage devices principles including structure.

CO3: Storage network design principles

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	1	1	1	1	-	-	1	1	1	1	2	1
CO 2	1	-	1	1	1	-	-	-	-	1	1	2	2
CO 3	2	1	1	-	1	-	-	1	1	1	1	2	1
Average	1.66	1.0	1.0	1.0	1.0	-	-	1.0	1.0	1.0	1.0	2.0	1.33

CCCA-609 Security in Cloud

Course Outcome:

CO1: Describe cloud security architectures from the perspectives of: providers, brokers, carriers, and auditors.

CO2: Describe a methodology for orchestrating a cloud ecosystem.

CO3: Understand how cloud computing changes the traditional enterprise security considerations compared to on-premise.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	1	1	1	1	1	-	1	1	-	1	1	1
CO 2	1	2	1	1	1	1	-	1	1	-	1	1	1
CO 3	2	1	1	1	1	1	-	1	1	-	1	1	-
Average	1.66	1.33	1.0	1.0	1.0	1.0	-	1.0	1.0	-	1.0	1.0	1.0

FDCA-510 Introduction to HTML, Bootstrap and CSS

Course Outcomes:

CO1: Building Strong expertise to develop front end application using HTML and CSS

CO2: To become proficient in Bootstrap concepts

CO3: To develop web pages based on Bootstrap

CO4: Create webpages that function using external data

CO5: Create visualizations in accordance with UI/UX theories.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	1	1	1	–	–	1	–	–	1	2	1
CO 2	–	–	1	1	1	–	–	1	–	–	1	2	1
CO 3	1	1	1	–	1	–	–	1	–	–	1	1	1
CO 4	2	2	1	2	1	–	–	2	–	–	1	1	1
CO 5	2	2	1	2	1	–	–	–	–	–	1	–	1
Average	1.5	1.5	1.0	1.5	1.0	–	–	1.25	–	–	1.0	1.5	1.0

FDCA-512 Programming with JavaScript

Course Outcomes:

CO1: To structure and implement HTML and CSS

CO2: To understand Client Server Technology

CO3: To analyses the web development practices

CO4: Create webpages that function using external data

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	2	2	2	1	–	–	–	1	1	1	2	1
CO 2	2	1	1	1	1	–	–	–	1	1	1	1	1
CO 3	1	1	1	–	1	–	–	–	1	1	1	2	1
CO 4	1	2	1	2	1	–	–	–	1	1	1	2	1
Average	1.5	1.5	1.2	1.66	1.0	–	–	–	1.0	1.0	1.0	2.33	1.0

FDCA-607 Node JS and MongoDB Development

Course Outcome:

CO1: Clearly understand the platform design choices that led to Node.js choosing an event loop and what this means for applications built on that foundation.

CO2: Understand the unique trade-offs present in event-driven programming.

CO3: Create Node.js modules and express code modularity in an application.

CO4: Understand the core flow control patterns in Node.js and know when it is appropriate to use callbacks, event emitters or streams.

CO5: To create and design database using Mongo DB

CO6: To analyze data deployed on Mongo DB database servers

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	2	2	1	1	–	–	1	–	–	2	2	2
CO 2	2	1	2	1	2	–	–	1	–	–	1	2	2
CO 3	1	1	1	1	1	–	–	1	–	–	1	1	1
CO 4	2	1	1	1	1	–	–	1	–	–	1	1	1
CO 5	1	1	1	1	1	–	–	1	–	–	1	–	–
CO 6	2	1	–	1	1	–	–	1	–	–	1	1	1
Average	1.5	1.16	1.4	1.0	1.16	–	–	1.0	–	–	1.16	1.4	1.4

FDCA-609 Angular JS Development

Course Outcomes:

CO1: Get familiar with client-side Angular framework.

CO2: Use various Angular features including directives, components, and services.

CO3: Implement a functional front-end web application using Angular.

CO4: Boost your hire ability through innovative and independent learning.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	2	2	2	2	1	–	–	–	1	1	1	2	2
CO 2	2	2	1	1	1	–	–	–	–	1	1	2	1
CO 3	1	1	1	–	1	–	–	–	–	1	1	1	2
CO 4	1	1	1	2	1	–	–	–	1	1	1	2	1
Average	1.5	1.5	1.25	1.66	1.0	–	–	–	1.0	1.0	1.0	1.75	1.5

CSCA 682 Dissertation

Course Outcome

CO1. Participate in the projects in industries during his or her industrial training.

CO2. Describe use of advanced tools and techniques encountered during industrial training and visit.

CO3. Interact with industrial personnel and follow engineering practices and discipline prescribed in industry.

CO4. Develop awareness about general workplace behavior and build interpersonal and team skills.

CO5. Prepare professional work reports and presentations.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	2	1	1	-	2	-	3	2	3	2	-	1	1
CO 2	2	2	1	-	2	-	3	1	3	2	-	1	1
CO 3	2	1	-	-	2	-	3	2	3	2	-	1	1
CO 4	2	1	–	-	2	-	3	1	3	2	-	1	1
CO 5	2	1	-	-	2	-	3	–	3	2	-	1	1
Average	2.0	1.2	1.0	-	2.0	-	3.0	1.5	3	2	-	1.0	1.0

CSCA 684 Seminar and Progress Reports

Course Outcome:

CO1: Collect , Organize & Analyze information about emerging technologies /market demands /current trends.

CO2: Exhibit effective communication skills, stage courage, and confidence.

CO3 : Awareness & in keeping with new innovations and inventions.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO 1	1	1	–	1	1	1	1	1	1	–	1	1	1
CO 2	1	1	–	–	1	1	3	–	1	1	1	–	–
CO 3	1	1	–	1	1	1	1	1	1	1	1	1	1
Average	1.0	1.0	–	1.0	1.0	1.0	1.6	1.0	1.0	1.0	1.0	1.0	1.0