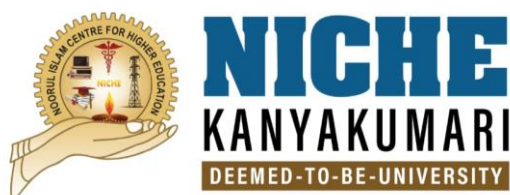


NOORUL ISLAM CENTRE FOR HIGHER EDUCATION

(Deemed to be University Under Section 3 of the UGC Act, 1956)
Kumaracoil, Thuckalay

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING



M.E. COMPUTER SCIENCE AND ENGINEERING **CURRICULUM AND SYLLABI**

REGULATION 2023

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION, Kumaracoil

Regulation : 2023

Curriculum and Syllabi

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

M.E. COMPUTER SCIENCE AND ENGINEERING

Vision of the University

To be recognized by the Government and society at large as an institution able to deliver excellence with relevance in the field of higher education and research focusing on the needs of the nation in tune with the technological revolution to cope with the knowledge explosion and global competence.

Mission of the University

To develop the institution as a Centre of Excellence, keeping pace with the advances in the field, so as to provide quality higher education to the students and instill in them high standards of discipline and ethics so that they become enlightened individuals in the service of humanity and to carry out focused research in the frontier areas of science and technology.

Faculty of Information and Computer Engineering

Department of Computer Science and Engineering

Vision of the Department

To offer the most conducive environment for quality academic and research oriented undergraduate and postgraduate education in computer science and engineering and prepare the students for a globalized technological society and orient them towards serving the society.

Mission of the Department

- Impart high quality professional training at the undergraduate and postgraduate level with an emphasis on basic principles of computer science and engineering.
- Empower the students with the required skills to solve the complex technological problems of modern society and also provide them with a framework for promoting collaborative and multidisciplinary activities.
- Conduct research to advance the state of the art in computer science and integrate research results and innovations into other scientific disciplines.

Description of the programme

Master of Engineering in Computer Science and Engineering is a 2-year program that includes all the advanced theoretical and technical aspects of computer science, engineering, and architecture. This involves programming and also more advanced topics like Cloud computing,

data science, artificial intelligence, cybersecurity, and IoT. The curriculum and syllabus are on par with the best universities in the country.

Master of Engineering in Computer Science and Engineering prepares the students for research activities and for the role of teacher. The field of computer science and engineering prioritizes computer design and software development, with a heavier emphasis on computing theory, emanating to a greater focus on cybersecurity, algorithms, and computer networks.

Students completing this computer science and engineering degree can pursue Research work , take job as computer systems analysts, helping to build and maintain complex technological systems. The job profiles are Software Developer, System Designer, Software Engineer Research Analyst, and the highly paid job profiles like Data Scientist and Machine Learning experts are on the rise.

Programme Educational Objectives - PEO	
PEO-01	Graduates can develop proficiency as a computer science engineer with an ability to solve a wide range of computational problems and have sustainable development in industry or any other work environment.
PEO-02	Graduates can analyze and adapt quickly to new environments and technologies, gather new information, and work on emerging technologies to solve multidisciplinary engineering problems.
PEO-03	Graduates can possess the ability to think analytically and logically to understand technical problems with computational systems for a lifelong learning which leads to pursuing research
PEO-04	Graduates can adopt ethical practices to collaborate with team members and team leaders to build technology with cutting-edge technical solutions for computing systems
PEO-05	Graduates can strongly focus on design thinking and critical analysis to create innovative products and become entrepreneurs.

Graduate Attributes-GA	
GA-1	Advanced Engineering Expertise Master advanced engineering principles and apply them to design, analyze, and innovate systems that address both present and emerging global challenges across diverse industries.
GA-2	Leadership in Research and Innovation Lead groundbreaking research and foster innovation by identifying opportunities for technological advancements, contributing original ideas that push the boundaries of engineering knowledge.
GA-3	Sustainable Engineering Practices Develop and implement engineering solutions that integrate sustainability, environmental stewardship, and resource efficiency, ensuring the long-term impact and responsibility of all projects.
GA-4	Ethical and Strategic Decision-Making Make informed, ethical decisions in complex engineering contexts, considering societal needs, environmental implications, and the long-term consequences of engineering practices.
GA-5	Global Competence in Engineering Solutions Exhibit a deep understanding of global engineering standards and practices, addressing international challenges and cultural sensitivities in engineering projects to make a broader societal impact.
GA-6	Technological Agility and Lifelong Learning Stay ahead of technological trends and exhibit agility in learning new tools, methodologies, and technologies, ensuring continuous professional growth in a rapidly evolving engineering landscape.
GA-7	Interdisciplinary and Collaborative Innovation Excel in multidisciplinary collaborations, leveraging knowledge from multiple fields to solve complex, large-scale engineering problems that require comprehensive and innovative solutions.
GA-8	Data-Driven Decision Making Employ advanced data analytics, machine learning, and computational tools to derive insights and make informed engineering decisions that improve
GA-9	Entrepreneurial Mindset and Innovation Leadership Cultivate an entrepreneurial mindset, translating engineering innovations into viable products, solutions, or services, and leading teams toward commercialization and societal impact.
GA-10	Safety, Risk, and Crisis Management Implement and manage advanced safety protocols and risk mitigation strategies to protect individuals, communities, and ecosystems in engineering practices, particularly in high-stakes and crisis environments.

Programme Outcome – POs

Programme Outcome – PO	
PO-A	Apply the knowledge of mathematical foundations and computer science & engineering concepts to solve complex problems related to design, development, testing and maintenance of computing systems.
PO-B	Ability to identify, formulate and analyze complex problems in computer based applications.
PO-C	Manage effectively on teams to accomplish a common goal.
PO-D	Apply professional ethics and agree to the norms or responsibilities in engineering practice of computer science.
PO-E	Communicate effectively and prepare technical documents and oral presentations.
PO-F	Ability to use current techniques, skills and state-of-art tools for computing system.
PO-G	Ability to apply design and development principles in the construction of software systems and in the allied engineering application domains.

Mapping of Graduate Attributes and Programme Educational Objectives(PEO)

GAs \ PEOs	G A-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10
PEO-01	H	A	H	A	A	A	A	A	A	A
PEO-02	A	A	A	A	H	A	H	A	A	A
PEO-03	A	A	A	A	H	A	A	A	A	A
PEO-04	H	A	A	A	H	A	A	H	A	A
PEO-05	H	A	A	A	H	H	A	H	H	A

H- Highly Associated

A- Associated

Not – Not Associated

Mapping of Graduate Attributes and Programme Outcomes (PO)

GAs POs	G A-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10
PO-A	H	A	H	A	A	A	A	A	A	A
PO-B	H	A	A	A	A	A	A	A	H	A
PO-C	A	A	A	A	A	H	H	H	A	A
PO-D	A	A	A	H	A	A	A	H	A	A
PO-E	A	A	A	A	A	A	A	A	A	A
PO-F	H	A	A	A	A	A	A	A	H	A
PO-G	A	H	H	A	A	A	A	A	A	A

H- Highly Associated

A- Associated

Not – Not Associated

Mapping of Programme Educational Objective (PEOs) and Programme Outcomes (POs)

PEO PO	PEO-01	PEO-02	PEO-03	PEO-04	PEO-05
PO-A	H	H	A	A	A
PO-B	H	H	H	A	A
PO-C	A	A	A	H	H
PO-D	A	A	A	A	A
PO-E	A	A	A	A	A
PO-F	A	H	A	H	A
PO-G	A	H	A	A	H

H- Highly Associated

A- Associated

Not – Not Associated

Duration of the programme: 2 Years/4 Semesters

Total credit : 66

Semester	I	II	III	IV	Total
Total Credits	20	20	10	16	66

CURRICULUM & SYLLABI

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MA4504	Applied Probability and Statistics	4	1	0	4
2.	CS4501	Advanced Data Structures & Algorithms	3	0	0	3
3.	CS4502	Advanced Operating Systems	3	0	0	3
4.	PEC	Elective – I	3	0	0	3
5.	PEC	Elective – II	3	0	0	3
6.	OE45D1	Research Methodology and IPR	2	0	0	2
PRACTICAL						
7.	CS4571	Advanced Data Structures and Algorithms Laboratory	0	0	4	2
Total Credits						20

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CS4503	Principles of Data Science	3	0	0	3
2.	CS4504	Cloud Computing Tools And Techniques	3	0	0	3
3.	CS4505	Advanced Database Management System	3	0	0	3
4.	CS4506	Agile Software Development	3	0	0	3
5.	PEC	Elective – III	3	0	0	3
6.	PEC	Elective – IV	3	0	0	3
PRACTICAL						
7.	CS4572	Cloud Computing Laboratory	0	0	4	2
Total Credits						20

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PEC	Elective V	3	0	0	3
2.	OEC	Open Elective-I	3	0	0	3
PRACTICAL						
1.	CS45P1	Project Phase – I	0	0	8	4
Total Credits						10

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	CS45P5	Project Phase – II	0	0	32	16
Total Credits						16

PROFESSIONAL ELECTIVE COURSES

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
Elective – I						
1.	CS45A1	Foundations of Human Computer Interaction	3	0	0	3
2.	CS45A2	Data Preparation and Analysis	3	0	0	3
3.	CS45A3	Fundamentals of Digital Image Processing	3	0	0	3
4.	CS45A4	Security Practices Algorithm	3	0	0	3
5.	CS45A5	Cellular Communications	3	0	0	3
Elective – II						
1.	CS45A6	Machine Learning	3	0	0	3
2.	CS45A7	Data Storage Technologies and Networks	3	0	0	3
3.	CS45A8	Mobile and Pervasive Computing Techniques	3	0	0	3

4.	CS45A9	Software Quality Assurance	3	0	0	3
5.	CS45B1	Android Application Development	3	0	0	3
Elective – III						
1.	CS45B2	Data Visualization	3	0	0	3
2.	CS45B3	Big Data Mining and Analytics	3	0	0	3
3.	CS45B4	Data Warehousing and Mining	3	0	0	3
4.	CS45B5	Social Network Analysis	3	0	0	3
5.	CS45B6	Virtualization Techniques	3	0	0	3
Elective – IV,V						
1.	CS45B7	Internet of Things	3	0	0	3
2.	CS45B8	Web Design and Management	3	0	0	3
3.	CS45B9	Database Administration and Tuning	3	0	0	3
4.	CS45C1	Information Retrieval Techniques	3	0	0	3
5.	CS45C2	Service Oriented Architecture & Design	3	0	0	3
6.	CS45C3	Ethical Hacking	3	0	0	3

OPEN ELECTIVE COURSES

Sl.No.	SUBJECT CODE	SUBJECT NAME	L	T	P	C
1.	OE45D1	Research Methodology and IPR	2	0	0	2
2.	OE45D2	Business Analytics	3	0	0	3
3.	OE45D3	Industrial Safety	3	0	0	3
4.	OE45D4	Operations Research	3	0	0	3
5.	OE45D5	Composite Materials	3	0	0	3
6.	OE45D6	Waste to Energy	3	0	0	3

SEMESTER - I

MA4504	APPLIED PROBABILITY AND STATISTICS	L	T	P	C
		4	1	0	4

OBJECTIVE:

To encourage students to develop knowledge in the concepts of probability and random variables. To apply the small and large sample tests and solve problems through testing of hypothesis. To enable the students to understand the properties of standard distributions and solve simulation problems.

Subject Code:		Subject Name: APPLIED PROBABILITY AND STATISTICS	
Course Outcome – COs		Cognitive Skill	
At the end of the course students should be able to,			
CO-01	Use the ideas of probability and random variables in solving engineering problems. To apply Baye's theorem and to find the moments and moment generating functions	R, U, A, E, An	
CO-02	Gather knowledge of the standard distributions such as binomial, poisson and normal distribution. To understand the functions of random variable and apply central limit theorem	R, U, A, E, An	
CO-03	Be familiar with some of the commonly encountered two dimensional random variables and to obtain Marginal and conditional distributions . Also to find the regression curve and correlation between variables	R, U, A, E, An	
CO-04	Use statistical tests in testing hypotheses on data. To know the type I and type II errors and to analyse small and large samples using tests based on normal, t, Chi square and F distributions for testing of mean , variance and proportions	R, U, A, E, An	
CO-05	Understand the types of simulation such as discrete event simulation and stochastic simulation. Apply Monte Carlo simulation techniques and generation random numbers using congruent method .	R, U, A, E, An	

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L
CO-01	S	M	S	M	S	S	S	L	M	L	L	M

CS4501	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the usage of algorithms in computing.
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications.
- To select and design data structures and algorithms that is appropriate for problems.
- To study about NP Completeness of problems.

Subject Code: CS45C01		Subject Name: Advanced Data Structures and Algorithms	
Course Outcome – Cos			Cognitive Skill
At the end of the course students should be able to,			
CO-01	Design data structures and algorithms to solve computing problems		R, U
CO-02	Design advance data structure using Non-Linear data structure.		U, An
CO-03	Design algorithms using graph structure and various string-matching algorithms to solve real-life problems		U, A, S
CO-04	Apply suitable design strategy for problem solving		U, A
CO-05	Have a basic ability to analyze algorithms and to determine algorithm correctness and time efficiency		U, A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	S	S	M	M	M	M	S
CO-02	S	S	M	M	M	S	M
CO-03	S	S	M	M	M	S	L
CO-04	S	S	M	M	M	L	L
CO-05	S	S	M	M	M	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I ROLE OF ALGORITHMS IN COMPUTING & COMPLEXITY ANALYSIS 9

Algorithms – Algorithms as a Technology -Time and Space complexity of algorithms- Asymptotic Analysis-Average and worst-case analysis-Asymptotic Notation-Importance of efficient algorithms- Program performance measurement - Recurrences: The Substitution Method – The Recursion-Tree Method- Data structures and algorithms.

UNIT II TREES AND GRAPHS 9

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion-B-Trees: Definition of Btrees – Basic operations on B-Trees – Deleting a key from a B-Tree- Fibonacci Heaps: structure – Mergeable-heap operations- Elementary Graph Algorithms: Representations of Graphs- Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm- Single-Source Shortest paths in Directed Acyclic Graphs

UNIT III MULTIMEDIA STRUCTURES 9

Segment Trees – k-d Trees: Node structure – 2-D trees – insertion - deletion – Point Quad Trees: insertion – deletion - Expanded Node Type– Range Searches – MX-Quad Trees: Range Queries – R-Trees – TV-Trees: Node Structure –Search - Insertion – Deletion - Extending and contracting.

UNIT IV ALGORITHMIC PARADIGM 9

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem – Elements of the Greedy Strategy- Huffman Codes.

UNIT V COMPLEXITY CLASSES 9

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems.

TOTAL: 45 PERIODS

REFERENCES

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms, Pearson Education, Reprint 2006.
2. Robert Sedgewick and Kevin Wayne, Algorithms, Fourth Edition, Pearson Education, March 2011
3. S.Sridhar, Design and Analysis of Algorithms, First Edition, Oxford University Press. 2014.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, Third Edition, Prentice-Hall, 2011.

CS4502	ADVANCED OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of distributed systems
- To get an insight into the various issues and solutions in distributed operating systems
- To learn about mobile and real-time operating systems

- To gain knowledge on the design concepts of mainframe operating systems

Subject Code: CS4502		Subject Name: Advanced Operating Systems	
Course Outcome – COs			Cognitive Skill
At the end of the course students should be able to,			
CO-01	Understand and explore the working of Theoretical Foundations of OS.		U, R
CO-02	Analyze the working principles of Distributed Deadlock Detection and resource management		A
CO-03	Understand the concepts of distributed shared memory and scheduling mechanisms		E, S
CO-04	Remember and analyze the concepts of Real Time Operating System and analyzing its role in mobile applications.		R, An
CO-05	Remember mainframe concepts and application of z/OS.		R

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	M	S	M	M	M	L	M
CO-02	S	S	M	M	M	L	M
CO-03	S	S	M	M	M	L	M
CO-04	S	S	M	M	L	L	M
CO-05	S	L	M	M	L	L	M

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT-I INTRODUCTION

9

Architectures of Distributed Systems - System Architecture types - issues in distributed operating systems - communication networks – communication primitives. Theoretical Foundations – inherent limitations of a distributed system – Lamport's logical clocks – vector clocks – causal ordering of messages – global state – cuts of a distributed computation – termination detection. Distributed Mutual Exclusion – introduction – the classification of mutual exclusion and associated algorithms – a comparative performance analysis.

UNIT-II DISTRIBUTED DEADLOCK DETECTION AND RESOURCE MANAGEMENT 9

Distributed Deadlock Detection -Introduction - deadlock handling strategies in distributed systems – issues in deadlock detection and resolution – control organizations for distributed deadlock detection – centralized and distributed deadlock detection algorithms –hierarchical deadlock detection algorithms. Agreement protocols – introduction-the system model, a classification of agreement problems, solutions to the Byzantine agreement problem, applications of agreement algorithms. Distributed resource management: introduction-architecture – mechanism for building distributed file systems – design issues – log structured file systems.

UNIT-III DISTRIBUTED SHARED MEMORY AND SCHEDULING 9

Distributed shared memory-Architecture– algorithms for implementing DSM – memory coherence and protocols – design issues. Distributed Scheduling – introduction – issues in load distributing – components of a load distributing algorithm – stability – load distributing algorithms – performance comparison – selecting a suitable load sharing algorithm – requirements for load distributing –task migration and associated issues. Failure Recovery and Fault tolerance: introduction– basic concepts – classification of failures – backward and forward error recovery, backward error recovery- recovery in concurrent systems – consistent set of checkpoints – synchronous and asynchronous check pointing and recovery – check pointing for distributed database systems recovery in replicated distributed databases.

UNIT-IV MOBILE AND REAL TIME OPERATING SYSTEMS 9

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

UNIT-V MAINFRAME AND LINUX OPERATING SYSTEMS 9

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

TOTAL: 45 PERIODS

REFERENCES

1. Mukesh Singhal, Niranjana Shivaratri, Advanced Concepts in Operating Systems Distributed, Database and Multiprocessor Operating Systems, Tata McGraw-Hill, 2001.
2. Rajib Mall, Real-Time Systems: Theory and Practice, Prentice Hall, 2006.
3. Mike Ebberts, John Kettner, Wayne OBrien, Bill Ogden, Introduction to the New Mainframe: z/OS Basics, Third Edition, International Business Machines Corporation, 2011.
4. Andrew S.Tanenbaum, "Modern operating system", PHI, 2003
5. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts, Wiley, Eighth edition, 2008.

CS4571	ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To acquire the knowledge of using advanced tree structures
- To learn the usage of heap structures
- To understand the usage of graph structures and spanning trees
- To understand the problems such as matrix chain multiplication, activity selection and Huffman coding
- To understand the necessary mathematical abstraction to solve problems.

Subject Code:CS4571		Subject Name: Advanced Data Structures & Algorithms Laboratory	
Course Outcome – COs			Cognitive Skill
At the end of the course students should be able to,			
CO-01	Design and implement basic and advanced data structures extensively		U
CO-02	Design algorithms using graph structures		A
CO-03	Design and develop efficient algorithms with minimum complexity using design techniques.		An
CO-04	Develop programs using various algorithms.		E
CO-05	Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.		A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	S	S	M	M	L	M	L
CO-02	S	S	M	M	L	L	L
CO-03	S	S	M	M	L	L	M
CO-04	S	S	M	M	L	L	M
CO-05	S	S	M	M	L	L	S

S-Strong, M-Medium, L-Low, N-Not relevant

LIST OF EXPERIMENTS

(Implement the following using any High-level language)

1. Implementation of recursive function for tree traversal and Fibonacci
2. Implementation of iteration function for tree traversal and Fibonacci
3. Implementation of Merge Sort and Quick Sort
4. Implementation of a Binary Search Tree
5. Red-Black Tree Implementation
6. Heap Implementation
7. Fibonacci Heap Implementation
8. Graph Traversals
9. Spanning Tree Implementation
10. Shortest Path Algorithms (Dijkstra's algorithm, Bellman Ford Algorithm)
11. Implementation of Matrix Chain Multiplication
12. Activity Selection and Huffman Coding Implementation

TOTAL: 45 PERIODS

SEMESTER - II

CS4503	PRINCIPLES OF DATA SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- Building the fundamentals of data science.
- Gaining practical experience in programming tools for data sciences
- Empowering students with tools and techniques used in data science

Subject Code: CS4503		Subject Name: Principles of Data Science	
Course Outcome – COs		Cognitive Skill	
At the end of the course students should be able to,			
CO-01	Understand the Evolution and Applications of Data Science	U	
CO-02	Apply data collection and pre-processing techniques	A	
CO-03	Analyze EDA, inference and regression techniques	An	
CO-04	Utilize Model Evaluation using Visualization techniques	U	
CO-05	Analyze the regression techniques in Model Evaluation	An	

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO -B	PO -C	PO -D	PO -E	PO -F	PO -G
CO-01	M	M	M	M	S	M	M
CO-02	S	L	M	M	S	L	L
CO-03	S	M	M	M	S	M	L
CO-04	S	M	M	M	S	M	M
CO-05	M	M	M	M	S	M	M

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT – I: INTRODUCTION TO DATA SCIENCE

9

Data science process – roles, stages in data science project – working with data from files – working with relational databases – exploring data – managing data – cleaning and sampling for modelling and validation – introduction to NoSQL.

UNIT – II: DATA PRE-PROCESSING

9

Data Collection Strategies – Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.

UNIT – III: INTRODUCTION TO R

9

Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames – reading data from files - Descriptive Statistics – Mean, Standard Deviation - manipulating objects – data distribution.

UNIT – IV: MODELING METHODS

9

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

UNIT – V: VALIDATION & VISUALIZATION

9

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

REFERENCES

1. Jojo Moolayil, “Smarter Decisions : The Intersection of IoT and Data Science”, PACKT, 2016.
2. Cathy O’Neil and Rachel Schutt , “Doing Data Science”, O’Reilly, 2015.

3. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big data Analytics”, EMC 2013
4. Raj, Pethuru, “Handbook of Research on Cloud Infrastructures for Big Data Analytics”, IGI Global.
5. Nina Zumel, John Mount, “Practical Data Science with R”, Manning Publications, 2014.
6. W. N. Venables, D. M. Smith and the R Core Team, “An Introduction to R”, 2013.

CS4504	CLOUD COMPUTING TOOLS AND TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- This course gives students an insight into the basics of cloud computing along with virtualization,
- Cloud computing is one of the fastest growing domain from a while now. It provide the architectural insights and limitations in cloud.
- Provides basic understanding about cloud and virtualization along with it how one can migrate over it.

Subject Code:CS4504		Subject Name: Cloud Computing Tools and Techniques	
Course Outcome – COs			Cognitive Skill
At the end of the course students should be able to,			
CO-01	Understand the basics of cloud computing along with virtualization.	U	
CO-02	Analyze the cloud insights, benefits and limitations of cloud computing.	An	
CO-03	Evaluate the Cloud Architecture- Layers and Models	E	
CO-04	Understand and Apply the different cloud simulators.	U,A	
CO-05	Analyze the working of VMWare Simulators.	An	

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	M	L	S	L	S	S	L
CO-02	N	S	L	S	M	N	M

CO-03	S	M	S	S	S	S	S
CO-04	S	S	L	M	L	N	S
CO-05	M	N	S	S	S	N	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I: CLOUD COMPUTING OVERVIEW

9

Origins of Cloud computing – Cloud components - Essential characteristics – On-demand self service, Broad network access, Location independent resource pooling ,Rapid elasticity , Measured service, Comparing cloud providers with traditional IT service providers, Roots of cloud computing.

UNIT II: CLOUD ARCHITECTURE- LAYERS AND MODELS

9

Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption. Cloud deployment model: Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing.

UNIT III: VIRTUALIZATION

9

Virtualization and cloud computing – Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations – Types of virtualization – Virtualization tools

UNIT IV: CLOUD SIMULATORS- CLOUDSIM AND GREENCLOUD

9

Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture(User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to GreenCloud

UNIT V: INTRODUCTION TO VMWARE SIMULATOR

9

Basics of VMWare, advantages of VMware virtualization, using VMware workstation, creating virtual machines-understanding virtual machines, create a new virtual machine on local host, cloning virtual machines, virtualize a physical machine, starting and stopping a virtual machine.

TOTAL: 45 PERIODS

REFERENCES

1. Anthony T.Velte , Toby J. Velte Robert,Elsenpeter Cloud computing a practical approach , TATA McGraw- Hill , New Delhi – 2010
2. Michael Miller - Que ,Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - 2008
3. Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Cloud computing for Dummies- Wiley Publishing, Inc, 2010
4. Rajkumar Buyya, James Broberg, Andrzej Goscinski, John , Cloud Computing (Principles and Paradigms), Edited by Wiley & Sons, Inc. 2011

CS4505	ADVANCED DATABASE MANAGEMENT SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic concepts and terminology related to DBMS and Relational Database Design.
- To the design and implement Distributed Databases.
- To understand advanced DBMS techniques to construct tables and write effective queries, forms, and reports

Subject Code: CS4505		Subject Name: Advanced Database Management System	
Course Outcome – COs			Cognitive Skill
CO-01	Understand the basics of DBMS and Relational Database Design.	U	
CO-02	Analyze the normalization and query processing techniques	An	
CO-03	Evaluate the complex queries including full outer joins, self-join, sub queries, and set theoretic queries.	E	
CO-04	Understand and Apply the concurrency control and locking protocols	U,A	
CO-05	Analyze the file organization, Query Optimization, Transaction management, and database administration techniques	An	

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	S	L	S	L	M	M	S
CO-02	S	L	S	L	L	N	S
CO-03	S	S	S	S	S	L	N
CO-04	S	M	S	M	S	S	S
CO-05	S	L	S	M	S	S	S

S- Strong, M-Medium,L-Low,N-Not relevant

UNIT I PARALLEL AND DISTRIBUTED DATABASES**9**

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems- Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Case Studies.

UNIT II DECOMPOSITION AND NORMALIZATION**9**

3NF and BCNF, Decomposition and synthesis approaches, Review of SQL99, Basics of query processing, external sorting, file scans- Relational Systems: Object Relational features in SQL/Oracle – Case Studies.

UNIT III DATABASE TRANSACTIONS**9**

Processing of joins, materialized vs. pipelined processing, query transformation rules, DB transactions, ACID properties, interleaved executions, schedules, serialisability

UNIT IV DEADLOCKS**9**

Correctness of interleaved execution, Locking and management of locks, 2PL, deadlocks, multiple level granularity, CC on B+ trees, Optimistic CC

UNIT V DYNAMIC DATABASES AND XML**9**

I/O based techniques, Multiversion approaches, Comparison of CC methods, dynamic databases, Failure classification, recovery algorithm, XML and relational databases

TOTAL: 45 PERIODS**References**

1. R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004
2. A. Silberschatz, H. Korth, S. Sudarshan, Database system concepts, 5/e, McGraw Hill, 2008.
3. K. V. Iyer, Lecture notes available as PDF file for classroom use.

CS4506	AGILE SOFTWARE DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamental principles and practices associated with each of the agile development methods
- To apply the principles and practices of agile software development on a project of interest and relevance to the student.

- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand Agile development and testing

Subject Code:CS4506		Subject Name: AGILE SOFTWARE DEVELOPMENT	
Course Outcome – Cos		Cognitive Skill	
CO-01	Understand the fundamental principles and practices associated with each of the agile development methods	R,U	
CO-02	Apply a thorough understanding of Agile scrum principles and specific practices	U,A	
CO-03	Analyze various testing in agile software development	An	
CO-04	Evaluate various agile software design principles	E	
CO-05	Apply and analyze agile methodology for recent trends	A, An	

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	S	M	S	S	M	M	L
CO-02	M	S	S	S	M	L	N
CO-03	L	M	S	S	S	M	L
CO-04	S	L	S	S	M	M	M
CO-05	M	S	S	S	M	M	L

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I AGILE FUNDAMENTALS

9

Theories for Agile Management –Traditional Model vs. Agile Model – Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams – Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values

UNIT II AGILE SCRUM PRINCIPLES

9

Agile Manifesto, Twelve Practices of XP, Scrum Practices, Applying Scrum. Need of scrum,

working of scrum, advanced Scrum Applications, Scrum and the Organization, scrum values. Daily scrum, Scrum roles – Product Owner, Scrum Master, Scrum Team, Scrum case study, Tools for Agile project management

UNIT III AGILITY AND QUALITY ASSURANCE

9

User Stories, Backlog Management. Agile Architecture: Feature Driven Development. Agile Risk Management: Risk and Quality Assurance, Agile Tools. Agile Testing Techniques, Test-Driven Development-Pair programming: Issues and Challenges - Agile approach to Global Software Development.

UNIT IV AGILE SOFTWARE DESIGN AND DEVELOPMENT

9

Agile design practices - Role of design Principles - Single Responsibility Principle, - Open Closed Principle - Liskov Substitution Principle - Interface Segregation Principles - Dependency Inversion Principle in Agile Design - Need and significance of Refactoring - Refactoring Techniques - Continuous Integration - Automated build tools - Version control.

UNIT V SCALING AGILE FOR LARGE PROJECTS

9

Market scenario and adoption of Agile - Agile ALM - Roles in an Agile project - Agile Metrics and Measurements - Agile Control: the 7 control parameters. Agile approach to Risk - Agile approach to Configuration Management - Agile projects on Cloud - Balancing Agility with Discipline - Agile rapid development technologies.

TOTAL: 45 PERIODS

TEXT BOOKS

1. David J. Anderson and Eli Schragenheim, Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.
2. Hazza and Dubinsky, Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.

REFERENCES

1. Robert C. Martin ,Agile Software Development, Principles, Patterns, and Practices Alan Apt Series (2011)
2. Succeeding with Agile : Software Development Using Scrum, Pearson (2010)
3. David J. Anderson and Eli Schragenheim, “Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003.
4. Hazza and Dubinsky, “Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.
5. Craig Larman, “Agile and Iterative Development: A Managers Guide, Addison-Wesley, 2004.
6. Kevin C. Desouza, “Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.
7. Andrew stellman, Jennifer Green, Head first Agile, O'Reilly, 2017.
8. Rubin K , Essential Scrum : A practical guide to the most popular Agile process, Addison-Wesley, 2013.
9. Andrew Stellman, Jill Alison Hart, Learning Agile, O'Reilly, 2015 E-Books and Online learning material

CS4572	CLOUD COMPUTING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- Understand the design challenges in the cloud.
- Understand the security design and architectural considerations for Cloud
- Understand the Identity, Access control in Cloud
- Able to monitor and audit cloud applications for security

Subject Code: CS4572		Subject Name: Cloud Computing Laboratory	
Course Outcome – Cos		Cognitive Skill	
The students will be able to,			
CO-01	Understand the installation of Hypervisors and its types. Also understand how to create virtual machines with guest OS.	U, A	
CO-02	Develop and deploy services on the cloud and set up a cloud environment.	A, E	
CO-03	Apply the security challenges in the cloud.	A	
CO-04	Experience cloud policy and Identity and Access Management.	A, An	
CO-05	Understand various risks and monitoring mechanisms in the cloud.	A, U	

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	S	S	L	M	S	S	S
CO-02	S	M	S	S	M	S	S
CO-03	M	S	S	S	L	M	S
CO-04	M	M	S	L	S	S	S
CO-05	S	S	S	L	L	L	S

S-Strong, M-Medium, L-Low, N-Not relevant

LIST OF PROGRAMS

1. Install VirtualBox/VMware/ Equivalent open-source cloud Workstation with different flavours of Linux or Windows OS on top of windows 8 and above.
2. Create Nested Virtual Machine (VM under another VM)

3. Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open-Source cloud software's like Open stack, Eucalyptus, Open Nebula with Role-based access control
4. Simulate a secure file sharing using a cloud sim
5. Implement data anonymization techniques over the simple dataset (masking, k-anonymization, etc)
6. Creating and Executing Your First Container Using Docker.
7. Run a Container from Docker Hub
8. Implementation of various scheduling mechanisms using open-source cloud simulator.
9. Implement any encryption algorithm to protect the images
10. implement an attribute-based access control mechanism based on a particular scenario
11. Develop a log monitoring system with incident management in the cloud

TOTAL: 45 PERIODS

PLATFORM NEEDED VMware, Docker, Open Stack, Open Nebula, Eucalyptus, Oracle VirtualBox, Cloud Sim

Elective I

CS45A1	FOUNDATIONS OF HUMAN COMPUTER INTERACTION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the foundations of Human Computer Interaction
- To understand Interaction Styles and to become familiar with the design technologies for individuals and persons with disabilities.
- To understand the process of Evaluation of Interaction Design.
- To clarify the significance of task analysis for ubiquitous computing
- To get insight on web and mobile interaction

Subject Code: CS45A1		Subject Name: Foundations of Human Computer Interaction	
Course Outcome – Cos			Cognitive Skill
CO-01	Understand the basics of human computer interactions via usability engineering and cognitive modeling.		R, U
CO-02	Understand the basic design paradigms, complex interaction styles.		R, U
CO-03	Understand the models and theories for user interaction.		An
CO-04	Examine the evaluation of interaction designs and implementations.		E
CO-05	Elaborate the above issues for web and mobile applications.		An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO -B	PO -C	PO -D	PO -E	PO -F	PO -G
CO-01	M	M	S	S	S	L	S
CO-02	M	M	S	S	S	L	S
CO-03	M	S	S	S	S	L	M
CO-04	M	M	S	S	S	M	L
CO-05	S	M	S	S	S	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I FOUNDATIONS OF HCI

9

Context of Interaction –Ergonomics - Designing Interactive systems – Understanding Users cognition and cognitive frameworks, User Centred approaches Usability, Universal Usability, Understanding and conceptualizing interaction, Guidelines, Principles and Theories. Importance of User Interface: Definition-Importance of good design-Benefits of good design-Human-centered development and Evaluation-Human Performance models-A Brief history of screen design.

UNIT II INTERACTION STYLES

9

GUI: Popularity of graphics - The concept of direct manipulation - Graphical system - Characteristics - Web user - Interface Popularity - Characteristics and Principles of User Interface. Understanding interaction styles, Direct Navigation and Immersive environments, Fluid navigation, Expressive Human and Command Languages, Communication and Collaboration Advancing the user experience, Timely user Experience, Information search, Data Visualization Design process: Human Interaction with computers - Importance of Human Characteristics - Human Consideration - Human Interaction Speeds and Understanding Business Junctions.

UNIT III EVALUATION OF INTERACTION

9

Evaluation Techniques- assessing user experience- usability testing – Heuristic evaluation and walkthroughs, analytics predictive models. Cognitive models, Socio-organizational issues and stakeholder requirements, Communication and collaboration models

UNIT IV MODELS AND THEORIES

9

Task analysis, dialog notations and design, Models of the system, Modeling rich interaction, Ubiquitous computing.

UNIT V WEB AND MOBILE INTERACTION

9

Hypertext, Multimedia and WWW, Designing for the web Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Use Transitions-Lookup patterns-Feedback patterns Mobile apps, Mobile navigation, content and control idioms, Multi-touch gestures, Inter-app integration, Mobile web

TOTAL: 45 PERIODS

REFERENCES:

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, Niklas Elmqvist,

“Designing the User Interface: Strategies for Effective Human-Computer Interaction”, Sixth Edition, Pearson Education, 2016.

2. Alan Dix, Janet Finlay, G D Abowd and Russel Beale, "Human Computer Interaction", Pearson Education, Third Edition, 2004.
3. Helen Sharp Jennifer Preece Yvonne Rogers, “Interaction Design: Beyond Human-Computer Interaction”, Wiley, 5th Edition, 2019.
4. Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel, “About Face: The Essentials of Interaction Design”, 4th Edition, Wiley, 2014.
5. Donald A. Norman, “Design of Everyday Things”, MIT Press, 2013.
6. Wilbert O Galitz, "The Essential Guide to User Interface Design", Third Edition, Wiley India Pvt., Ltd., 2007.

CS45A2	DATA PREPARATION AND ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- The data for analysis and develop meaningful data visualizations.
- How to perform exploratory analysis with the help of descriptive and perceptive statistics.
- Illustrate data visualizations for understanding and presenting.

Subject Code: CS45A2		Subject Name: Data preparation and Analysis	
Course Outcome – Cos		Cognitive Skill	
CO-01	Select appropriate data preparation technique to transform raw data into a standard format.	R, U	
CO-02	Apply data cleaning methods on real-time data for usage of data in analytics.	U, A	
CO-03	Make use of statistical methods for performing exploratory analysis.	A	
CO-04	Infer complex data models with respect to time series and geographical data mining.	A	
CO-05	Understand the basics of R programming Language..	R, U	

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO -B	PO -C	PO -D	PO -E	PO -F	PO -G
CO-01	L	M	L	M	L	M	M
CO-02	M	L	M	S	M	S	L
CO-03	L	L	S	S	S	M	M
CO-04	S	L	S	M	M	S	S
CO-05	M	M	S	L	M	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: DATA GATHERING AND PREPARATION

9

Data Exploration as a process – Data Mining – Motivation behind data mining – Data Preparation: Inputs, Outputs – Data Anomalies: Missing value, Noise, Inconsistency, Incomplete, Modelling tools and Data preparation – Stages of data preparation – Data discovery – Data characterization – Data Set Assembly

Unit II: DATA CLEANING

9

Consistency checking - Heterogeneous and missing data - Data Transformation and segmentation.

Unit III: EXPLORATORY ANALYSIS

9

Exploratory Analysis - Descriptive and comparative statistics - Clustering and association, - Hypothesis generation - Identifying and understanding groups: Learning Decision Trees from Data.

Unit IV: VISUALIZATION

9

Visualization - Designing visualizations - Time series - Geolocated data - Correlations and connections - Hierarchies and networks - Interactivity.

Unit V: R PROGRAMMING LANGUAGE

9

Advantages of R over other programming Languages – Working with Directories and Data Types in R – Control Statements, Loops – Data Manipulation and Integration in R – Exploring Data in R: Data Frames – R Functions for dat in data frame – Loading dataframes – Decision Tree packages in R – Issues in Decision Tree Learning – Hierarchical and K-means clustering functions in R – Mining algorithm interfaces in R.

TOTAL : 45 PERIODS

REFERENCES

1. Glenn J. Myatt, Wayne P. Johnson, “Making Sense of Data: A Practical Guide to Exploratory Data Analysis and Data Mining”, 2nd Edition, Wiley, 2014.
2. D. Pyle, Data Preparation for Data Mining. Morgan Kaufmann, 1999.
3. Ian H. Witten, Eibe Frank. Data Mining: Practical Machine Learning Tools and Techniques(Second Edition) Morgan Kaufmann, 2005.

CS45A3	FUNDAMENTALS OF DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study fundamental concepts of digital image processing.
- To understand and learn image processing operations and restoration.
- To use the concepts of Feature Extraction
- To study the concepts of Image Compression.
- To expose students to current trends in the field of image segmentation.

Subject Code: CS45A3		Subject Name: Fundamentals Of Digital Image Processing	
Course Outcome – COs			Cognitive Skill
CO-01	Understand the need for image transforms different types of image transforms and their properties.	R, U	
CO-02	Learn different techniques employed for the restoration of images.	A	
CO-03	Understand Image segmentation and feature analysis	An	
CO-04	Evaluate the methodologies for image segmentation, restoration etc	U, E	
CO-05	Apply segmentation techniques and do object recognition.	U, A	

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	M	M	S	S	S	M	S
CO-02	M	M	S	S	S	M	S
CO-03	S	M	S	S	S	M	M
CO-04	S	S	S	S	S	M	S
CO-05	S	S	S	S	S	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I INTRODUCTION

9

Examples of fields that use digital image processing, fundamental steps in digital image processing, components of image processing system. Digital Image Fundamentals: A simple image formation model, image sampling and quantization, basic relationships between pixels. Image enhancement in the spatial domain: Basic gray-level transformation, histogram processing, enhancement using arithmetic and logic operators, basic spatial filtering, smoothing, and sharpening spatial filters, combining the spatial enhancement methods.

UNIT II IMAGE RESTORATION**9**

A model of the image degradation/restoration process, noise models, restoration in the presence of noise—only spatial filtering, Wiener filtering, constrained least squares filtering, geometric transforms; Introduction to the Fourier transform and the frequency domain, estimating the degradation function. Color Image Processing: Color fundamentals, color models, pseudo color image processing, basics of full-color image processing, color transforms, smoothing and sharpening, color segmentation

UNIT III FEATURE EXTRACTION**9**

Detection of discontinuities – Edge linking and Boundary detection- Thresholding- -Edge based segmentation-Region based Segmentation- matching-Advanced optimal border and surface detection- Use of motion in segmentation. Image Morphology – Boundary descriptors- Regional descriptors.

UNIT IV IMAGE COMPRESSION**9**

Fundamentals, image compression models, error-free compression, lossy predictive coding, image compression standards Morphological Image Processing: Preliminaries, dilation, erosion, open and closing, hit or miss transformation, basic morphological algorithms

UNIT V IMAGE SEGMENTATION**9**

Detection of discontinuous, edge linking and boundary detection, thresholding, region-based segmentation. Object Recognition: Patterns and patterns classes, recognition based on decision-theoretic methods, matching, optimum statistical classifiers, neural networks, structural methods – matching shape numbers, string matching.

TOTAL: 45 PERIODS**REFERENCES**

1. R. C.Gonzalez, R.E.Woods,” Digital Image processing”, Pearson edition, Inc3/e,2008.
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis and Machine Vision”, Third Edition, Third Edition, Brooks Cole, 2008.
3. Anil K.Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall India, 2007.
4. Madhuri A. Joshi, ‘Digital Image Processing: An Algorithmic Approach”, Prentice- Hall India, 2006.
5. Rafael C.Gonzalez , Richard E.Woods and Steven L. Eddins, “Digital Image Processing Using MATLAB”, Second Edition, Pearson Education, 2017.

CS45A4	SECURITY PRACTICES ALGORITHMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and cloud security
- To perform a detailed study of Privacy and Storage security and related Issues

Subject Code: CS45A4		Subject Name: Security Practices Algorithms
Course Outcome – COs		Cognitive Skill
CO-01	Understand the core fundamentals of system security	R, U
CO-02	Apply the security concepts to wired and wireless networks	A
CO-03	Implement and Manage the security essentials in IT Sector	An
CO-04	Explain the concepts of Cyber Security and Cyber forensics	U
CO-05	Be aware of Privacy and Storage security Issues.	U, A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	M	M	S	S	L	M	M
CO-02	M	M	S	S	L	M	M
CO-03	S	L	S	S	L	S	M
CO-04	M	L	S	S	L	M	M
CO-05	L	M	S	S	L	L	L

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I SYSTEM SECURITY

9

Model of network security – Security attacks, services and mechanisms – OSI security architecture - A Cryptography primer- Intrusion detection system- Intrusion Prevention system - Security web applications- Case study: OWASP - Top 10 Web Application Security Risks.

UNIT II NETWORK SECURITY

9

Internet Security - Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security - Mobile security - IOT security – Case Study - Kali Linux.

UNIT III SECURITY MANAGEMENT

9

Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System. Case study: Metasploit

UNIT IV CYBER SECURITY AND CLOUD SECURITY**9**

Cyber forensics- disk forensics – network forensics – wireless forensics – database forensics – malware forensics – mobile forensics – email forensics- best security practices for automate Cloud infrastructure management – establishing trust in iaas, paas, and saas cloud types. Case Study: dvwa

UNIT V PRIVACY AND STORAGE SECURITY**9**

Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- privacy and security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.

TOTAL:45 PERIODS**REFERENCES**

1. John R. Vacca, Computer and Information Security Handbook, Third Edition, Elsevier 2017
2. Michael E. Whitman, Herbert J. Mattord, Principles of Information Security, Seventh Edition, Cengage Learning, 2022
3. Richard E. Smith, Elementary Information Security, Third Edition, Jones and Bartlett Learning, 2019
4. Mayor, K.K.Mookhey, Jacopo Cervini, Fairuzan Roslan, Kevin Beaver, Metasploit Toolkit for Penetration Testing, Exploit Development and Vulnerability Research, Syngress publications, Elsevier, 2007. ISBN : 978-1-59749-074-0
5. John Sammons, “The Basics of Digital Forensics- The Primer for Getting Started in Digital Forensics”, Syngress, 2012
4. Cory Altheide and Harlan Carvey, “Digital Forensics with Open Source Tools”, 2011 Syngress, ISBN: 9781597495875.
5. Siani Pearson, George Yee "Privacy and Security for Cloud Computing" Computer Communications and Networks, Springer, 2013.

CS45A5	CELLULAR COMMUNICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic concepts in cellular communication.
- To learn the characteristics of wireless channels.
- To understand the impact of digital modulation techniques in fading.
- To get exposed to diversity techniques in wireless communication.
- To acquire knowledge in multicarrier systems.

Subject Code: CS45A5		Subject Name: CELLULAR	
COMMUNICATIONS			
Course Outcome – Cos			Cognitive Skill
CO-01	Design solutions for cellular communication		R, U

CO-02	Determine the capacity of wireless channels	A
CO-03	Analyze the performance of the digital modulation techniques in fading channels	An
CO-04	Apply various diversity techniques in wireless communication	U
CO-05	Design multicarrier systems in wireless communication	U, A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	M	L	S	S	L	L	L
CO-02	M	L	S	S	L	L	L
CO-03	M	S	S	S	M	M	M
CO-04	M	S	S	S	L	S	S
CO-05	M	M	S	S	L	M	M

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I CELLULAR CONCEPTS

9

Frequency Reuse – Channel Assignment Strategies – Handoff Strategies – Interference and system capacity- Co-Channel Interference- Adjacent Channel Interference – Trunking and Grade of service – Improving coverage & capacity in cellular systems-Cell Splitting- Sectoring- Repeaters for Range Extension-Microcell Zone Concept.

UNIT II THE WIRELESS CHANNEL

9

Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver –Capacity comparisons – Capacity of Frequency Selective Fading channels.

UNIT III PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS

9

Performance of flat fading and frequency selective fading – Impact on digital modulation techniques – Outage Probability– Average Probability of Error – Combined Outage and Average Error Probability – Doppler Spread – Inter symbol Interference.

UNIT IV DIVERSITY TECHNIQUES

9

Realization of Independent Fading Paths – Receiver Diversity – Selection Combining – Threshold Combining – Maximal-Ratio Combining – Equal - Gain Combining – Capacity with Receiver diversity – Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme– Transmit & Receive Diversity-MIMO Systems.

UNIT V MULTICARRIER MODULATION**9**

Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset.

TOTAL:45 HOURS**REFERENCES**

1. Theodore.S. Rappaport, “Wireless Communications: Principles and Practice”, 2nd Edition, Pearson Education, India, 2010.
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.
3. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Wiley Series in Telecommunications, Cambridge University Press, 2005.
4. Saad Z. Asif, “5G Mobile Communications Concepts and Technologies” CRC press – 2019.
5. Keith Q. T. Zhang, “Wireless Communications: Principles, Theory and Methodology” 1st edition, John Wiley & Sons, 2016.
6. Ramjee Prasad, "OFDM for Wireless Communication Systems", Artech House, 2004.
7. Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, John Wiley & Sons Inc., 2013.

Elective II

CS45A6	MACHINE LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning.
- To explore the different supervised learning techniques including ensemble methods.
- To learn different aspects of unsupervised learning and reinforcement learning.
- To learn the role of probabilistic methods for machine learning.
- To understand the basic concepts of neural networks and deep learning.

Subject Code: CS45A6		Subject Name: Machine Learning	
Course Outcome – Cos		Cognitive Skill	
At the end of the course students should be able to,			
CO-01	Understand and outline problems for each type of machine learning.	U, R	
CO-02	Design a Decision tree and Random forest for an application.	A	

CO-03	Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results.	R, A
CO-04	Use a tool to implement typical Clustering algorithms for different types of applications.	A, An
CO-05	Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.	A, An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	L	L	L	M	L	M	M
CO-02	M	M	S	M	M	M	L
CO-03	M	M	M	M	M	S	S
CO-04	S	S	S	M	M	S	S
CO-05	S	S	M	M	S	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: MATHEMATICAL FOUNDATIONS FOR MACHINE LEARNING 9

What is Machine Learning? Need –History – Definitions – Applications - Advantages, Disadvantages & Challenges -Types of Machine Learning Problems – Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability -Vector Calculus & Optimization - Decision Theory - Information theory

Unit II: SUPERVISED LEARNING METHODS 9

Introduction-Discriminative and Generative Models -Linear Regression - Least Squares -Under-fitting / Overfitting -Cross-Validation – Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbors - Tree based Methods –Decision Trees –ID3 – CART - Ensemble Methods –Random Forest - Evaluation of Classification Algorithms

Unit III: UNSUPERVISED LEARNING METHODS 9

Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity - Dimensionality Reduction –Principal Component Analysis – Recommendation Systems - EM algorithm. Reinforcement Learning – Elements -Model based Learning – Temporal Difference Learning

Unit IV: PROBABILISTIC MODELLING 9

Introduction -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori -Bayesian Belief Networks -Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks – Probability Density Estimation - Sequence Models – Markov Models – Hidden Markov Models

Unit V: BASICS OF NEURAL NETWORKS AND DEEP LEARNING**9**

Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network – Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning– Convolution Neural Networks – Recurrent Neural Networks – Use cases

TOTAL : 45 PERIODS**REFERENCES**

1. Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, Chapman & Hall/CRC, 2nd Edition, 2014.
2. Kevin Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
3. Ethem Alpaydin, “Introduction to Machine Learning”, Third Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014
4. Tom M Mitchell, “Machine Learning”, McGraw Hill Education, 2013.
5. Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, First Edition, Cambridge University Press, 2012.
6. Shai Shalev-Shwartz and Shai Ben-David, “Understanding Machine Learning: From Theory to Algorithms”, Cambridge University Press, 2015
7. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.
8. Hal Daumé III, “A Course in Machine Learning”, 2017 (freely available online)

CS45A7	DATA STORAGE TECHNOLOGIES AND NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To gain knowledge and understand the design of a Data Centre.
- To understand the best practice of design in the Data Centre.
- To learn the options in the running of an efficient Data Centre.
- To understand the value of data to a business, Information Lifecycle.
- To understand the challenges in data storage and data management.
- To learn solutions available for data storage

Subject Code: CS45A7		Subject Name: Data storage technologies and networks	
Course Outcome – COs			Cognitive Skill
CO-01	To explain the design of a data center and storage requirements		R, A
CO-02	To discuss the various types of storage and their properties		U
CO-03	To explain physical and virtualization of storage		R, U

CO-04	To explain the backup, archiving with regard to recovery and business continuity	U, E
CO-05	To explain the design of a data center and storage requirements	A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO -B	PO -C	PO -D	PO -E	PO -F	PO -G
CO-01	M	M	S	M	S	M	S
CO-02	M	M	S	S	L	M	M
CO-03	S	L	S	L	M	L	M
CO-04	M	S	S	M	M	M	S
CO-05	S	S	S	S	S	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I DATA CENTRE

9

Introduction, Site Selection and Environmental Considerations, Hierarchical or Layered Architecture, Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data centre infrastructure, role of each element in supporting business activities

UNIT II DATA CENTRE DESIGN ARCHITECTURE

9

Design and Standards Recommendations, Raised Access Floor and Design Best Practices, connecting the infrastructure with copper and fiber. IT Hardware, Cooling System Options and Environmental Control, Electrical Power Systems, Room Layout, Fire Protection and Security Systems, Building Automation and Energy Management Systems, Commissioning and Handover

UNIT III STORAGE MANAGEMENT

9

Introduction to Storage Technology, Storage Systems Architecture, Physical and logical components of a connectivity environment, Major physical components of a disk drive and their functions, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Integrated and Modular storage systems, high-level architecture and working of an intelligent storage systems

UNIT IV NETWORKED STORAGE

9

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, Need for long-term archiving solutions and describe how CAS fulfill the need, Appropriateness of the different networked storage options for different application environments

UNIT V SECURING STORAGE AND STORAGE VIRTUALIZATION**9**

Information Security, Critical security attributes for information systems, Storage security domains, Analyze the common threats in, each domain, Storage Virtualization: Forms, Configurations and Challenges, Types of Storage Virtualization: Block-level and File-Level.

TOTAL: 45 PERIODS**REFERENCES**

1. Mauricio Arregoces, Data Center Fundamentals, Cisco Press; 1st edition, 2003.
2. Robert Spalding, Storage Networks: The Complete Reference, Tata McGraw Hill, Osborne, 2003.
3. Marc Farley, Building Storage Networks, Tata McGraw Hill, Osborne. 2001.
4. Meeta Gupta, Storage Area Network Fundamentals, Pearson Education Limited, 2002
5. G. Somasundaram, Alok Shrivastava, Information Storage and Management, EMC Education Series, Wiley, Publishing Inc., 2011.
6. Gustavo Santana, Data Center Virtualization Fundamentals: Understanding Techniques and Designs for Highly Efficient Data Centers with Cisco Nexus, UCS, MDS, and Beyond, Cisco Press; First Edition, 2013.

CS45A8	MOBILE AND PERVASIVE COMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics of Mobile Computing and Pervasive Computing
- To learn the role of cellular networks in Mobile and Pervasive Computing
- To expose to the concept of sensor and mesh networks
- To expose to the context aware and wearable computing
- To learn to develop applications in mobile and pervasive computing environment

Course Outcome		Cognitive Skill
CO-01	Understand the basic architecture for a pervasive computing environment	U
CO-02	Identify and allocate the resources on the 3G-4G wireless networks	U,R
CO-03	Analyze the role of sensors and mesh networks in Wireless networks	An
CO-04	Develop mobile computing applications based on the paradigm of context aware computing and wearable computing	An,E
CO-05	Deploy the location and context information for application development	E,S

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO -B	PO -C	PO -D	PO -E	PO -F	PO -G
CO-01	S	M	S	M	S	M	S
CO-02	M	M	S	S	L	M	M
CO-03	S	L	S	L	M	L	M
CO-04	S	S	S	S	S	S	S
CO-05	S	S	S	S	S	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I INTRODUCTION

9

Differences between Mobile Communication and Mobile Computing – Contexts and Names – Functions – Applications and Services – New Applications – Making Legacy Applications Mobile Enabled – Design Considerations – Integration of Wireless and Wired Networks – Standard Bodies – Pervasive Computing – Basics and Vision – Principles of Pervasive Computing Categories of Pervasive Devices

UNIT II 3G AND 4G CELLULAR NETWORKS

9

Migration to 3G Networks – IMT 2000 and UMTS – UMTS Architecture – User Equipment – Radio Network Subsystem – UTRAN – Node B – RNC functions – USIM – Protocol Stack – CS and PS Domains – IMS Architecture – Handover – 3.5G and 3.9G a brief discussion – 4G LAN and Cellular Networks – LTE – Control Plane – NAS and RRC – User Plane – PDCP, RLC and MAC – WiMax IEEE 802.16d/e – WiMax Internetworking with 3GPP

UNIT III SENSOR AND MESH NETWORKS

9

Sensor Networks – Role in Pervasive Computing – In Network Processing and Data Dissemination – Sensor Databases – Data Management in Wireless Mobile Environments – Wireless Mesh Networks – Architecture – Mesh Routers – Mesh Clients – Routing – Cross Layer Approach – Security Aspects of Various Layers in WMN – Applications of Sensor and Mesh networks.

UNIT IV CONTEXT AWARE COMPUTING & WEARABLE COMPUTING **9**

Adaptability – Mechanisms for Adaptation - Functionality and Data – Transcoding – Location Aware Computing – Location Representation – Localization Techniques – Triangulation and Scene Analysis – Delaunay Triangulation and Voronoi graphs – Types of Context – Role of Mobile Middleware – Adaptation and Agents – Service Discovery Middleware Health BAN- Medical and Technological Requirements-Wearable Sensors-Intra-BAN communications

UNIT V APPLICATION DEVELOPMENT

9

Three tier architecture - Model View Controller Architecture - Memory Management – Information Access Devices – PDAs and Smart Phones – Smart Cards and Embedded Controls – J2ME – Programming for CLDC – GUI in MIDP – Application Development ON Android and iPhone

TOTAL:45 PERIODS

REFERENCES

1. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, “Mobile Computing: Technology, Applications and Service Creation”, 2nd ed, Tata McGraw Hill, 2017.
2. Reto Meier, “Professional Android 2 Application Development”, Wrox Wiley, 2010.
3. Pei Zheng and Lionel M Li, ‘Smart Phone & Next Generation Mobile Computing’, Morgan Kaufmann Publishers, 2006.
4. Frank Adelstein, ‘Fundamentals of Mobile and Pervasive Computing’, TMH, 2005
5. Jochen Burthardt et al, ‘Pervasive Computing: Technology and Architecture of Mobile Internet Applications’, Pearson Education, 2003
6. Feng Zhao and Leonidas Guibas, ‘Wireless Sensor Networks’, Morgan Kaufmann Publishers, 2004
7. Uwe Hansmaan et al, ‘Principles of Mobile Computing’, Springer, 2nd edition, 2006
8. Reto Meier, “Professional Android 2 Application Development”, Wrox Wiley, 2010.
9. Mohammad s. Obaidat et al, “Pervasive Computing and Networking”, John Wiley, 2011
10. Stefan Poslad, “Ubiquitous Computing: Smart Devices, Environments and Interactions”, Wiley, 2009
11. Frank Adelstein Sandeep K. S. Gupta Golden G. Richard III Loren Schwiebert “Fundamentals of Mobile and Pervasive Computing, “, McGraw-Hill, 2005

CS45A9	SOFTWARE QUALITY ASSURANCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- Be exposed to the software quality factors, Quality Assurance (SQA) architecture and SQA components.
- Understand the integration of SQA components into the project life cycle.
- Be familiar with the software quality infrastructure.
- Be exposed to the management components of software quality.
- Be familiar with the Quality standards, certifications and assessments

Course Outcome		Cognitive Skill
CO-01	Utilize the concepts of SQA in software development life cycle	R
CO-02	Demonstrate their capability to adopt quality standards.	U

CO-03	Assess the quality of software products.	An
CO-04	Develop mobile computing applications based on the paradigm of context aware computing and wearable computing	A
CO-05	Ensure whether the product meets company's quality standards and client's expectations and demands	E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	S	M	S	M	S	M	S
CO-02	L	M	S	S	L	M	M
CO-03	M	L	S	L	M	L	M
CO-04	S	S	S	S	S	S	S
CO-05	S	S	S	S	M	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE 9

Need for Software quality – Software quality assurance (SQA) – Software quality factors- McCall's quality model – SQA system components – Pre project quality components – Development and quality plans.

UNIT II SQA COMPONENTS AND PROJECT LIFE CYCLE 9

Integrating quality activities in the project life cycle – Reviews – Software Testing –Quality of software maintenance components – Quality assurance for external participants contribution – CASE tools for software quality Management.

UNIT III SOFTWARE QUALITY INFRASTRUCTURE 9

Procedures and work instructions – Supporting quality devices - Staff training and certification - Corrective and preventive actions – Configuration management – Software change control – Configuration management audit -Documentation control.

UNIT IV SOFTWARE QUALITY MANAGEMENT & METRICS 9

Project process control – Software quality metrics – Cost of software quality – Classical quality cost model – Extended model – Application and Problems in application of Cost model

UNIT V STANDARDS, CERTIFICATIONS & ASSESSMENTS 9

Quality management standards – ISO 9001 and ISO 9000-3 –Capability Maturity Models – CMM and CMMI assessment methodologies - Bootstrap methodology – SPICE Project – SQA

project process standards – Organization of Quality Assurance – Role of management in SQA – SQA units and other actors in SQA systems.

TOTAL: 45 PERIODS

REFERENCES

1. Daniel Galin, “Software Quality Assurance”, Pearson Publication, 2009.
2. Alan C. Gillies, “Software Quality: Theory and Management”, International Thomson Computer Press, 2011.
3. Kshirasagar Naim and Priyadarshi Tripathy,” Software Testing and Quality Assurance Theory and Practice”, John Wiley & Sons Inc., 2008
4. Mordechai Ben-Menachem “Software Quality: Producing Practical Consistent Software”, International Thompson Computer Press, 2014

CS45B1	ANDROID APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To facilitate students to understand android SDK
- To help students to gain basic understanding of Android application development
- To understand how to work with various mobile application development frameworks
- To inculcate working knowledge of Android Studio development tool
- To learn the basic and important design concepts and issues of development of mobile applications.

Subject Code:		Subject Name: Android Application Development			
Course Outcome – Cos					Cognitive Skill
CO-01	Identify various concepts of mobile programming that make it unique from programming for other platforms.				R, U
CO-02	Create, test and debug Android application by setting up Android development				U
CO-03	Demonstrate methods in storing, sharing and retrieving data in Android applications				A
CO-04	Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces				E
CO-05	Create interactive applications in android using databases with multiple activities including audio, video and notifications and deploy them in marketplace				A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO							
	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G

CO-01	S	S	S	S	S	M	S
CO-02	L	M	S	S	L	M	M
CO-03	M	L	S	S	M	L	M
CO-04	M	S	S	S	S	S	S
CO-05	M	S	S	S	M	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I MOBILE PLATFORM AND APPLICATIONS 9

Mobile Device Operating Systems — Special Constraints & Requirements — Commercial Mobile Operating Systems — Software Development Kit: iOS, Android, BlackBerry, Windows Phone — MCommerce — Structure — Pros & Cons — Mobile Payment System — Security Issues.

UNIT II INTRODUCTION TO ANDROID 9

Introduction to Android: The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application,Android Manifest file.

UNIT III ANDROID APPLICATION DESIGN ESSENTIAL 9

Anatomy of Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.

UNIT IV ANDROID USER INTERFACE DESIGN & MULTIMEDIA 9

User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation. Playing Audio and Video, Recording Audio and Video, Using the Camera to Take and Process Pictures

UNIT V ANDROID APIs 9

Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

TOTAL: 45 PERIODS

REFERENCES

1. Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education, 2nd ed. (2011)
1. Google Developer Training, "Android Developer Fundamentals Course – Concept Reference”, Google Developer Training Team, 2017.
2. Prasanth Kumar Pattnaik,Rajib Mall,”Fundamentals of Mobile Computing”,PHI Learning Pvt.Ltd,New Delhi-2012
5. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd, 2010
6. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd, 2009
7. Dawn Griffiths and David Griffiths, “Head First Android Development”, 1st Edition, O’Reilly SPD Publishers, 2015. ISBN-13: 978-9352131341
3. Erik Hellman, “Android Programming – Pushing the Limits”, 1st Edition, Wiley India Pvt Ltd, 2014. ISBN-13: 978-8126547197.

4. Bill Phillips, Chris Stewart and Kristin Marsicano, “Android Programming: The Big Nerd Ranch Guide”, 4th Edition, Big Nerd Ranch Guides, 2019. ISBN-13: 978-0134706054

ELECTIVE - III

CS45B2	DATA VISUALIZATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand how accurately represent voluminous complex data set in web and from other data sources.
- To understand the methodologies used to visualize large data sets.
- To understand the process involved in data visualization and security aspects involved in data visualization.

Subject Code: CS45B2		Subject Name: Data Visualization	
Course Outcome – COs			Cognitive Skill
CO-01	Understand the basics of data visualization and representation.		U
CO-02	Understand various methodologies present in data visualization.		U
CO-03	Discuss the process involved in data visualization.		U
CO-04	Design and use various methods in interactive data visualization.		A
CO-05	Design and use various security methods in visualization.		A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	M	S	S	M	S	M	S
CO-02	M	S	S	S	L	M	M
CO-03	L	S	S	L	M	L	M
CO-04	S	S	S	M	S	S	S
CO-05	S	S	S	S	M	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I INTRODUCTION 9

Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools.

UNIT II VISUALIZING DATA METHODS 9

Mapping - Time series - Connections and correlations - Scatterplot maps - Trees, Hierarchies and Recursion - Networks and Graphs, Info graphics.

UNIT III VISUALIZING DATA PROCESS 9

Acquiring data, - Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder, Asynchronous Image Downloads, Advanced Web Techniques, Using a Database, Dealing with a Large Number of Files. Parsing data - Levels of Effort, Tools for Gathering Clues, Text Is Best, Text Markup Languages, Regular Expressions (regexps), Grammars and BNF Notation, Compressed Data, Vectors and Geometry, Binary Data Formats, Advanced Detective Work.

UNIT IV INTERACTIVE DATA VISUALIZATION 9

Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geomapping – Exporting, Framework – T3, .js, tablo.

UNIT V INFORMATION DASHBOARD DESIGN 9

Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media –Critical Design Practices – Putting it all together- Unveiling the dashboard.

TOTAL: 45 PERIODS

REFERENCES:

1. Scott Murray, “Interactive data visualization for the web”, O’Reilly Media, Inc., 2013.
2. Ben Fry, “Visualizing Data”, O’Reilly Media, Inc., 2007.
3. Greg Conti, “Security Data Visualization: Graphical Techniques for Network Analysis”, No Starch Press Inc, 2007.
4. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.
5. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014

CS45B3	BIG DATA MINING AND ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know the fundamental concepts of big data and analytics.
- To explore tools and practices for working with big data
- To learn about stream computing.
- To know about the research that requires the integration of large amounts of data.

Subject Code: CS45B3

Subject Name: Big Data Mining and Analytics

Course Outcome – COs		Cognitive Skill
CO-01	Work with big data tools and its analysis techniques.	A
CO-02	Analyze data by utilizing clustering and classification algorithms.	An
CO-03	Learn and apply different mining algorithms and recommendation systems for large volumes of data.	U,A
CO-04	Perform analytics on data streams.	A
CO-05	Learn NoSQL databases and management.	U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO -B	PO -C	PO -D	PO -E	PO -F	PO -G
CO-01	M	S	S	S	S	M	S
CO-02	M	M	S	S	S	M	M
CO-03	L	L	S	L	S	L	M
CO-04	M	S	S	S	S	S	S
CO-05	M	S	S	S	S	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I INTRODUCTION TO BIG DATA

9

Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage - A General Overview of High- Performance Architecture - HDFS - MapReduce and YARN - Map Reduce Programming Model

UNIT II DATA MINING AND LARGE SCALE FILES

9

Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining - Distributed File Systems – Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques.

UNIT III CLUSTERING AND CLASSIFICATION

9

Advanced Analytical Theory and Methods: Overview of Clustering - K-means - Use Cases - Overview of the Method - Determining the Number of Clusters - Diagnostics - Reasons to Choose and Cautions - Classification: Decision Trees - Overview of a Decision Tree - The General Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees in R - Naïve Bayes - Bayes' Theorem - Naïve Bayes Classifier.

UNIT IV ASSOCIATION AND RECOMMENDATION SYSTEM

9

Advanced Analytical Theory and Methods: Association Rules - Overview - Apriori Algorithm - Evaluation of Candidate Rules - Applications of Association Rules - Finding Association & finding similarity - Recommendation System: Collaborative Recommendation- Content Based Recommendation - Knowledge Based Recommendation- Hybrid Recommendation Approaches.

UNIT V NOSQL DATA MANAGEMENT FOR BIG DATA AND VISUALIZATION 9

NoSQL Databases : Schema-less Models: Increasing Flexibility for Data Manipulation- Key Value Stores- Document Stores - Tabular Stores - Object Data Stores - Graph Databases Hive - Sharding — Hbase – Analyzing big data with twitter - Big data for E-Commerce Big data for blogs - Review of Basic Data Analytic Methods using R.

TOTAL: 45 PERIODS

REFERENCES:

1. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/Elsevier Publishers, 2013.
3. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
4. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
5. Dietmar Jannach and Markus Zanker, "Recommender Systems: An Introduction", Cambridge University Press, 2010.
6. Kim H. Pries and Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers " CRC Press, 2015.
7. Jimmy Lin and Chris Dyer, "Data-Intensive Text Processing with MapReduce", Synthesis Lectures on Human Language Technologies, Vol. 3, No. 1, Pages 1-177, Morgan Claypool publishers, 2010.

CS45B4	DATA WAREHOUSING AND MINING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand data warehouse concepts, architecture, business analysis and tools.
- To understand data pre-processing and data visualization techniques.
- To study algorithms for finding hidden and interesting patterns in data.
- To understand and apply various classification and clustering techniques using tools.

Subject Code: CS45B4		Subject Name: Data Warehousing and Mining	
Course Outcome – Cos			Cognitive Skill
CO-01	Understand data warehouse system and perform business analysis with OLAP tools.		U, A

CO-02	Understand data mining systems and data visualization concepts.	U
CO-03	Apply frequent pattern analysis techniques for data mining.	A
CO-04	Apply appropriate classification and clustering techniques for data analysis.	A
CO-05	Understand and work with WEKA tool.	U,A

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO- A	PO -B	PO -C	PO -D	PO -E	PO -F	PO -G
CO-01	M	S	S	M	S	M	S
CO-02	M	M	S	S	L	M	M
CO-03	S	M	S	S	M	S	M
CO-04	S	S	M	S	S	S	S
CO-05	M	S	S	S	M	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I INTRODUCTION TO DATA WAREHOUSING

9

Evolution of Decision Support Systems- Data warehousing Components – Building a Data warehouse, Data Warehouse and DBMS, Data marts, Metadata, Multidimensional data model, OLAP vs OLTP, OLAP operations, Data cubes, Schemas for Multidimensional Database: Stars, Snowflakes and Fact constellations

UNIT II DATA MINING – INTRODUCTION

9

Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques – Issues – applications- Data Objects and attribute types, Statistical description of data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and dissimilarity measures.

UNIT III DATA MINING – FREQUENT PATTERN ANALYSIS

9

Mining Frequent Patterns, Associations and Correlations – Mining Methods- Pattern Evaluation Method – Pattern Mining in Multilevel, Multi Dimensional Space – Constraint Based Frequent Pattern Mining, Classification using Frequent Patterns

UNIT IV CLASSIFICATION AND CLUSTERING

9

Decision Tree Induction – Bayesian Classification – Rule Based Classification – Classification by Back Propagation – Support Vector Machines — Lazy Learners – Model Evaluation and Selection-Techniques to improve Classification Accuracy. Clustering Techniques – Cluster analysis-Partitioning Methods – Hierarchical Methods – Density Based Methods – Grid Based Methods – Evaluation of clustering – Clustering high dimensional data- Clustering with constraints, Outlier analysis-outlier detection methods.

UNIT V WEKA TOOL**9**

Datasets – Introduction, Iris plants database, Breast cancer database, Auto imports database – Introduction to WEKA, The Explorer – Getting started, Exploring the explorer, Learning algorithms, Clustering algorithms, Association–rule learners.

TOTAL: 45 PERIODS**REFERENCES:**

1. Jiawei Han and Micheline Kamber, —Data Mining Concepts and Techniques, Third Edition, Elsevier, 2012.
2. Alex Berson and Stephen J.Smith, —Data Warehousing, Data Mining & OLAP, Tata McGraw – Hill Edition, 35th Reprint 2016.
3. K.P. Soman, Shyam Diwakar and V. Ajay, —Insight into Data Mining Theory and Practice, Eastern Economy Edition, Prentice Hall of India, 2006.
4. Ian H.Witten and Eibe Frank, —Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, Second Edition.

CS45B5	SOCIAL NETWORK ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain knowledge about the current web development and emergence of social web.
- To study about the modeling, aggregating and knowledge representation of semantic web.
- To appreciate the use of machine learning approaches for web content mining.
- To learn about the extraction and mining tools for social networks.
- To gain knowledge on web personalization and web visualization of social networks.

Subject Code: CS45B5		Subject Name: Social Network Analysis	
Course Outcome – COs		Cognitive Skill	
CO-01	Apply knowledge of current web development in the era of social web.	A	
CO-02	Model, aggregate and represent knowledge for semantic web.	U	
CO-03	Use machine learning approaches for web content mining.	U	
CO-04	Design extraction and mining tools for social networks.	An	
CO-05	Develop personalized web sites and visualization for social networks.	A	

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G

CO-01	S	S	S	M	S	S	S
CO-02	M	M	S	S	L	M	M
CO-03	S	L	S	S	M	S	L
CO-04	S	S	L	S	S	S	S
CO-05	M	S	S	S	M	M	S

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I CLUSTERING AND CLASSIFICATION

9

Supervised Learning – Decision tree - Naïve Bayesian Text Classification - Support Vector Machines - Ensemble of Classifiers – Unsupervised Learning – K-means Clustering – Hierarchical Clustering – Partially Supervised Learning – Markov Models – Probability-Based Clustering – Vector Space Model

UNIT II SOCIAL MEDIA MINING

9

Data Mining Essentials – Data Mining Algorithms - Web Content Mining – Latent semantic Indexing – Automatic Topic Extraction – Opinion Mining and Sentiment Analysis – Document Sentiment Classification

UNIT III EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS

9

Extracting evolution of Web Community from a Series of Web Archive – Detecting Communities in Social Networks – Definition of Community – Evaluating Communities – Methods for Community Detection & Mining – Applications of Community Mining Algorithms – Tools for Detecting Communities – Social Network Infrastructure and Communities – Decentralized Online Social Networks – Multi-Relational Characterization of Dynamic Social Network Communities

UNIT IV HUMAN BEHAVIOR ANALYSIS AND PRIVACY ISSUES

9

Understanding and Predicting Human Behavior for Social Communities – User Data Management, Inference and Distribution – Enabling New Human Experiences – Reality Mining – Context-Awareness – Privacy in Online Social Networks – Trust in Online Environment – Trust Models Based on Subjective Logic – Trust Network Analysis – Trust Transitivity Analysis – Combining Trust and Reputation – Trust Derivation Based on Trust Comparisons – Attack Spectrum and Countermeasures

UNIT V VISUALIZING SOCIAL NETWORKS

9

Introduction, A Taxonomy of Visualizations, Structural Visualization, Semantic and Temporal Visualization, Statistical Visualization, The Convergence of Visualization, Interaction and Analytics, Structural and Semantic Filtering with Ontologies, Centrality-based Visual Discovery and Exploration.

TOTAL : 45 PERIODS

REFERENCES:

1. Peter Mika, “Social networks and the Semantic Web”, Springer, 2007.

2. Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, 2010.
3. Bing Liu, "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)", Springer; Second Edition, 2011.
4. Charu C Aggarwal, "Social Network Analytics", Springer, 2011
5. Reza Zafarani, Mohammad Ali Abbasi, Huan Liu, "Social Media Mining", Cambridge University Press, 2014.
6. Guandong Xu, Yanchun Zhang and Lin Li, "Web Mining and Social Networking Techniques and applications", Springer, 2011.
7. Dion Goh and Schubert Foo, "Social information retrieval systems: emerging technologies and Applications for searching the Web effectively", Idea Group, 2007.

CS45B6	VIRTUALIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of virtualization and virtual machines.
- To understand the implementation of process and system virtual machines.
- To explore the aspects of high-level language virtual machines.
- To gain expertise in server, network and storage virtualization.
- To understand and deploy practical virtualization solutions and enterprise solutions.

Subject Code: CS45B6		Subject Name: Virtualization Techniques	
Course Outcome – Cos			Cognitive Skill
CO-01	Classify Virtual Machines.		U
CO-02	Deploy legacy OS on virtual machines.		An,E
CO-03	Analyze the intricacies of server, storage and network virtualizations.		An
CO-04	Design and develop applications on virtual machine platforms.		A
CO-05	Suggest appropriate high level language virtual machine for the problem in hand.		U

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO							
	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	M	M	S	M	S	S	S

CO-02	S	M	S	S	L	S	S
CO-03	S	L	S	S	M	S	L
CO-04	S	S	S	S	S	S	S
CO-05	M	L	S	M	S	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I OVERVIEW OF VIRTUALIZATION 9

Primer on virtualization – Benefits of virtual machine – hypervisor – managing virtual resources – virtualized cloud data centre - Virtualization and cloud computing – Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations -
- Virtual Machine Basics - Process vs System Virtual Machines - Taxonomy. Emulation: Basic Interpretation - Threaded Interpretation - Precoded and Direct Threaded Interpretation - Binary Translation. System Virtual Machines - Key Concepts - Resource utilization basics.

UNIT II PROCESS VIRTUAL MACHINES 9

Implementation – Compatibility – Levels – Framework – State Mapping – Register – Memory Address Space – Memory Architecture Emulation – Memory Protection – Instruction Emulation – Performance Tradeoff - Staged Emulation – Exception Emulation – Exception Detection – Interrupt Handling – Operating Systems Emulation – Same OS Emulation – Different OS Emulation – System Environment.

UNIT III HIGH LEVEL LANGUAGE VIRTUAL MACHINES AND SERVER VIRTUALIZATION 9

HLL Virtual Machines: Pascal P-Code – Object Oriented HLLVMs - Java VM architecture - Java Native Interface - Common Language Infrastructure. Server virtualization: Partitioning techniques - virtual hardware - uses of virtual servers - server virtualization platforms

UNIT IV NETWORK AND STORAGE VIRTUALIZATION 9

Design of Scalable Enterprise Networks – Layer2 Virtualization – VLAN - VFI - Layer 3 Virtualization – VRF - Virtual Firewall Contexts - Network Device Virtualization - Data- Path Virtualization - Routing Protocols. Hardware Devices – SAN backup and recovery techniques – RAID – Classical Storage Model – SNIA Shared Storage Model – Virtual Storage: File System Level and Block Level

UNIT V APPLYING VIRTUALIZATION 9

Practical Virtualization Solutions: Comparison of Virtualization Technologies: Guest OS/ Host OS – Hypervisor – Emulation – Kernel Level – Shared Kernel, Enterprise Solutions: VMWare Server – VMWareESXi – Citrix Xen Server – Microsoft Virtual PC – Microsoft Hyper-V – Virtual Box, Server Virtualization: Configuring Servers with Virtualization – Adjusting and Tuning Virtual servers – VM Backup – VM Migration, Desktop Virtualization: Terminal services – Hosted Desktop – Web-based Solutions – Localized Virtual Desktops, Network and Storage Virtualization: Virtual Private Networks – Virtual LAN – SAN and VSAN – NAS

TOTAL: 45 PERIODS

REFERENCES

1. James E. Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier/Morgan Kaufmann, 2005.
2. David Marshall, Wade A. Reynolds, “Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center”, Auerbach Publications, 2006.
3. Kumar Reddy, Victor Moreno, “Network virtualization”, Cisco Press, July, 2006.
4. Chris Wolf, Erick M. Halter, “Virtualization: From the Desktop to the Enterprise”, A Press 2005.
5. Kenneth Hess, Amy Newman, “Practical Virtualization Solutions: Virtualization from the Trenches”, Prentice Hall, 2010.

ELECTIVE - IV

CS45B7	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of Internet of Things.
- To learn about the basics of IOT protocols.
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario.

Subject Code:CS45B7		Subject Name: Internet of things	
Course Outcome – Cos			Cognitive Skill
CO-01	Analyze various protocols for IoT		An
CO-02	Develop web services to access/control IoT devices.		A
CO-03	Design a portable IoT using Raspberry Pi		U
CO-04	Deploy an IoT application and connect to the cloud.		A
CO-05	Analyze applications of IoT in real time scenario		An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	S	M	S	L	M	M	L
CO-02	S	S	L	L	M	S	S

CO-03	L	L	S	M	L	L	M
CO-04	L	L	S	S	M	M	L
CO-05	L	S	S	L	M	S	L

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I INTRODUCTION TO IoT

9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

UNIT II IoT ARCHITECTURE

9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

UNIT III IoT PROTOCOLS

9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security

UNIT IV CLOUD ARCHITECTURE BASICS

9

The Cloud types; IaaS, PaaS, SaaS.- Development environments for service development; Amazon, Azure, Google Appcloud platform in industry

UNIT V IOT PROJECTS ON RASPBERRY PI

9

Building IOT with RASPBERRY PI- Creating the sensor project - Preparing Raspberry Pi - Clayster libraries – Hardware Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data

TOTAL: 45 PERIODS

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things – A hands-on approach, Universities Press, 2015.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), Architecting the Internet of Things, Springer, 2011.
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015.
4. Ovidiu Vermesan Peter Friess, 'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
5. N. Ida, Sensors, Actuators and Their Interfaces: A Multidisciplinary Introduction, 2nd Edition Scitech Publishers, 2014.
6. Reese, G. (2009). Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. Sebastopol, CA: O'Reilly Media, Inc. (2009).

CS45B8	WEB DESIGN AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the design principles and interaction.
- To explore the detailed design practices, standards.
- To gain an insight into Content Management System for content design.
- To use any Content Management System tool for better content management.
- To get familiarized with Web Analytics for better management.

Subject Code: CS45B8		Subject Name: Web Design and Management	
Course Outcome – Cos		Cognitive Skill	
CO-01	Design web pages that follow standards and are usable.	R,U	
CO-02	Design web sites that are appealing.	R,An	
CO-03	To be able to use Content management System for designing web Content.	U	
CO-04	To take advantage of Content Management System tools for managing content for large web sites.	A	
CO-05	To be able to use analytics tools for better management.	A	

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	M	M	S	S	L	S	S
CO-02	M	L	S	S	N	S	S
CO-03	M	M	S	S	S	S	S
CO-04	M	M	S	S	S	M	M
CO-05	S	M	N	M	L	S	S

S-Strong, M-Medium,L-Low,N-Not relevant

User Centered Design, Web Medium, Information Architectures, Site Types and Architectures, Page Structure, Site Maps, Navigation, Search, Web Design Process, Designing for Multiple Screen Resolutions, Creating A Unified Site Design, Evaluating Web Sites.

UNIT II COMPONENTS OF WEB PAGE DESIGN 9

Elements Of Page Design, Adding Styles With CSS, Pages And Layout, Typography, Color, Images, GUI Widgets and Forms, Responsive Web Designs, User Input Forms, Working With Data Tables, Web Standards And Styles.

UNIT III WEB DESIGN 9

Features – Automated Templates – Template Processor –Front Controller Pattern – Content Modeling – Content Aggregation – Plug-Ins – Search Engine Optimization – Recommended Usage of Tools – WORDPRESS

UNIT IV WEB PROJECT MANAGEMENT 9

Project Life Cycle - Project Definition - Discovery and Requirements - Project Schedule and Budgeting - Running the project - Technical Documentation - Development, Communicaton, Documentation - QA and testing -Deployment - Support and operations

UNIT V WEB ANALYTICS PROCESS 9

Web Analytics Process – Data Collection – Qualitative Analysis – Log File Analysis – Page Tagging – Hybrid Methods – Click Analytics – Onsite and Offsite Analytics – Web Analytics Methods

TOTAL: 45 PERIODS

REFERENCES:

1. Patrich J. Lynch, Sarah Horton, “Web Style Guide-Foundations of User Experience Design”, Yale University Press, 4th Edition, 2016.
2. Thomas A. Powell, “The Complete Reference– Web Design”, Tata McGraw Hill, Second Edition, 2003.
3. Joel Sklar, “Principles of Web Design, Cengage Learning”, Web Warrior Series, 6th Edition, 2015.
4. Deane Barker, “Web Content management-Systems, Features and Best Practices”, O’reilly Media, 1st Edition, 2016.
5. Brian Clifton, “Advanced web Metrics with Google Analytics”, Third Edition, Sybex Publishers, 2012.
6. Avinash Kaushik, “Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity”, 1st edition, Sybex publishers, 2009.

CS45B9	DATABASE ADMINISTRATION AND TUNING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the tasks in database administration.
- To learn the methods to secure the database and to recover from failures.
- To understand the fundamentals of database tuning.

- To apply indexing techniques and query optimization for database tuning.
- To understand and measure performance monitors to troubleshoot the database system.

Subject Code: CS45B9		Subject Name: Database Administration and Tuning	
Course Outcome – Cos		Cognitive Skill	
CO-01	Describe the principle functions in database administration and security	U	
CO-02	Discuss the need for performance tuning in databases	R,U	
CO-03	Write optimized code for accessing multiple databases	U	
CO-04	Reconstruct indexes and optimize queries for better database performance.	An,A	
CO-05	Carry out troubleshooting in database systems	A	

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	S	M	S	M	M	L	L
CO-02	S	M	S	S	M	L	L
CO-03	L	M	S	S	L	M	M
CO-04	M	M	S	M	L	M	S
CO-05	S	M	S	M	L	M	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I INTRODUCTION TO DATABASE ADMINISTRATION 10

Database Administration - DBA Tasks- Database Design - Performance Monitoring and Tuning – Availability - Database Security and Authorization - Backup and Recovery - Data Integrity - DBMS Release Migration - Types of DBAs - Creating the Database Environment - Choosing a DBMS - DBMS Architectures - DBMS Clustering - DBMS Proliferation - Hardware Issues - Installing the DBMS - DBMS Installation Basics Hardware Requirements - Storage Requirements Memory Requirements Configuring the DBMS - Connecting the DBMS to Supporting Infrastructure Software - Installation Verification - DBMS Environments - Upgrading DBMS Versions and Releases - Fallback Planning - Migration Verification

UNIT II DATABASE SECURITY, BACKUP AND RECOVERY 10

Database Users - Granting and Revoking Authority - Types of Privileges - Granting to PUBLIC- Revoking Privileges - Security Reporting - Authorization Roles and Groups - Using Views for Security - Using Stored Procedures for Security Auditing - SQL Injection Prevention - External Security - Job Scheduling and Security - Image Copy Backups - Full vs. Incremental Backups -

Database Objects and Backups - DBMS Control - Concurrent Access Issues - Backup Consistency - Log Archiving and Backup - DBMS Instance Backup - Designing the DBMS Environment for Recovery - Types of Recovery - Alternatives to Backup and Recovery – DBA Tools – DBA Rules of Thumb.

UNIT III FUNDAMENTALS OF TUNING 8

Database Tuning- Tuning SQL Guidelines – Tuning Disk I/O – Tuning Memory – Tuning contention - using Application Design; Tuning Memory Usage - Tuning Data Access - Tuning Data Manipulation - Reducing Network Traffic - Using Automatic Workload Repository(AWR) - Automatic Database Diagnostic Monitor(ADDM) - Tuning SQL - SQL Tuning Advisor - Performance Tuning in a Multitenant Environment - Distributed Databases and Networking Tool.

UNIT IV INDEX TUNING AND QUERY OPTIMIZATION 9

Types of Queries – Data Structures – B tree – B+ Tree - Hash Structures – Bit Map Indexes – Clustering Indexes – Non Clustering Indexes – Composite Indexes – Hot Tables – Comparison of Indexing and Hashing Techniques. Optimization Techniques - Tuning Relational Systems – Normalization – Tuning Denormalization – Clustering Two Tables – Aggregate Maintenance – Record Layout – Query Cache – Parameter Cache - Query Tuning – Triggers – Client Server Mechanisms – Objects, Application Tools and Performance – Tuning the Application Interface – Bulk Loading Data – Accessing Multiple Databases.

UNIT V TROUBLESHOOTING 8

Query Plan Explainers – Performance Monitors – Event Monitors. Finding 'Suspicious' Queries – Analyzing Query's Access Plan – Profiling Query Execution. Tuning DBMS Subsystems - Disk Subsystem - Buffer Manager - Logging Subsystem - Locking Subsystem. Troubleshooting CPU, Disks and Controllers, Memory, and Networks.

TOTAL: 45 PERIODS

REFERENCES:

1. Craig S. Mullins, "Database Administration: The Complete Guide to Practices and Procedures",
2. Addison-Wesley Professional, 2nd edition, 2013.
3. Dennis Shasha and Philippe Bonnet, "Database Tuning, Principles, Experiments and Troubleshooting Techniques", Elsevier Reprint, 2005.
4. Silberschatz, Korth, "Database System Concepts", McGraw Hill, 6th edition, 2010.
5. Thomas Connolly and Carlolyn Begg, "Database Systems, A Practical Approach to Design,
6. Implementation and Management", Fourth Edition, Pearson Education, 2008.

CS45C1	INFORMATION RETRIEVAL TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of information retrieval techniques.
- To understand the various model of information retrieval.
- To learn measuring effectiveness and efficiency of information retrieval techniques.

- To get used to performing Parallel Information Retrieval.
- To understand the concepts of digital libraries.

Subject Code: CS45C1		Subject Name: Information Retrieval Techniques	
Course Outcome – Cos		Cognitive Skill	
CO-01	Understand the basic concepts of information retrieval.	U, R	
CO-02	Utilize the information retrieval models and evaluating their performance.	U, E	
CO-03	Measure effectiveness and efficiency of information retrieval techniques.	An	
CO-04	Use parallel Information Retrieval approaches in real world problems.	An, S	
CO-05	Implement different techniques of recommender system.	An, A	

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	S	M	S	S	S	M	S
CO-02	S	S	S	S	S	L	M
CO-03	L	M	S	S	S	M	L
CO-04	S	L	S	S	S	M	S
CO-05	M	S	S	S	M	M	L

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I INTRODUCTION

9

Basic Concepts – Practical Issues – Retrieval Process – Architecture – Boolean Retrieval – Retrieval Evaluation – Open Source IR Systems–History of Web Search – Web Characteristics– The impact of the web on IR –IR Versus Web Search–Components of a Search engine

UNIT II MODELING AND RETRIEVAL EVALUATION

9

Basic IR Models – Boolean Model - TF-IDF (Term Frequency/Inverse Document Frequency) Weighting – Vector Model – Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models – Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing

UNIT III INDEXING

9

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching – Sequential Searching and Pattern Matching. Query Operations –Query Languages – Query

Processing – Relevance Feedback and Query Expansion – Automatic Local and Global Analysis
– Measuring Effectiveness and Efficiency

UNIT IV EVALUATION AND PARALLEL INFORMATION RETRIEVAL 9

Traditional Effectiveness Measures – Statistics in Evaluation – Minimizing Adjudication Effect
– Nontraditional Effectiveness Measures – Measuring Efficiency – Efficiency Criteria –
Queueing Theory – Query Scheduling – Parallel Information Retrieval – Parallel Query
Processing – MapReduce

UNIT V RECOMMENDER SYSTEM 9

Recommender Systems Functions – Data and Knowledge Sources – Recommendation
Techniques – Basics of Content-based Recommender Systems – High Level Architecture –
Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix
factorization models – Neighborhood models - Scout Portal Toolkit(SPT).

TOTAL: 45 PERIODS

TEXT BOOKS

1. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, “Modern Information Retrieval: The Concepts and Technology behind Search”, (ACM Press Books), Second Edition, 2011.
2. Ricci, F, Rokach, L. Shapira, B.Kantor, —Recommender Systems Handbook, First Edition, 2011.

REFERENCES

1. Chrstopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, “Introduction to Information Retrieval”, Cambridge University Press, First South Asian Edition, 2008.
2. Stefan Butcher, Charles L. A. Clarke, Gordon V. Cormack, “Information Retrieval Implementingand Evaluating Search Engines”, The MIT Press, Cambridge, Massachusetts London, England, 2010.
3. C. Manning, P. Raghavan, and H. Schütze, —Introduction to Information Retrieval, Cambridge University Press, 2012.

CS45C2	SERVICE ORIENTED ARCHITECTURE AND DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- Learn XML fundamentals.
- Be exposed to build applications based on XML.
- Understand the key principles behind SOA.
- Be familiar with the web services technology elements for realizing SOA.
- Learn the various web service standards.

Subject Code: CS45C2	Subject Name: Service Oriented Architecture and Design
Course Outcome – Cos	Cognitive Skill

CO-01	Understand the concepts of XML	U, R
CO-02	Build applications based on XML.	A, S
CO-03	Understand about Service Architecture.	An, A
CO-04	Develop web services using technology elements.	An, E
CO-05	Design SOA-based applications and analyze them.	An, E, S

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	S	M	S	S	S	M	L
CO-02	M	S	S	S	S	L	N
CO-03	L	M	S	S	S	M	L
CO-04	S	L	S	S	S	M	M
CO-05	M	S	S	S	S	M	L

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I XML

8

XML document structure – Well formed and valid documents – Namespaces – DTD – XML Schema – X-Files.

UNIT II BUILDING XML- BASED APPLICATIONS

8

Parsing XML – using DOM, SAX – XML Transformation and XSL – XSL Formatting – Modeling Databases in XML.

UNIT III SERVICE ORIENTED ARCHITECTURE

9

SOA and MSA Basics – Service Orientation in Daily Life – SOA Architecture - Characteristics of SOA, Comparing SOA with Client-Server and Distributed architectures – Benefits of SOA — Principles of Service orientation – Service layers - Drivers SOA- Dimensions of SOA- Conceptual Model of SOA.

UNIT IV WEB SERVICES(WS) AND STANDARDS

9

Standards and Guidelines for SOA - Web Services Platform - Service descriptions – WSDL – Messaging with SOAP – Service discovery – UDDI – Message Exchange Patterns- Orchestration – Choreography –WS Transactions.

UNIT V SERVICE ORIENTED ANALYSIS AND DESIGN

11

Need for Models- Principles of Service Design- Non-functional Properties for Services- Design

of Activity Services - Design of Data Services- Design of Client Services - Design of Business Process Services. Technologies for SOA: Technologies for Service Enablement - Technologies for Service Integration - Service Orchestration - SOA Governance and Implementation: Strategic Architecture Governance - Service Design- Time Governance - Service Run-time Governance- Approach for Enterprise-wide SOA Implementation.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Ron Schmelzer et al. "XML and Web Services", Pearson Education, 2002.
2. Thomas Erl, "Service Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2005.
3. Frank P.Coyle, "XML, Web Services and the Data Revolution", Pearson Education, 2002.
4. Eric Newcomer, Greg Lomow, "Understanding SOA with Web Services", Pearson Education, 2005.
5. Sandeep Chatterjee and James Webber, "Developing Enterprise Web Services: An Architect's Guide", Prentice Hall, 2004.
6. James McGovern, Sameer Tyagi, Michael E.Stevens, Sunil Mathew, "Java Web Services Architecture", Morgan Kaufmann Publishers, 2003.

REFERENCES:

1. Thomas Erl, "SOA Principles of Service Design "(The Prentice Hall Service-Oriented Computing Series from Thomas Erl), 2005.
2. Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education, 2005.
3. Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services, An Architect's Guide", Pearson Education, 2005.
4. Dan Woods and Thomas Mattern, "Enterprise SOA Designing IT for Business Innovation" O'REILLY, First Edition, 2006

CS45C3	ETHICAL HACKING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand and analyze Information security threats and counter measures
- To perform security auditing & testing
- To understand issues relating to ethical hacking
- To study & employ network defense measures

Subject Code: CS45C3		Subject Name: Ethical Hacking	
Course Outcome – Cos		Cognitive Skill	
CO-01	Understand and identify the vulnerabilities/threats/attacks.	R,U	
CO-02	Understand penetration and Apply security testing.	U,A	
CO-03	Analyze system hacking and implement various sniffing	An	

	algorithms.	
CO-04	Evaluate and Define Web services and related flaws	E
CO-05	Apply and design a computer against a variety of security attacks using various tools.	A

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G
CO-01	S	M	S	S	S	M	L
CO-02	M	S	M	M	S	L	N
CO-03	L	M	M	M	S	M	L
CO-04	S	L	M	M	S	M	M
CO-05	M	S	S	S	S	M	L

T- Strong, M-Medium,L-Low,N-Not relevant

U-

UNIT I INTRODUCTION

Understanding the importance of security-Concept of ethical hacking and essential Terminologies Threat- Attack- Vulnerabilities- Target of Evaluation -Exploit. Phases involved in hacking- Network and Computer Attacks – Malware – Protecting Against Malware Attacks.- Intruder Attacks – Addressing Physical Security

UNIT II FOOTPRINTING & PORT SCANNING

9

Footprinting - Introduction to foot printing- Understanding the information gathering methodology of the hackers-Tools used for the reconnaissance phase. Port Scanning - Introduction- using port scanning tools- Ping sweepsScripting Enumeration-Introduction- Enumerating windows OS & Linux OS.

UNIT III SYSTEM HACKING AND WIRELESS NETWORK HACKING

9

Aspect of remote password guessing- Role of eavesdropping -Various methods of password cracking- Keystroke Loggers- Understanding Sniffers - Comprehending Active and Passive Sniffing- ARP Spoofing and Redirection-DNS and IP Sniffing- HTTPS Sniffing. Introduction to 802.11-Role of WEP- Cracking WEP Keys – Hacking Tools-Securing Wireless Networks.

UNIT IV HACKING WEB SERVICES & SESSION HIJACKING

9

Web application vulnerabilities- Application coding errors- SQL injection into Back-end Databases- Cross-site scripting- cross-Site request forging-Authentication bypass- Web services and related flaws- Protective http headers Understanding Session Hijacking- Phases involved in Session Hijacking-Types of Session Hijacking- Session Hijacking Tools

Access Control Lists. – Cisco Adaptive Security Appliance Firewall – Configuration and Risk Analysis Tools for Firewalls and Routers – Intrusion Detection and Prevention Systems – Network-Based and Host-Based IDSs and IPSs – Web Filtering – Security Incident Response Teams – Honeypots.

TOTAL : 45 PERIODS

REFERENCES

1. Kimberly Graves, "Certified Ethical Hacker", Wiley India Pvt Ltd, 2010.
2. Michael T. Simpson, "Hands-on Ethical Hacking & Network Defense", Course Technology, 2010
3. Patrick Engebretson, "The Basics of Hacking and Penetration Testing" Ethical Hacking and Penetration Testing Made Easy, Syngress Media, Second Revised Edition, 2013.
4. RajatKhare, "Network Security and Ethical Hacking", Luniver Press, 2006.
5. Ramachandran V, "Wireless Penetration Testing Beginner's Guide " 3rd ed.. Packt Publishing, 2011.
6. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003.

OPEN ELECTIVE COURSES

Sl.No.	SUBJECT CODE	SUBJECT NAME	L	T	P	C
1.	OE45D1	Research Methodology and IPR	2	0	0	2
2.	OE45D2	Business Analytics	3	0	0	3
3.	OE45D3	Industrial Safety	3	0	0	3
4.	OE45D4	Operations Research	3	0	0	3
5.	OE45D5	Composite Materials	3	0	0	3
6.	OE45D6	Waste to Energy	3	0	0	3

OE45D1	RESEARCH METHODOLOGY & IPR	L	T	P	C
		2	0	0	2

Course Outcomes:

At the end of the course the student will be able to

- Illustrate research problem formulation.
- Analyze research related information and research ethics.
- Correlate the results of any research article with other published results and write a review article in the field of engineering.
- Explain why intellectual property rights (IPR) will play such a significant role in the development of people and nations, and briefly discuss the necessity to spread awareness of IPR among students in general and engineers in particular.
- Discuss how IPR protection encourages innovators to conduct additional research and invest in R & D, which results in the development of new and improved products, which in turn leads to economic growth and societal benefits.

Course Outcome		Cognitive Skill
CO-01	Illustrate research problem formulation.	A, An
CO-02	Analyze research related information and research ethics.	An
CO-03	Correlate the results of any research article with other published results and write a review article in the field of engineering.	A, An, E
CO-04	Explain why intellectual property rights (IPR) will play such a significant role in the development of people and nations, and briefly discuss the necessity to spread awareness of IPR among students in general and engineers in particular.	A, An
CO-05	Discuss how IPR protection encourages innovators to conduct additional research and invest in R & D, which results in the development of new and improved products, which in turn leads to economic growth and societal benefits	A, An, E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	S	S	M	M	S	M	M	M	M	M	S

CO-02	S	S	S	M	M	M	M	M	M	M	M	M
CO-03	S	S	S	M	M	M	S	M	M	M	S	S
CO-04	S	S	M	S	M	M	M	M	S	M	M	M
CO-05	S	M	M	M	M	S	M	S	S	M	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I: RESEARCH METHODOLOGY

6

Meaning of research problem, Sources of research problem, Criteria and Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT II: LITERATURE SURVEY AND ETHICS

6

Effective literature studies approaches - analysis Plagiarism - Research ethics.

UNIT III: TECHNICAL WRITING

6

Effective technical writing - how to write a manuscript/ responses to reviewers comments - preparation of research article/ research report - Writing a Research Proposal - presentation and assessment by a review committee.

UNIT IV: INTELLECTUAL PROPERTY RIGHTS

6

Nature of Intellectual Property: Patents, Designs, Trade Mark and Copyright - Process of Patenting and Development: technological research, innovation, patenting & development - Procedure for grants of patents - Patenting under PCT.

UNIT V: PATENT RIGHTS AND NEW DEVELOPMENTS IN IPR

6

Scope of Patent Rights - Licensing and transfer of technology - Patent information and databases - Geographical Indications - New Developments in IPR: Administration of Patent System - New developments in IPR - IPR of Biological Systems - Computer Software etc - Traditional knowledge.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. C.R.Kothari, "Research Methodology", 3rd Edition, New Age International, 2017.
2. Ranjit Kumar, "Research Methodology – A Step by Step for Beginner's", 2nd Edition, Pearson, Education, 2016.
3. Ann M. Korner, Guide to Publishing a Scientific paper, Bioscript Press 2004.
4. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.
5. Kompal Bansal & Parshit Bansal, "Fundamentals of IPR for Beginner's", 1st Edition, BS Publications, 2016.

REFERENCES:

1. Kothari, C. R. Research Methodology - Methods and Techniques, New Age International publishers, New Delhi, 2004.

2. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students", Juta & Company, 1996.
3. Robert P. Merges, Peter S. Menell and Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers, 2016.
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974. 7. Asimov, "Introduction to Design", Prentice Hall, 1962.

WEB RESOURCES:

1. <https://nptel.ac.in/courses/106/105/106105077/>

OE45D2	BUSINESS ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide sound knowledge in the basic concepts of linear control theory and design of control system.

Course Outcomes:

At the end of the course the student will be able to

- Analyze business data using statistical tools.
- Apply trend analysis and regression to make informed decisions.
- Design organizational structures for effective business analytics.
- Utilize forecasting techniques for prediction and decision-making.
- Employ decision analysis methods and stay updated on recent trends in business intelligence and data storytelling.

Course Outcome		Cognitive Skill
CO-01	Analyze business data using statistical tools.	An
CO-02	Apply trend analysis and regression to make informed decisions.	A
CO-03	Design organizational structures for effective business analytics.	A, An, E
CO-04	Utilize forecasting techniques for prediction and decision-making.	An, S

CO-05	Employ decision analysis methods and stay updated on recent trends in business intelligence and data storytelling.	A, An
-------	--	-------

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	M	M	M	S	M	M	M	M	M	S
CO-02	S	S	S	M	M	M	M	M	M	M	M	M
CO-03	S	M	S	M	M	M	S	M	M	M	S	S
CO-04	S	S	M	S	M	M	M	M	S	M	M	M
CO-05	S	M	M	M	M	S	M	S	S	M	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I

9

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics.

Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT II

9

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression.

Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT III

9

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT IV**9**

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

Monte Carlo Simulation and Risk Analysis: Monte Carlo Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT V**9**

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making, Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TOTAL: 45 PERIODS**REFERENCE BOOKS:**

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

OE45D3	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course the student will be able to

- Identify and mitigate industrial safety hazards effectively.
- Apply maintenance engineering principles to optimize equipment performance.
- Implement strategies for wear reduction and corrosion prevention.
- Utilize fault tracing techniques to diagnose equipment problems efficiently.
- Develop and execute periodic and preventive maintenance programs for machinery and equipment.

Course Outcome		Cognitive Skill
CO-01	Identify and mitigate industrial safety hazards effectively.	U, A

CO-02	Apply maintenance engineering principles to optimize equipment performance.	A
CO-03	Implement strategies for wear reduction and corrosion prevention.	An
CO-04	Utilize fault tracing techniques to diagnose equipment problems efficiently.	A, An
CO-05	Develop and execute periodic and preventive maintenance programs for machinery and equipment	A, An, E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	S	S	M	M	S	M	M	M	M	M	S
CO-02	S	S	S	M	M	M	M	M	M	M	M	M
CO-03	S	S	S	M	M	M	S	M	M	M	S	S
CO-04	S	S	M	S	M	M	M	M	S	M	M	M
CO-05	S	M	M	M	M	S	M	S	S	M	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

UNIT I

9

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II

9

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III

9

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications,

i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV

9

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V

9

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

TOTAL: 45 PERIODS

REFERENCE BOOKS:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OE45D4	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course the student will be able to

- Formulate and solve optimization problems using simplex method, sensitivity analysis, and parametric programming.
- Apply linear programming to model real-world scenarios, understand duality theory, and analyze sensitivity.
- Solve nonlinear programming problems with Kuhn-Tucker conditions.
- Develop scheduling and sequencing models for resource utilization and inventory control.
- Apply competitive modeling, dynamic programming, and game theory to optimize decision-making in various scenarios.

Course Outcome		Cognitive Skill
CO-01	Formulate and solve optimization problems using simplex method, sensitivity analysis, and parametric programming.	A
CO-02	Apply linear programming to model real-world scenarios, understand duality theory, and analyze sensitivity.	A, U
CO-03	Solve nonlinear programming problems with Kuhn-Tucker conditions.	A, An
CO-04	Develop scheduling and sequencing models for resource utilization and inventory control.	A, E
CO-05	Apply competitive modeling, dynamic programming, and game theory to optimize decision-making in various scenarios.	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	M	M	M	S	M	S	M	M	S	S
CO-02	S	S	S	M	M	M	M	S	M	M	S	M
CO-03	S	M	S	M	M	M	S	M	M	M	S	S
CO-04	S	S	M	S	M	M	M	M	S	M	S	M
CO-05	S	M	M	M	M	S	M	S	S	M	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I

9

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

UNIT II

9

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

UNIT III

9

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

UNIT IV**9**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V**9**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

TOTAL: 45 PERIODS**REFERENCE BOOKS:**

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

OE45D5	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course the student will be able to

- Understand the classification, characteristics, and advantages of composite materials, along with their applications in various industries.
- Demonstrate knowledge of different reinforcements used in composites and their preparation methods, properties, and applications.
- Gain proficiency in manufacturing metal matrix composites, ceramic matrix composites, and polymer matrix composites, including understanding the processes involved and their resulting properties.
- Analyze the mechanical behavior and strength of composite materials, including failure criteria and design considerations for laminated structures.
- Apply learned concepts to solve real-world problems related to the design, manufacturing, and application of composite materials in engineering projects.

Course Outcome		Cognitive Skill
CO-01	Understand the classification, characteristics, and advantages of composite materials, along with their applications in various industries.	U
CO-02	Demonstrate knowledge of different reinforcements used in composites and their preparation methods, properties, and applications.	A, An
CO-03	Gain proficiency in manufacturing metal matrix composites, ceramic matrix composites, and polymer matrix composites, including understanding the processes involved and their resulting properties.	U, An, E
CO-04	Analyze the mechanical behavior and strength of composite materials, including failure criteria and design considerations for laminated structures.	An
CO-05	Apply learned concepts to solve real-world problems related to the design, manufacturing, and application of composite materials in engineering projects.	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	S	M	M	M	S	M	M	M	M	M	S
CO-02	M	S	S	M	M	M	M	M	M	M	M	M
CO-03	M	S	S	M	M	M	S	M	M	M	S	S
CO-04	M	S	M	S	M	M	M	M	S	M	M	M
CO-05	M	S	M	M	M	S	M	S	S	M	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I: INTRODUCTION

9

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II: REINFORCEMENTS

9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT III: MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT IV: MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT V: STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCES:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

OE45D6	WASTE TO ENERGY	L	T	P	C
		3	0	0	3

Course Outcomes:

At the end of the course the student will be able to

- Identify and classify waste types for energy generation.
- Apply biomass pyrolysis and gasification techniques.
- Understand biomass combustion principles and technologies.
- Analyze biogas properties, plant technology, and applications.
- Evaluate biomass conversion processes and related energy programs.

Course Outcome		Cognitive Skill
CO-01	Identify and classify waste types for energy generation.	U, An
CO-02	Apply biomass pyrolysis and gasification techniques.	A, S
CO-03	Understand biomass combustion principles and technologies.	U, A
CO-04	Analyze biogas properties, plant technology, and applications.	An
CO-05	Evaluate biomass conversion processes and related energy programs.	A, An, E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	M	M	S	S	M	S	M	S	M	M	S	S
CO-02	M	M	S	S	M	M	M	S	M	M	S	S
CO-03	M	M	S	S	M	M	S	S	M	M	S	S
CO-04	M	M	S	S	M	M	M	S	S	M	S	S
CO-05	M	M	S	S	M	S	M	S	S	M	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

UNIT I: INTRODUCTION TO ENERGY FROM WASTE

9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT II: BIOMASS PYROLYSIS

9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III: BIOMASS GASIFICATION

9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier

engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV: BIOMASS COMBUSTION

9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V: BIOGAS

9

Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

REFERENCES:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.