



FRANCIS XAVIER[™]
ENGINEERING COLLEGE
AN AUTONOMOUS INSTITUTION

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CURRICULUM AND SYLLABI

Choice Based Credit System

Regulations 2019

M.E – Computer Science and Engineering

(With Specialization in Networks)

Department Vision

“To become a center of excellence in Computer Science and Engineering and Research to create global leaders with holistic growth and ethical values for the industry and academics”

Department Mission

- To produce technocrats in the industry and academia by educating computer concepts and techniques.
- To facilitate the students to trigger more creativity by applying modern tools and technologies in the field of computer science and engineering
- To inculcate the spirit of ethical values contributing to the welfare of the society.

**DEPARTMENT OF COMPUTER SCIENCE AND
ENGINEERING**

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- PEO 1 Engineering basics:** To communicate deep knowledge on basic sciences and applications of basic sciences in engineering.
- PEO 2 Career Development:** To assimilate the knowledge on basic sciences and engineering concepts to address industrial, social and environmental issues and to innovate technologies for betterment.
- PEO 3 Leadership responsibilities:** To develop interpersonal skills to strengthen team work, leadership quality and to promote awareness about continual learning not limited to higher studies.
- PEO 4 Professional qualification:** To boost professionalism in problem solving through moral and professional ethics shouldering social task.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

- PO1 Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
- PO3 Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4 Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- PO5 Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- PO6 The Engineer and Society:** Apply reasoning informed by the contextual knowledge to

assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

- PO7 Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8 Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9 Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10 Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- PO11 Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO12 Life-Long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

- PSO1 Basic Engineering :** To analyze, design and develop computing solutions by applying foundational concepts of Computer Science and Engineering
- PSO2 Software Development :** To apply software engineering principles and practices for developing quality software for scientific and business applications.
- PSO3 Emerging Technologies :** To adapt to emerging Information and Communication Technologies (ICT) to innovate ideas and solutions to existing/novel problems.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)	PROGRAMME OUTCOMES (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
PEO 1	3	3	3	3	2	3					2	2
PEO 2	3			3			3					3
PEO 3						2	1		3		2	
PEO 4						3		3				

1→Low 2→Medium 3→High

MAPPING OF PROGRAMME SPECIFIC OUTCOMES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Outcomes and the Programme outcomes is given in the following Table

PROGRAMME SPECIFIC OUTCOMES(PSO)	PROGRAMME OUTCOMES (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
PSO 1	3		3					3				
PSO 2		3	3		2	1	2			2	3	
PSO 3					3					1		2

1→Low 2→Medium 3→High

M.E COMPUTER SCIENCE AND ENGINEERING (with specialization in Networks)
REGULATIONS 2019
CHOICE BASED CREDIT SYSTEM

SUMMARY OF CREDIT DISTRIBUTION

S. No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS IN %	Range Of Total Credits	
		I	II	III	IV							Min	Max
1	FC	4								4	5.714%	5%	10%
2	PC	18	14							32	45.714%	15%	20%
3	PE		6	9						15	21.429%	15%	20%
4	EEC		1	6	12					19	27.143%	5%	10%
	TOTAL	22	21	15	12					70	100%	-	-

FC - Foundation Courses

PC - Professional Core

PE - Professional Elective

EEC - Employability Enhancement Course

M.E COMPUTER SCIENCE AND ENGINEERING (with specialization in Networks)**REGULATIONS 2019****CHOICE BASED CREDIT SYSTEM****I – IV SEMESTERS CURRICULUM AND SYLLABI**

FIRST SEMESTER							
Code No.	Course	Category	L	T	P	C	H
19MA1251	Mathematical Foundations for Computer Science	FC	4	0	0	4	4
19CP1601	Advanced Data Structures and Algorithms	PC	4	0	0	4	4
19CP1602	Advanced Computer Architecture	PC	3	0	0	3	3
19CP1603	Advanced Operating Systems	PC	3	0	0	3	3
19CP1604	Machine Learning Techniques	PC	3	0	0	3	3
19CP1605	Advanced Software Engineering	PC	3	0	0	3	3
19NE1611	Data Structures Laboratory		0	0	4	2	4
TOTAL			20	0	4	22	24

SECOND SEMESTER							
Code No.	Course	Category	L	T	P	C	H
19NE2601	Network Design and Programming	PC	3	0	0	3	3
19NE2602	Network Security	PC	3	0	0	3	3
19CP2603	Internet of Things	PC	3	0	0	3	3
19NE2604	Wireless Technologies	PC	3	0	0	3	3
	Professional Elective –I	PC	3	0	0	3	3
	Professional Elective –II	PC	3	0	0	3	3
19NE2611	Network Design and Programming Laboratory	PC	0	0	4	2	2
19NE2912	Term Paper Writing and Seminar	EEC	0	0	2	1	1
TOTAL			18	0	6	21	24

THIRD SEMESTER							
Code No.	Course	Category	L	T	P	C	H
	Professional Elective –III	PE	3	0	0	3	3
	Professional Elective –IV	PE	3	0	0	3	3
	Professional Elective –V	PE	3	0	0	3	3
19NE3911	Project Phase – I	EEC	0	0	12	6	12
TOTAL			9	0	12	15	21
FOURTH SEMESTER							
Code No.	Course	Category	L	T	P	C	H
19NE4911	Project Phase – II	EEC	0	0	24	12	24
TOTAL			0	0	24	12	24

L Lecture

T Tutorial

P Practical

H Hours

Code No.	Course	L	T	P	C
PROFESSIONAL ELECTIVES					
PROFESSIONAL ELECTIVE I					
19CP2709	Software Architectures and Design	3	0	0	3
19NE2702	Image and Video Processing	3	0	0	3
19NE2703	Mobile Application Development	3	0	0	3
19NE2704	Block Chain Technology	3	0	0	3
PROFESSIONAL ELECTIVE II					
19NE2705	Multimedia Communication Networks	3	0	0	3
19NE2706	Mobile and Pervasive Computing	3	0	0	3
19NE2707	Simulation of Computer Systems and Networks	3	0	0	3
19NE2708	High Speed Switching Architectures	3	0	0	3
PROFESSIONAL ELECTIVE III					
19NE3701	Network Management	3	0	0	3
19NE3702	Network Performance Analysis	3	0	0	3
19NE3703	Next Generation Networks	3	0	0	3
19NE3704	Software Defined Networks and Network Function Virtualization (SDN and NFV)	3	0	0	3
PROFESSIONAL ELECTIVE IV					
19NE3705	Embedded Software Development	3	0	0	3
19NE3706	Protocols and Architectures for Wireless Sensor Networks	3	0	0	3
19NE3707	Information Storage Management	3	0	0	3

Code No.	Course	L	T	P	C
19NE3708	Cloud Computing and Big Data	3	0	0	3
PROFESSIONAL ELECTIVE V					
19NE3709	Social Network Analysis	3	0	0	3
19NE3710	Web Engineering	3	0	0	3
19NE3711	Ethical Hacking	3	0	0	3
19NE3712	Digital Forensics	3	0	0	3
EMPLOYABILITY ENHANCEMENT COURSE (EEC)					
19NE2912	Term Paper Writing and Seminar	0	0	2	1
19NE3911	Project Work Phase – I	0	0	12	6
19NE4911	Project Work Phase – II	0	0	24	12
FOUNDATION COURSES (FC)					
19MA1251	Mathematical Foundations for Computer Science	4	0	0	4
PROFESSIONAL CORE (PC)					
19CP1601	Advanced Data Structures and Algorithms	4	0	0	4
19CP1602	Advanced Computer Architecture	3	0	0	3
19CP1603	Advanced Operating System	3	0	0	3
19CP1604	Machine Learning Techniques	3	0	0	3
19CP1605	Advanced Software Engineering	3	0	0	3
19NE1611	Data Structures Laboratory	0	0	4	2
19NE2601	Network Design and Programming	3	0	0	3
19NE2602	Network Security	3	0	0	3

Code No.	Course	L	T	P	C
19CP2603	Internet of Things	3	0	0	3
19NE2604	Wireless Technologies	3	0	0	3
19NE2611	Network Design and Programming Laboratory	0	0	4	2

1. Dallas E. Johnson, —Applied Multivariate Methods for Data Analysis, Thomson and Duxbury press, 1998.
2. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan and Sons, New Delhi, 2001.
3. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers ", Pearson Education, Asia, 8th Edition, 2015.
4. Richard A. Johnson and Dean W. Wichern, —Applied Multivariate Statistical Analysis, 5th Edition, Pearson Education, Asia, 2002.
5. Devore, J. L., —Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage Learning, 2014.

COURSE OUTCOME(S):

- CO101. 1 Basic probability axioms and rules and the moments of discrete and continuous random variables.
- CO101. 2 Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- CO101. 3 Use statistical tests in testing hypotheses on data.
- CO101. 4 Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.
- CO101. 5 Ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO101.	3	2										1
CO101.	3	2										1
CO101.	3	3		2	1	1			1			1
CO101.	3	3		2	1	1			1			1
CO101.	3	3			1	1						1

1→Low 2→Medium 3→High

19CP1601

ADVANCED DATA STRUCTURES AND ALGORITHMS

L T P C
4 0 0 4

OBJECTIVES:

1. To understand the usage of algorithms in computing.
2. To learn and use hierarchical data structures and its operations
3. To learn the usage of graphs and its applications.
4. To select and design data structures and algorithms that is appropriate for problems.

4. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, —Data Structures and Algorithms, Pearson Education, Reprint 2006.

COURSE OUTCOME(S):

- CO102. 1 Design data structures and algorithms to solve computing problems
- CO102. 2 Design algorithms using graph structure to solve real-life problems.
- CO102. 3 Design algorithms using various string matching algorithms to solve real-life problems.
- CO102. 4 Apply suitable design strategy for problem solving.
- CO102. 5 Understand NP Complete and NP Hard Problems.

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO102.	3		2	3	1	1						1
CO102.	3		2	3	1	1					2	1
CO102.	3		2	3	1	1					2	1
CO102.	3	2	2	3	1	1						1
CO102.	3		2	3	1	1						1

1→Low 2→Medium 3→High

19CP1602

ADVANCED COMPUTER ARCHITECTURE

L T P C
3 0 0 3

OBJECTIVES:

1. To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
2. To learn the different multiprocessor issues.
3. To expose the different types of multicore architectures.
4. To understand the design of the memory hierarchy.

PRE-REQUISITE:

- Computer Organization and Architecture

UNIT I FUNDAMENTALS OF COMPUTER DESIGN AND ILP

9

Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP – Multithreading.

UNIT II MEMORY HIERARCHY DESIGN

9

CO103.	3	2	2	2		1					1	2
CO103.	3	2	2	2							1	2
CO103.	3	2	2	3	1						1	2
CO103.	3	3	3	3	1						1	2
CO103.	3			3	1						1	2

1→Low 2→Medium 3→High

19CP1603

ADVANCED OPERATING SYSTEM

L T P C
3 0 0 3

OBJECTIVES:

1. To be able to read and understand sample open source programs and header files.
2. To learn how the processes are implemented in linux.
3. To understand the implementation of the Linux file system.
4. To study Linux memory management data structures and algorithms.
5. To acquire the knowledge in the implementation of interprocess communication.
6. To understand how program execution happens in Linux.

PRE-REQUISITE:

- Operating System

UNIT I INTRODUCTION

9

Basic Operating System Concepts - Overview of Unix File System - Files - Links - Types - Inodes - Access Rights - System Calls - Overview of Unix Kernels -Model - Implementation - Reentrant Kernels - Address Space - Synchronization - Interprocess Communication - Process Management Memory Management - Device Drivers.

UNIT II PROCESSES

9

Processes, Lightweight Processes, and Threads - Process Descriptor - State - Identifying a Process - Relationships among processes - Organization - Resource Limits - Creating Processes - System Calls - Kernel Threads - Destroying Processes -Termination - Removal.

UNIT III FILE SYSTEM

9

The Virtual File System (VFS) - Role - File Model -System Calls - Data Structures - Super Block, Inode, File, dentry Objects - dentry Cache - Files Associated with a Process - Filesystem Types - Special Filesystems - Filesystem Type Registration - Filesystem Handling - Namespaces – Mounting Unmounting - Implementation of VFS System Calls.

UNIT IV MEMORY MANAGEMENT

9

Page frame management -page descriptors - non-uniform memory access - memory zones - reserved page frames - zoned page frame allocator - kernel mappings - buddy system algorithm - page frame cache - zone allocator.

UNIT V PROCESS COMMUNICATION AND PROGRAM EXECUTION 9

Process Communication - Pipes -Usage - Data Structures - Creating and Destroying a Pipe - Reading From and Writing into a Pipe. Program Execution - Executable Files - Process Credentials - Command-Line Arguments and Shell Environment - Libraries - Program Segments and Process Memory Regions - Execution tracing - Executable Formats - Execution Domains - The exec Functions.

Total: 45 Periods

REFERENCE BOOK(S):

1. Daniel P. Bovet and Marco Cesati, "Understanding the Linux Kernel", 3rd Edition, O'Reilly Publications, 2005.
2. Harold Abelson, Gerald Jay Sussman and Julie Sussman, —Structure and Interpretation of Computer Programs, Second Edition, Universities Press, 2013.
3. Maurice J. Bach, —The Design of the Unix Operating System, 1st Edition Pearson Education, 2003.
4. Michael Beck, Harald Bohme, Mirko Dziadzka, Ulrich Kunitz, Robert Magnus, Dirk Verworner, —Linux Kernel Internals, 2nd Edition, Addison-Wesley, 1998.
5. Robert Love, —Linux Kernel Development, 3rd Edition, Addison-Wesley, 2010

COURSE OUTCOME(S):

- CO104. 1 To explain the functionality of a large software system by reading its source.
- CO104. 2 To revise any algorithm present in a system.
- CO104. 3 To design a new algorithm to replace an existing one.
- CO104. 4 To use appropriate algorithm for memory management.
- CO104. 5 To appropriately modify and use the data structures of the linux kernel for a different software system.

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO104.	3	2	2	2	2						1	1
CO104.	3	3	3	3	3						1	1
CO104.	3	3	3	3	3	1					1	1
CO104.	3	3	3	3	3						1	1
CO104.	3	3	3	3	3						1	1

1→Low 2→Medium 3→High

19CP1604**MACHINE LEARNING TECHNIQUES**

L	T	P	C
3	0	0	3

OBJECTIVES:

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To have a thorough understanding of the Supervised and Unsupervised learning techniques
3. To study the various probability based learning techniques
4. To understand graphical models of machine learning algorithms

PRE-REQUISITE:

- Artificial Intelligence

UNIT I INTRODUCTION**9**

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

UNIT II LINEAR MODELS**9**

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back- Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

UNIT III TREE AND PROBABILISTIC MODELS**9**

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map.

UNIT IV DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS**9**

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process.

UNIT V GRAPHICAL MODELS**9**

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods.

Total: 45 Periods

REFERENCE BOOK(S):

1. Ethem Alpaydin, —Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014.
2. Jason Bell, —Machine learning – Hands on for Developers and Technical Professionals, First Edition, Wiley, 2014.
3. Peter Flach, —Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.
4. Stephen Marsland, —Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
5. Tom M Mitchell, —Machine Learning, First Edition, McGraw Hill Education, 2013

COURSE OUTCOME(S):

- CO105. 1 Distinguish between, supervised, unsupervised and semi-supervised learning
- CO105. 2 Apply the appropriate machine learning strategy for any given problem
- CO105. 3 Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem.
- CO105. 4 Design systems that uses the appropriate graph models of machine learning
- CO105. 5 Modify existing machine learning algorithms to improve classification efficiency.

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO105.	3										1	2
CO105.	2	3	3	3							1	2
CO105.	2	3	2	3							1	2
CO105.	3	2	3	3	2	1					1	2
CO105.	2	3	3	3							1	2

1→Low 2→Medium 3→High

19CP1605

ADVANCED SOFTWARE ENGINEERING

L T P C
3 0 0 3

OBJECTIVES:

1. To understand Software Engineering Lifecycle Models
2. To do project management and cost estimation

3. To gain knowledge of the System Analysis and Design concepts.
4. To understand software testing approaches
5. To be familiar with DevOps practices

PRE-REQUISITE:

- Software Engineering

UNIT I INTRODUCTION 9

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management Project planning – Estimation – Scheduling – Risk management – Software configuration management.

UNIT II SOFTWARE REQUIREMENT SPECIFICATION 9

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram.

UNIT III ARCHITECTURE AND DESIGN 9

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client- server - Tiered - Pipe and filter.- User interface design.

UNIT IV TESTING 9

Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking.

UNIT V DEVOPS 9

DevOps:Motivation-Cloud as a platform-Operations- Deployment Pipeline:Overall Architecture-Building and Testing-Deployment- Case study: Migrating to Microservices.

Total: 45 Periods**REFERENCE BOOK(S):**

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2nd edition, Pearso Education, 2004.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2nd edition, PHI Learning Pvt. Ltd., 2010.
3. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.

4. Len Bass, Ingo Weber and Liming Zhu, —DevOps: A Software Architect's Perspective, Pearson Education, 2016
5. Rajib Mall, Fundamentals of Software Engineering, 3rd edition, PHI Learning Pvt. Ltd., 2009.
6. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007.

COURSE OUTCOME(S):

- CO106. 1 Understand the advantages of various Software Development Lifecycle Models
- CO106. 2 Gain knowledge on project management approaches as well as cost and schedule estimation strategies
- CO106. 3 Perform formal analysis on specifications, Use UML diagrams for analysis and design
- CO106. 4 Architect and design using architectural styles and design patterns
- CO106. 5 Understand software testing approaches and the advantages of DevOps practices

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO106.	3		3	3	3	3	3					
CO106.	3		1	3	3	2	3					
CO106.	3		3	2	3	3	3					
CO106.	3		3	3	3	3	2					
CO106.	3		3	2	3	3	3					

1→Low 2→Medium 3→High

19NE1611**DATA STRUCTURES LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVES:

1. To acquire the knowledge of using advanced tree structures.
2. To learn the usage of heap structures.
3. To understand the usage of graph structures and spanning trees

PRE-REQUISITE:

- Data Structures

LIST OF EXPERIMENTS:

Each student has to work individually on assigned lab exercises. Lab sessions could be scheduled as one contiguous four-hour session per week or two two-hour sessions per week. There will be about 15 exercises in a semester. It is recommended that all implementations are carried out in Java. If C or C++

has to be used, then the threads library will be required for concurrency. Exercises should be designed to cover the following topics:

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

Total: 60 Periods

COURSE OUTCOME(S):

- CO107. 1 Design and implement basic and advanced data structures extensively.
- CO107. 2 Design algorithms using graph structures
- CO107. 3 Design and develop efficient algorithms with minimum complexity using design techniques

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO107.	3	2	3		3							1
CO107.	3	2	3		3							1
CO107.	3	2	3		3							1

1→Low 2→Medium 3→High

19NE2601

NETWORK DESIGN AND PROGRAMMING

L T P C
3 0 0 3

OBJECTIVES:

1. To understand the basic networking principles
2. To explore various networking devices and protocols required for network design and management
3. To study two novel networking technologies: SDN and DTN
4. To learn network programming in UNIX C

PRE-REQUISITE:

- Computer Networks

UNIT I NETWORKING PRINCIPLES 9

Advanced multiplexing – Code Division Multiplexing, DWDM and OFDM – Shared media networks – Collision detection and collision avoidance, Hidden and Exposed Terminals – Switched networks – Datagrams, Virtual circuits, Cell switching and Label switching – Wireless Networks – Infrastructure based, ad hoc and hybrid – End to end semantics – Connectionless, Connection oriented, Wireless Scenarios –Applications, Quality of Service – End to end level and network level solutions.

UNIT II PHYSICAL NETWORK DESIGN 9

LAN cabling topologies – Ethernet Switches – High speed and Gigabit and 10Gbps – Building cabling topologies and Campus cabling topologies – Routers, Firewalls and L3 switches –Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP - WAN Design and Enterprise Networks – Core networks, distribution networks and access networks.

UNIT III LOGICAL DESIGN AND MANAGEMENT 9

IPv4 and IPv6 Dynamic Addressing –Hierarchical routing – VLSM and CIDR – Transition from IPv4 to IPv6 – NAT and DHCP – Static and Dynamic routes – RIP, OSPF and BGP – VPN –RMON and SNMP.

UNIT IV INNOVATIVE NETWORKS 9

Software Defined Networks – Evolution of switches and control planes – Centralized and distributed data and control planes – OpenFlow and SDN Controllers – Network Function Virtualization – Needs of the Data Centres – SDN solutions for data centres - Delay Tolerant Networks – Overlay architecture – Bundle Protocol – Opportunistic routing and Epidemic routing .

UNIT V NETWORK PROGRAMMING IN UNIX C 9

Socket address structures – Byte ordering and byte manipulation functions – Elementary TCP sockets – socket, connect, bind, listen, accept and close functions – TCP client and server – Elementary UDP sockets –recvfrom and sendto functions , connect function with UDP – Raw sockets – Client-server design alternatives – Iterative and Concurrent servers

Total: 45 Periods**REFERENCE BOOK(S):**

1. Larry Peterson and Bruce Davie, —Computer Networks: A Systems Approach, 5th edition, Morgan Kauffman, 2011

2. ParitoshPuri, M.P.Singh,||Asurvey paper on routing in delay tolerant networks||, International Conference on Information and Computer Networks (ISCON), 2013, DOI:10.1109/ICISCON 2013.6524206
3. Paul Goransson, Chuck Black, —Software Defined Networks: A Comprehensive Approach||, Morgan Kauffman, 2014
4. W.Richard Stevens, Bill Fenner and Andrew M Rudoff, —Unix Network Programming: The Sockets Networking API: Volume 1||, 3rd Edition, Addison Wesley, 2003
5. Ying Dar Lin, Ren-Hung Hwang and Fred Baker, —Computer Networks: An Open Source Approach||, McGraw Hill, 2011.

COURSE OUTCOME(S):

- CO201. 1 Design and implement LANs and internetworks
- CO201. 2 Develop network based applications in UNIX C and Python
- CO201. 3 Develop and analyze the performance of various TCP variants using an FTP application
- CO201. 4 Develop a dynamic routing based internetwork with 2 routers and two or more LANs using RIP/OSPF and check the connectivity and configuration
- CO201. 5 Develop a LAN with a switch/hub with 3 PCs and check the connectivity and configuration

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO201.	3		3	3		3	3					
CO201.	3	3	3	3		3	3					
CO201.	3		3	3		3	3					
CO201.	3		3	3		3	3					
CO201.	3		3	3		3	3					

1→Low 2→Medium 3→High

19NE2602**NETWORK SECURITY**

L T P C
3 0 0 3

OBJECTIVES:

1. To understand the fundamentals of network security
2. To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
3. To understand the various key distribution and management schemes.
4. To understand how to deploy encryption techniques to secure data in transit across data networks

5. To design security applications in the field of Information technology

PRE-REQUISITE:

- Cryptography and Network Security

UNIT I INTRODUCTION 10

Services, Mechanisms and attacks-Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).FINITE FIELDS AND NUMBER THEORY: Groups, Rings, Fields-Modular arithmetic-Euclid's algorithm-Finite fields- Polynomial Arithmetic –Prime numbers-Fermat's and Euler's theorem-Testing for primality -The Chinese remainder theorem- Discrete logarithms.

UNIT II BLOCK CIPHERS & PUBLIC KEY ENCRYPTION 10

Data Encryption Standard-Block cipher design principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES-Blowfish-RC5 algorithm. Public key encryption: Principles of public key cryptosystems-The RSA algorithm – Key Management -Diffie Hellman Key exchange-Elliptic curve arithmetic-Elliptic curve cryptography.

UNIT III HASH FUNCTIONS AND DIGITAL SIGNATURES 9

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC –MD5 - SHA - HMAC – CMAC - Digital signature and authentication protocols – DSS – El Gamal – Schnorr.

UNIT IV E-MAIL, IP & WEB SECURITY 8

E-mail Security: Pretty Good Privacy-S/MIME. IPSecurity: Overview of IPsec - IP security policy- Encapsulation Security Payload (ESP)-Combining Security Associations-Internet Key Exchange. Web Security: Web Security Considerations-Secure Socket Layer(SSL)-Transport Layer Security(TLS)- - Secure Electronic Transaction (SET).

UNIT V SYSTEM SECURITY 8

Authentication applications – Kerberos – X.509 Authentication services - Firewalls – Types of Firewalls- Firewall design principles- Trusted System. Intruders – Intrusion detection – Viruses and related threats – Virus Countermeasures.

Total: 45 Periods

REFERENCE BOOK(S):

1. Behrouz A. Ferouzan, —Cryptography & Network Security, Tata Mc Graw Hill, 2007.
2. Bruce Schneier and Neils Ferguson, —Practical Cryptography, First Edition, Wiley Dreamtech India Pvt Ltd, 2003.

3. Charles Pfleeger, —Security in Computing, 4th Edition, Prentice Hall of India, 2006.
4. Charlie Kaufman and Radia Perlman, Mike Speciner, —Network Security, Second Edition, Private Communication in Public World, PHI 2002.
5. Douglas R Simson —Cryptography – Theory and practice, First Edition, CRC Press, 1995.
6. <http://nptel.ac.in/>.
7. Man Young Rhee, —Internet Security: Cryptographic Principles, —Algorithms and Protocols, Wiley Publications, 2003.
8. Ulysess Black, —Internet Security Protocols, Pearson Education Asia, 2000.
9. William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education, March 2013.

COURSE OUTCOME(S):

- CO202. 1 Compare various Security Techniques Design Secure applications Inject secure coding in the developed applications
- CO202. 2 Implement basic security algorithms required by any computing system
- CO202. 3 Analyze the vulnerabilities in any computing system and hence be able to design a security solution
- CO202. 4 Analyze the possible security attacks in complex real time systems and their effective countermeasures
- CO202. 5 Identify the security issues in the network and resolve it.
- CO202. 6 Evaluate security mechanisms using rigorous approaches, including theoretical derivation, modeling, and simulations
- CO202. 7 Formulate research problems in the computer security field

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO202. 1	3	2										2
CO202. 2	3		2	2							2	2
CO202. 3	3	3									2	2
CO202. 4	3	3									2	2
CO202. 5	3											2
CO202. 6	3											2
CO202. 7	3			2							2	2

1→Low 2→Medium 3→High

19CP2603

INTERNET OF THINGS

L T P C
3 0 0 3

OBJECTIVES:

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

PRE-REQUISITE:

- Networks

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 BUILDING IoT WITH RASPBERRY PI & ARDUINO 9

Building IOT with RASPBERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & EndPoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

UNIT V CASE STUDIES AND REAL-WORLD APPLICATIONS 9

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs – Cloud for IoT - Amazon Web Services for IoT.

Total: 45 Periods**REFERENCE BOOK(S):**

1. Arshdeep Bahga, Vijay Madiseti, —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. Honbo Zhou, —The Internet of Things in the Cloud: A Middleware Perspective, CRC Press, 2012.
4. Jan Höller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi, —The Internet of Things – Key applications and Protocols, Wiley, 2012.

COURSE OUTCOME(S):

- CO203. 1 Analyze various protocols for IoT
- CO203. 2 Develop web services to access/control IoT devices.
- CO203. 3 Design a portable IoT using Raspberry Pi
- CO203. 4 Deploy an IoT application and connect to the cloud.
- CO203. 5 Analyze applications of IoT in real time scenario

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO203.	3	2		2		1					1	2
CO203.	3		3			1					1	2
CO203.	3				3	1					1	2
CO203.	3	2		2	2	1					1	2
CO203.	3					1					1	2

1→Low 2→Medium 3→High

19NE2604

WIRELESS TECHNOLOGIES

L T P C
3 0 0 3

OBJECTIVES:

1. To understand the concepts of various wireless technologies
2. To review the concepts of wireless networks
3. To explore the emerging wireless technologies and their potential impact

PRE-REQUISITE:

- Mobile Computing

UNIT I

WIRELESS LAN and PAN

9

7. Vijay. K. Garg, —Wireless Communication and Networking, Morgan Kaufmann Publishers, 2007.

COURSE OUTCOME(S):

- CO204. 1 To design the various wireless networks.
- CO204. 2 To be able to design the 4G and LTE networks
- CO204. 3 To design application sensor networks
- CO204. 4 To design Heterogeneous networks
- CO204. 5 To analyze the security protocols

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO204. 1	3		3								2	2
CO204. 2	3		3								2	2
CO204. 3	3		3								2	2
CO204. 4	3		3								2	2
CO204. 5	3			2	3						1	2

1→Low 2→Medium 3→High

19NE2611 NETWORK DESIGN AND PROGRAMMING LABORATORY **L T P C**
0 0 4 2

OBJECTIVES:

- To practice LAN and WAN design
- To learn network programming in UNIX C and Python
- Establish a LAN with a switch/hub with 3 PCs and check the connectivity and configuration
- Establish a internetwork with 2 routers and two or more LANs using static routes and check the connectivity and configuration
- Establish a dynamic routing based internetwork with 2 routers and two or more LANs using RIP/OSPF and check the connectivity and configuration
- In the internetwork created in experiment number 4, analyze the performance of various TCP variants using an FTP application

PRE-REQUISITE:

- Computer Networks

LIST OF EXPERIMENTS:

- Develop a C program that demonstrates inter process communication
- Develop a TCP client/server application

3. Develop a UDP client/server application
4. Develop an Iterative UDP server with 2 or 3 clients
5. Develop a concurrent TCP server with 2 or 3 clients
6. Develop a multiprotocol server with TCP and UDP and 2 clients
7. Develop simple Python programs that use frequently used syntactic constructs
8. Develop a Socket based application in Python
9. Build client applications for major APIs (Amazon S3, Twitter etc) in Python
10. Develop an application that interacts with e-mail servers in python
11. Develop applications that work with remote servers using SSH, FTP etc in Python

Total: 60 Periods

COURSE OUTCOME(S):

CO207. 1 Design and implement LANs

CO207. 2 Design and implement internetworks

CO207. 3 Develop network based applications in UNIX C and Python

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO207. 1	3		3	3							2	2
CO207. 2	3		3	3							2	2
CO207. 3	3		3	3	3						2	2

1→Low 2→Medium 3→High

19NE2912

TERM PAPER WRITING AND SEMINAR

L T P C
0 0 2 1

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.

6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained. Activities to be carried out.

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic	You are requested to select an area of interest, topic and state an objective	2 nd week	3 % Based on clarity of thought, current relevance and clarity in writing
Stating an Objective			
Collecting Information about your area & topic	<ol style="list-style-type: none"> 1. List 1 Special Interest Groups or professional society 2. List 2 journals 3. List 2 conferences, symposia or workshops 4. List 1 thesis title 5. List 3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in your area 7. Attach a call for papers (CFP) from your area. 	3 rd week	3% (the selected information must be area specific and of international and national standard)
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	<ul style="list-style-type: none"> • You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read - try to: <ul style="list-style-type: none"> • Pick papers that are related to each other in some ways and/or that are in the same field so 	4 th week	6% (the list of standard papers and reason for selection)

	<p>that you can write a meaningful survey out of them,</p> <ul style="list-style-type: none"> • Favour papers from well-known journals and conferences, • Favour -first or -foundational papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships with respect to each other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered 		
<p>Reading and notes for first 5 papers</p>	<p>Reading Paper Process</p> <ul style="list-style-type: none"> • For each paper • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on 	<p>5th week</p>	<p>8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)</p>

	<p>other's work, in the author's opinion?</p> <ul style="list-style-type: none"> • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? <p>Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)</p>		
Reading and notes for next 5 papers	Repeat Reading Paper Process	6 th week	8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for final 5 papers	Repeat Reading Paper Process	7 th week	8% (the table given should indicate your understanding of the paper and the evaluation is based on

			your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8 th week	8% (this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9 th week	6% (Clarity, purpose and conclusion) 6% Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10 th week	5% (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11 th week	10% (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12 th week	5% (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13 th week	10% (formatting, English, Clarity and linking) 4% Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14 th & 15 th week	10% (based on presentation and Viva-voce)

Total: 30 Periods

19CP2709

SOFTWARE ARCHITECTURES AND DESIGN

L T P C
3 0 0 3

OBJECTIVES:

1. To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation.
2. To learn the design principles and to apply for large scale systems
3. To design architectures for distributed heterogeneous systems ,environment through brokerage interaction
4. To build design knowledge on service oriented and model driven architectures and the aspect oriented architecture.

5. To develop appropriate architectures for various Case studies like semantic web services, supply chain cloud services.

PRE-REQUISITE:

- Distributed Systems

UNIT I INTRODUCTION TO SOFTWARE ARCHITECTURE 9

Introduction to Software Architecture-Bridging Requirements and Implementation, Design Guidelines, Software Quality attributes. Software Architecture Design Space. Agile Approach to Software Architecture Design, Models for Software Architecture Description Languages (ADL).

UNIT II OBJECT-ORIENTED PARADIGM 9

Object-Oriented Paradigm -Design Principles. Data-Centered Software Architecture: Repository Architecture, Blackboard Architecture. Hierarchical Architecture Main-Subroutine, Master-Slave, Layered, Virtual Machine. Interaction-Oriented Software Architectures: Model-View-Controller (MVC), Presentation-Abstraction-Control (PAC)

UNIT III DISTRIBUTED ARCHITECTURE 9

Distributed Architecture: Client-Server, Middleware, Multi-tiers, Broker Architecture – MOM,CORBA Message Broker Architecture- Service-Oriented Architecture (SOA), SOAP, UDDI, SOA Implementation in Web Services, Grid/cloud Service Computing. Heterogeneous Architecture-Methodology of Architecture Decision, Quality Attributes.

UNIT IV USER INTERFACES CONTAINERS 9

Architecture of User Interfaces containers, case study-web service. Product Line Architectures - methodologies, processes and tools. Software Reuse and Product Lines -Product Line Analysis, Design and implementation, configuration Models. Model Driven Architectures (MDA) –why MDA-Model transformation and software architecture, SOA and MDA. Eclipse modeling framework.

UNIT V ASPECT ORIENTED ARCHITECTURES 9 Aspect

Oriented Architectures- AOP in UML,AOP tools, Architectural aspects and middleware Selection of Architectures, Evaluation of Architecture Designs, Case Study: Online Computer Vendor, order processing, manufacture &shipping –inventory, supply chain cloud service Management, semantic web services.

Total: 45 Periods

REFERENCE BOOK(S):

1. Essentials of software Architecture , Ion Gorton, Second Edition, Springer-verlag, 2011.
2. Software Architecture Design Illuminated, Kai Qian Jones and Bartlett Publishers Canada, 2010.

COURSE OUTCOME(S):

- CO201-1. 1 Understand the need of software architecture for sustainable dynamic systems
- CO201-1. 2 Sound knowledge on design principles and to apply for large scale systems
- CO201-1. 3 Ability to design architectures for distributed heterogeneous systems
- CO201-1. 4 Good knowledge on service oriented and model driven architectures and the aspect oriented architecture
- CO201-1. 5 Working knowledge to develop appropriate architectures through various case studies

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO201-	3										1	2
CO201-	3			2							1	2
CO201-	3		2								1	2
CO201-	3			2							1	2
CO201-	3			2							1	2

1→Low 2→Medium 3→High

19NE2702

IMAGE AND VIDEO PROCESSING

L T P C
3 0 0 3

OBJECTIVES:

1. To understand the image processing concepts and analysis
2. To understand the image processing techniques
3. To familiarize the image processing environment and their applications,
4. To appreciate the use of image processing in various applications
5. To understand the video processing concepts

PRE-REQUISITE:

- Digital Image Processing

UNIT I IMAGE PROCESSING FUNDAMENTALS

9

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical, statistical and spatial operations.

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9

Image Transforms -Discrete and Fast Fourier Transform and Discrete Cosine Transform ,Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models.

UNIT III IMAGE SEGMENTATION AND MORPHOLOGY 9

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations Distance Transforms- Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions- Component Labeling – Regional descriptors and Feature Selection Techniques.

UNIT IV IMAGE ANALYSIS AND CLASSIFICATION 9

Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification.

UNIT V BASIC STEPS OF VIDEO PROCESSING 9

Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations.

Total: 45 Periods

REFERENCE BOOK(S):

1. Alasdair McAndrew, —Introduction to Digital Image Processing with Matlab, Cengage Learning 2011,India.
2. Anil J Jain, —Fundamentals of Digital Image Processing, PHI, 2006.
3. Yao wang, Joem Ostarmann and Ya – quin Zhang, ”Video processing and communication “,1st edition , PHI.
4. Kavyan Najarian and Robert Splerstor, Biomedical signals and Image processing, CRC – Taylor and Francis, New York, 2006
5. Rafael C.Gonzalez and Richard E.Woods, —Digital Image Processing, Third Edition, Pearson Education, 2008, New Delhi.
6. S.Sridhar, —Digital Image Processing, Oxford University Press, 2011.

COURSE OUTCOME(S):

CO201-2.1 Design and implement algorithms for image processing applications that

incorporates different concepts of medical Image Processing

CO201-2. 2 Familiar with the use of MATLAB and its equivalent open source tools.

CO201-2. 3 Critically analyze different approaches to image processing applications

CO201-2. 4 Explore the possibility of applying Image processing concepts in various applications

CO201-2. 5 Critically analyze different approaches to video processing applications

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO201-	3		3								1	2
CO201-	3				2						1	2
CO201-	3	2									1	2
CO201-	3			2							1	2
CO201-	3	2									1	2

1→Low 2→Medium 3→High

19NE2703

MOBILE APPLICATION DEVELOPMENT

L T P C
3 0 0 3

OBJECTIVES:

1. Understand system requirements for mobile applications.
2. Generate suitable design using specific mobile development frameworks.
3. Generate mobile application design.
4. Implement the design using specific mobile development frameworks.
5. Deploy the mobile applications in marketplace for distribution

PRE-REQUISITE:

- Java Programming

UNIT I INTRODUCTION

9

Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications.

UNIT II BASIC DESIGN

9

Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for

CO305-2.6 Deploy mobile applications in Android and iPhone marketplace for distribution

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO305-3.1	3		2								2	
CO305-3.2	3	2										2
CO305-3.3	3		2								2	3
CO305-3.4	3		3		2						2	2
CO305-3.5	3		3		2						2	3
CO305-3.6	3		3	2	2						2	3

1→Low 2→Medium 3→High

19NE2704

BLOCK CHAIN TECHNOLOGY

L T P C
3 0 0 3

OBJECTIVES:

1. This course aims to provide conceptual understanding of the function of Block chains as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable. It covers the technological underpinnings of block chain operations as distributed data structures and decision making systems, their functionality and different architecture types. It provides a critical evaluation of existing “smart contract” capabilities and platforms, and examines their future directions, opportunities, risks and challenges.

PRE-REQUISITE:

- Artificial Intelligence

UNIT I

9

The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS).

UNIT II

9

cryptographic basics for cryptocurrency - a short overview of Hashing, signature schemes, encryption schemes and elliptic curve cryptography.

UNIT III

9

Bitcoin - Wallet - Blocks - Merkle Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin.

UNIT IV**9**

Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts.

UNIT V**9**

Zero Knowledge proofs and protocols in Blockchain - Succinct non interactive argument for Knowledge (SNARK) - pairing on Elliptic curves - Zcash.

Total: 45 Periods**REFERENCE BOOK(S):**

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
2. Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 2015 .
3. J.A.Garay et al, The bitcoin backbone protocol - analysis and applications EUROCRYPT 2015 LNCS VOI 9057, (VOLII), pp 281-310.
4. R.Pass et al, Analysis of Blockchain protocol in Asynchronous networks , EUROCRYPT 2017.

COURSE OUTCOME(S):

- CO201-4. 1 Understand the structure of a blockchain and why/when it is better than a simple distributed database
- CO201-4. 2 Analyze the incentive structure in a blockchain based system and critically assess its functions, benefits and vulnerabilities;
- CO201-4. 3 Evaluate the setting where a blockchain based structure may be applied, its potential and its limitations
- CO201-4. 4 Understand what constitutes a “smart” contract, what are its legal implications and what it can and cannot do, now and in the near future
- CO201-4. 5 Analyze to what extent smart and self-executing contracts can benefit automation, governance, transparency and the Internet of Things (IOT)
- CO201-4. 6 Attain awareness of the new challenges that exist in monetizing businesses around blockchains and smart contracts
- CO201-4. 7 Describe and understand the differences between the most prominent blockchain structures and permissioned blockchain service providers, as well as rising alliances and networks.

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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CO201-4. 1	3										3	2
CO201-4. 2	3	3		3							3	2
CO201-4. 3	3										3	2
CO201-4. 4	3		3	3							3	2
CO201-4. 5	2	3		3	1						2	2
CO201-4. 6	2		2								3	2
CO201-4. 7	2										3	2

1→Low 2→Medium 3→High

19NE2705

MULTIMEDIA COMMUNICATION NETWORKS

L T P C
3 0 0 3

OBJECTIVES:

1. To understand the multimedia communication models
2. To study the multimedia transport in wireless networks
3. To explore real-time multimedia network applications

PRE-REQUISITE:

- Computer Networks

UNIT I

MULTIMEDIA COMMUNICATION MODELS

9

Common Multimedia applications - VoIP- Video Conferencing- Military Surveillance- Interactive TV- Video on Demand- Smart Phone - Requirements and Design challenges of multimedia communications- Architecture of Internet Multimedia Communication- Protocol Stack-H.323.

UNIT II

BEST EFFORT AND GUARANTEED SERVICE MODEL

9

Best effort service model and its limitations-Resource allocation-Metrics-Max and Min fair sharing-Queuing-FIFO-Priority queue-Fair queue- Waited fair queue-Traffic policing-Token bucket-leaky bucket-Admission control-Packet classification and scheduling.

UNIT III

MULTIMEDIA ON IP NETWORKS

9

QoS aware routing-RSVP-Integrated and Differentiated services-MPLS-Multicasting-IGMP-PIMDVMRP

UNIT IV

TRANSPORT LAYER SUPPORT FOR MULTIMEDIA

9

Multimedia over TCP-Significance of UDP- Multimedia Streaming- Audio and Video Streaming-Interactive and non Interactive Multimedia-RTP/RTCP-SIP-RTSP.

UNIT V

MULTIMEDIA QOS ON WIRELESS NETWORKS

9

IEEE 802.11e, IEEE 802.16, 3G networks-UMTS, 3GPP, 4G networks-LTE-IMS

Total: 45 Periods

REFERENCE BOOK(S):

1. James F. Kurose and Keith W. Ross, —Computer Networking-A Top-Down Approach Featuring the Internetl, Pearson, 2012.
2. Larry L. Peterson and Bruce S. Davie, —Computer Networks- A Systems Approachl, Morgan Kaufmann Publishers, 2007.
3. Mario Marques da Silva, —Multimedia Communications and Networkingl, CRC Press, 2012.
4. Mark Wuthnow, Jerry Shih, Matthew Stafford, —IMS: A New Model for Blending Applicationsl, Auerbach Publications, 2009.

COURSE OUTCOME(S):

- CO202-1.1 To select suitable multimedia communication model for the required application
- CO202-1.2 Deploy the right Multimedia Communication models
- CO202-1.3 Apply QoS to multimedia network applications with efficient routing techniques
- CO202-1.4 Analyze various transport layer protocols
- CO202-1.5 Develop the real-time multimedia network applications

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO202-1.1	3			3							1	1
CO202-1.2	3		2								2	2
CO202-1.3	3		2	2							2	2
CO202-1.4	3		2	2							2	2
CO202-1.5	3		2	2							2	2

1→Low 2→Medium 3→High

19NE2706

MOBILE AND PERVASIVE COMPUTING

L T P C
3 0 0 3

OBJECTIVES:

1. To learn the basic architecture and concepts till Third Generation Communication systems.
2. To understand the latest 4G Telecommunication System Principles.
3. To introduce the broad perspective of pervasive concepts and management
4. To explore the HCI in Pervasive environment
5. To apply the pervasive concepts in mobile environment

PRE-REQUISITE:

- Mobile Computing

UNIT I INTRODUCTION 9

History – Wireless communications: GSM – DECT – TETRA – UMTS – IMT – 2000 – Blue tooth, WiFi, WiMAX, 3G ,WATM.- Mobile IP protocols -WAP push architecture-Wml scripts and applications. Data networks – SMS – GPRS – EDGE – Hybrid Wireless100 Networks – ATM – Wireless ATM.

UNIT II OVERVIEW OF A MODERN 4G TELECOMMUNICATIONS SYSTEM 9

Introduction. LTE-A System Architecture. LTE RAN. OFDM Air Interface. Evolved Packet Core. LTE Requirements. LTE-Advanced. LTE-A in Release. OFDMA – Introduction. OFDM Principles. LTE Uplink—SC-FDMA. Summary of OFDMA.

UNIT III PERVASIVE CONCEPTS AND ELEMENTS 9

Technology Trend Overview - Pervasive Computing: Concepts - Challenges - Middleware - Context Awareness - Resource Management - Human–Computer Interaction - Pervasive Transaction Processing - Infrastructure and Devices - Wireless Networks - Middleware for Pervasive Computing Systems - Resource Management - User Tracking- Context Management -Service Management - Data Management - Security Management – Pervasive Computing Environments - Smart Car Space - Intelligent Campus.

UNIT IV HCI IN PERVASIVE COMPUTING 9

Prototype for Application Migration - Prototype for Multimodalities - Human–Computer Interface in Pervasive Environments - HCI Service and Interaction Migration - Context- Driven HCI Service Selection - Interaction Service Selection Overview - User Devices - Service-Oriented Middleware Support - User History and Preference - Context Manager - Local Service Matching - Global Combination - Effective Region - User Active Scope - Service Combination Selection Algorithm.

UNIT V PERVASIVE MOBILE TRANSACTIONS 9

Pervasive Mobile Transactions - Introduction to Pervasive Transactions - Mobile Transaction Framework - Unavailable Transaction Service - Pervasive Transaction Processing Framework - Context-Aware Pervasive Transaction Model - Context Model for Pervasive Transaction Processing - Context-Aware Pervasive Transaction Model - A Case of Pervasive Transactions - Dynamic Transaction Management - Context-Aware Transaction Coordination Mechanism - Coordination Algorithm for Pervasive Transactions - Participant Discovery - Formal Transaction Verification - Petri Net with Selective Transition.

Total: 45 Periods**REFERENCE BOOK(S):**

1. Alan Colman, Jun Han, and Muhammad Ashad Kabir, Pervasive Social Computing Socially-Aware Pervasive Systems and Mobile Applications, Springer, 2016.

2. J.Schiller, —Mobile Communication, Addison Wesley, 2000.
3. Juha Korhonen, —Introduction to 4G Mobile Communications, Artech House Publishers, 2014.
4. Kolomvatsos, Kostas, Intelligent Technologies and Techniques for Pervasive Computing, IGI Global, 2013.
5. M. Bala Krishna, Jaime Lloret Mauri, —Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G Networks, CRC 2016.
6. Minyi Guo, Jingyu Zhou, Feilong Tang, Yao Shen, — Pervasive Computing: Concepts, Technologies and Applications, CRC Press, 2016.

COURSE OUTCOME(S):

- CO202-2. 1 Obtain a through understanding of Basic architecture and concepts of till Third Generation Communication systems
- CO202-2. 2 Explain the latest 4G Telecommunication System Principles.
- CO202-2. 3 Incorporate the pervasive concepts
- CO202-2. 4 Implement the HCI in Pervasive environment
- CO202-2. 5 Work on the pervasive concepts in mobile environment

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO202-2. 1	3	3	2	2							2	2
CO202-2. 2	2	2		2	2						2	2
CO202-2. 3	2	2	2	2							2	2
CO202-2. 4	3		3	2							2	2
CO202-2. 5	3										2	2

1→Low 2→Medium 3→High

19NE2707 SIMULATION OF COMPUTER SYSTEMS AND NETWORKS **L T P C**
3 0 0 3

OBJECTIVES:

1. To understand how simulators are built.
2. To understand the statistical models used in simulations.
3. To learn different ways of generating random numbers.
4. To learn modeling of the data given as input to simulators.
5. To understand how computer networks are simulated using case studies.

PRE-REQUISITE:

- Computer Networks

UNIT I	STATISTICAL AND QUEUING MODELS	9
Statistical models – Discrete, continuous and empirical distributions – Characteristics of Queuing systems – Measures of performance of queuing systems – Markovian models.		
UNIT II	RANDOM NUMBER AND RANDOM VARIATE GENERATION	9
Properties of random numbers – Generating uniform random numbers – Generating non-uniform random numbers - Tests for random numbers – Random-variate generation		
UNIT III	ANALYSIS OF SIMULATION DATA	9
Input modeling – Identifying the distribution – Parameter estimation – Goodness-of-fit tests – Multivariate and time-series input models – Verification and validation of simulation models		
UNIT IV	SIMULATION OF COMPUTER NETWORKS	9
Introduction – Performance modeling – Modeling Techniques – Protocol modeling – Workload modeling – Network Topology modeling – Performance metrics in computer network simulation – Validation and verification – Discrete event simulation – GPU-based simulations – Multi-agent-based simulations – Network simulators.		
UNIT V	CASE STUDIES OF NETWORK SIMULATORS	9
NS-3 based Simulative Platform - Evolved packet system – Differentiated services domain – ns-3 simulator – Simulation techniques for next generation wireless heterogeneous networks - Features of common network simulators - OpNet, mininet.		

Total: 45 Periods

REFERENCE BOOK(S):

1. J. B. Sinclair, —Simulation of Computer Systems and Computer Networks: A Process-Oriented Approach, 2004.
2. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, —Discrete-event System Simulation, Fifth Edition, Pearson, 2010.
3. Law, Averill, —Simulation Modeling and Analysis with Expert Software, Mc Graw Hill, 2006.
4. Mohammad S. Obaidat, Petros Nicopolitidis, Faouzi Zarai, —Modeling and Simulation of Computer Networks and Systems – Methodologies and Applications, Morgan Kaufmann, 2015.
5. Sheldon M. Ross, —Simulation, Fifth Edition, Elsevier, 2013.

COURSE OUTCOME(S):

CO202-3. 1 Understand the modeling and development of simulations and simulators

CO202-3. 2 Differentiate the different ways in which simulators are designed

CO202-3. 3 Analyse how computer networks are simulated

CO202-3. 4 Use simulators like ns-3

CO202-3. 5 Compare the features of different simulators

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO202-3. 1	3										1	1
CO202-3. 2	3										2	2
CO202-3. 3	3	3									2	2
CO202-3. 4	3	3			3						2	2
CO202-3. 5	3	3									1	1

1→Low 2→Medium 3→High

19NE2708

HIGH SPEED SWITCHING ARCHITECTURES

L T P C
3 0 0 3

OBJECTIVES:

1. To learn the basics of switching
2. To explore the various space division switches
3. To evaluate the performance of various switching architectures
4. To study the architecture of IP routers
5. To study about MPLS switches

PRE-REQUISITE:

- Computer Architecture

UNIT I

SWITCHING BASICS

9

Circuit switching, Message switching and Packet switching – Datagrams and Virtual circuits – Cell switching – Label switching – L2 switching Vs L3 switching – VLANs – Switching and Bridging – Loop resolution, Spanning tree algorithms – Cut through and Store and forward switches – Head of line blocking – Back pressure – Switch design goals.

UNIT II

SWITCHING ARCHITECTURES

9

Shared medium switches – Shared memory switches – Space division switches – Cross bar based switching architecture – Input queued, Output queued and Combined input-output queued switches – Non blocking and blocking cross bar switches – Banyan networks – Batcher Banyan networks – Optical switches – Unbuffered and buffered switches – Buffering strategies – Optical packet switches and Optical burst switches – MEMS optical switches.

UNIT III PACKET QUEUES AND DELAY ANALYSIS 9

Littles theorem – Birth and death processes – Queuing disciplines – Markovian FIFO queuing – Non Markovian – PollaczekKhinchine formula –M/M/1, M/G/1 and M/D/1 models – Self similar models and Batch arrivals models – Network of queues – Burkes theorem and Jackson theorem.

UNIT IV P ROUTER ARCHITECTURE 9

Bus based router architecture with single processor and multiple processors – Architecture with multiple parallel forwarding engines – Switch based router architecture with multiple processors – Switch based router architecture with multiple processors – Switch based architecture with fully distributed processors – Critical and non critical data path processing – fast and slow path.

UNIT V MPLS ROUTERS 9

MPLS – Layer 2.5 - Labels – Switching and Distribution –Label Switched Path – Label Forwarding Instance Base – Label Stacking - IP Lookup vs Label lookup – Label Distribution Protocol – MPLS based VPNs– Label switching – Label switched path – Comparison with ATM technology.

Total: 45 Periods**REFERENCE BOOK(S):**

1. Damitri P Bertsekas and Gallager, —Data Networks, 2nd edition, PHI, 1992
2. Elhanany, Itamar, Hamdi and Mounir, —High Performance Packet Switching Architectures, Springer 2007
3. H.Jonathan Chao and Bin Liu, —High Performance Switches and Routers, John Wiley and Sons, 2007
4. Howard C Berkowitz, —Designing Routing and Switching Architectures for Enterprise Networks, Sams, 1999
5. Luc De Ghein, —MPLS Fundamentals, Cisco Press 2014.

COURSE OUTCOME(S):

- CO202-4. 1 Apply switching concepts to build networks
- CO202-4. 2 Deploy the network with appropriate type of switches
- CO202-4. 3 Select and configure the appropriate type of IP router
- CO202-4. 4 Analyze P router Architecture
- CO202-4. 5 Design and implement MPLS networks

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO202-4. 1	3		3	2							2	2
CO202-4. 2	3		3	2							2	2
CO202-4. 3	3		3								2	2
CO202-4. 4	3		2								2	2
CO202-4. 5	3		2								2	2

1→Low 2→Medium 3→High

19NE3701

NETWORK MANAGEMENT

L T P C

3 0 0 3

OBJECTIVES:

1. To appreciate the need for interoperable network management as a typical distributed application
2. To familiarize concepts and terminology associated with SNMP
3. To be aware of current trends in network management technologies

PRE-REQUISITE:

- Computer Networks

UNIT I

OSI NETWORK MANAGEMENT

8

OSI Network management model - Organizational model - Information model, Communication model. Abstract Syntax Notation - Encoding Structure, Macros Functional Model CMIP/CMIS.

UNIT II

BROADBAND NETWORK MANAGEMENT

9

Broadband networks and services, ATM Technology - VP, VC, ATM Packet, Integrated service, ATM LAN emulation, Virtual LAN, ATM Network Management - ATM Network reference model, Integrated local Management Interface. ATM Management Information base, Role of SNMP and ILMI in ATM Management, M1, M2, M3, M4 interface. ATM Digital Exchange Interface Management.

UNIT III

SIMPLE NETWORK MANAGEMENT PROTOCOL

10

SNMPv1 Network Management: Communication and Functional Models. The SNMP Communication Model, Functional model. SNMP Management SNMPv2: Major Changes in SNMPv2, SNMPv2 System Architecture, SNMPv2 Structure of Management Information, The SNMPv2 Management Information Base, SNMPv2 Protocol, Compatibility With SNMPv1. Configuration management, Fault management, Performance management, Event Correlation Techniques 168 security management, Accounting management, Report Management, Policy Based Management, Services Level Management.

UNIT IV

NETWORK MANAGEMENT SYSTEMS

9

CO303-1.4	3	3	3	3	2							1
CO303-1.5	3		3		1						1	1

1→Low 2→Medium 3→High

19NE3702

NETWORK PERFORMANCE ANALYSIS

L T P C
3 0 0 3

OBJECTIVES:

1. To understand the mathematical basis for analyzing the performance of networks.
2. To understand queuing theory and queuing models.
3. To analytically model traffic control protocols, and error control protocols using these concepts.
4. To model performance of wired and wireless MAC such as 802.3, 802.11 and 802.16.
5. To model network traffic and study the performance of different packet scheduling algorithms.

PRE-REQUISITE:

- Computer Networks

UNIT I MARKOV CHAINS BASICS

9

Overview of Random Processes, Markov Chains – Markov matrices, State transition matrix, Markov chains at equilibrium – steady state distribution vector.

UNIT II REDUCIBLE AND PERIODIC MARKOV CHAINS

9

Reducible Markov chain – Transition matrix, Reducible Composite Markov chain, Transient analysis, Steady state, Periodic Markov chain – Transition matrix, canonical form, Strongly and weakly periodic Markov chains, Queuing Analysis –M/M/1 queues, M/M/1/B queues, D/M/1/B queues, performance, communicating Markov chains.

UNIT III TRAFFIC CONTROL, ERROR CONTROL AND MAC MODELING

9

Modeling traffic control protocols – Modeling leaky bucket and token bucket algorithms, Modeling Error control protocols - Stop and wait and GBN ARQ performance, Modeling media access control protocols – 802.1p, ALOHA, 802.3.

UNIT IV WIFI AND WIMAX PERFORMANCE

9

Modeling 802.11 protocol – Basic DCF modeling, RTS/CTS modeling, Modeling 802.11e, Performance, 802.11e HCCA Performance. Modeling 802.16 protocol – system and user performance.

UNIT V NETWORK TRAFFIC AND SCHEDULING

9

Modeling network traffic – Flow traffic models – Continuous time modeling, Discrete time modeling, Pareto traffic distribution, Destination traffic. Scheduling algorithms – Analysis.

Total: 45 Periods

REFERENCE BOOK(S):

1. Anurag Kumar, D. Manjunath, Joy Kuri, Communication Networking: An analytical Approach, Elsevier, 2004.
2. Bertsekas D and Gallager R, Data Networks, 2nd Edition, Prentice-Hall, 1992.
3. Fayez Gebali, Analysis of computer networks, 2nd Edition, Springer, 2015.
4. Harrison P G and Patel N M, Performance Modelling of Communication Networks and Computer Architectures, Addison-Wesley, 1993.
5. Robertazzi T G, Computer Networks and Systems: Queuing Theory and Performance Evaluation, 2nd, Edition, Springer-Verlag, 1994.

COURSE OUTCOME(S):

- CO303-2. 1 Apply markov chain models and analyse the behavior of network systems
- CO303-2. 2 Perform queuing theory based analysis of various L2 layer functions, such as flow control, error control, and MAC
- CO303-2. 3 Build network traffic models
- CO303-2. 4 Analyse QoS functions such as scheduling and traffic control
- CO303-2. 5 Analyze the network traffic

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO303-2. 1	3	3	3	3								1
CO303-2. 2	3	3	3	3								1
CO303-2. 3	3	3	3	3								1
CO303-2. 4	3	3	3	3								1
CO303-2. 5	3			2							1	2

1→Low 2→Medium 3→High

19NE3703

NEXT GENERATION NETWORKS

L T P C
3 0 0 3

OBJECTIVES:

1. To learn the technical, economic and service advantages of next generation networks.
2. To learn the evolution of technologies of 4G and beyond.
3. To learn Software defined Mobile Network issues and integrating challenges with LTE.
4. To explore the NGN framework catering the services of end user with QoS provisioning.
5. To learn about the NGM management and standards.

PRE-REQUISITE:

- Computer Networks

UNIT I	INTRODUCTION	9
Evolution of public mobile services -motivations for IP based services, Wireless IP network architecture –3GPP packet data network architecture. Introduction to next generation networks - Changes, Opportunities and Challenges, Technologies, Networks, and Services, Next Generation Society, future Trends.		
UNIT II	4G and BEYOND	9
Introduction to LTE-A –Requirements and Challenges, network architectures –EPC, E-UTRAN architecture-mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.		
UNIT III	SDMN-LTE INTEGRATION	9
SDN paradigm and applications, SDN for wireless-challenges, Leveraging SDN for 5G networks-ubiquitous connectivity-mobile cloud-cooperative cellular network-restructuring mobile networks to SDN-SDN/LTE integration benefits.		
UNIT IV	NGN ARCHITECTURE	9
Evolution towards NGN-Technology requirements, NGN functional architecture- Transport stratum, service stratum, service/ content layer and customer terminal equipment function. NGN entities, Network and Service evolution -fixed, mobile, cable and internet evolution towards NGN.		
UNIT V	NGN MANAGEMENT AND STANDARDIZATION	9
NGN requirements on Management-Customer, third party, Configuration, Accounting, performance, device and information management. Service and control management- End-to-End QoS and security. ITU and GSI-NGN releases, ETSI-NGN concept and releases, NGMN alliance and NGMN.		
		Total: 45 Periods

REFERENCE BOOK(S):

1. Jingming Li Salina, Pascal Salina "Next Generation Networks-perspectives and potentials" Wiley, January 2008.
2. Madhusanga Liyanage, Andrei Gurtov, Mika Ylianttila, "Software Defined Mobile Networks beyond LTE Network Architecture", Wiley, June 2015.
3. Martin Sauter, "3G,4G and Beyond bringing networks, devices and web together", Wiley, 2nd edition-2013.

4. Savo G Glisic," Advanced Wireless Networks- Technology and Business models", Wiley, 3rd edition- 2016.
5. Thomas Plavyk, —Next generation Telecommunication Networks, Services and Management!, Wiley & IEEE Press Publications, 2010.

COURSE OUTCOME(S):

- CO303-3.1 To be able to understand the issues and challenges of wireless domain in future generation network design
- CO303-3.2 To be able to explore the LTE concepts and technologies
- CO303-3.3 To be able to understand the integration of SDN with LTE
- CO303-3.4 To be able to understand the NGN architecture
- CO303-3.5 To be able to understand the NGN management and standardizations

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO303-3.1			2		2	2						2
CO303-3.2		2										
CO303-3.3		2										
CO303-3.4	2											
CO303-3.5	2		2								1	2

1→Low 2→Medium 3→High

19NE3704 SOFTWARE DEFINED NETWORKS AND NETWORK FUNCTION L T P C

VIRTUALIZATION (SDN AND NFV)

3 0 0 3

OBJECTIVES:

1. To understand the concepts of software defined networks
2. To learn the interface between networking devices and the software controlling them
3. To learn network virtualization and tools
4. To explore modern approaches like vmware, openflow, openstack

PRE-REQUISITE:

- Computer Networks, Cloud Computing

UNIT I SOFTWARE DEFINED NETWORK (SDN)

9

CO303-4. 5 To employ network management tools

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO303-4. 1	2		2									
CO303-4. 2					3							
CO303-4. 3	2											
CO303-4. 4	2	2									1	2
CO303-4. 5	3										1	2

1→Low 2→Medium 3→High

19NE3705

EMBEDDED SOFTWARE DEVELOPMENT

L T P C
3 0 0 3

OBJECTIVES:

1. To understand the architecture of embedded processor, microcontroller and peripheral devices.
2. To interface memory and peripherals with embedded systems.
3. To study the embedded network environment.
4. To understand challenges in Real time operating systems.
5. To study, analyze and design applications on embedded systems

PRE-REQUISITE:

- Embedded Systems

UNIT I EMBEDDED PROCESSORS

9

Embedded Computers - Characteristics of Embedded Computing Applications - Challenges in Embedded Computing System Design - Embedded System Design Process- Formalism for System Design - Structural Description - Behavioural Description - ARM Processor - Intel ATOM Processor.

UNIT II EMBEDDED COMPUTING PLATFORM

9

CPU Bus Configuration - Memory Devices and Interfacing - Input/Output Devices and Interfacing - System Design - Development and Debugging – Emulator – Simulator - JTAG Design Example – Alarm Clock - Analysis and Optimization of Performance - Power and Program Size.

UNIT III EMBEDDED NETWORK ENVIRONMENT

9

Distributed Embedded Architecture - Hardware And Software Architectures - Networks for Embedded Systems - I2C - CAN Bus - SHARC Link Supports – Ethernet – Myrinet – Internet - Network-based

Design - Communication Analysis - System Performance Analysis - Hardware Platform Design - Allocation and Scheduling - Design Example - Elevator Controller.

UNIT IV REAL-TIME CHARACTERISTICS

9 Clock

Driven Approach - Weighted Round Robin Approach - Priority Driven Approach - Dynamic versus Static Systems - Effective Release Times and Deadlines - Optimality of the Earliest Deadline First (EDF) Algorithm - Challenges in Validating Timing Constraints in Priority Driven Systems - Off-Line versus On-Line Scheduling.

UNIT V SYSTEM DESIGN TECHNIQUES

9

Design Methodologies - Requirement Analysis – Specification - System Analysis and Architecture Design - Quality Assurance - Design Examples - Telephone PBX - Ink jet printer - Personal Digital Assistants - Set-Top Boxes.

Total: 45 Periods

REFERENCE BOOK(S):

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things" Wiley Publication, First edition, 2013
2. Andrew N Sloss, D. Symes, C. Wright, | Arm system developers guidel, Morgan Kauffman/Elsevier, 2006.
3. ArshdeepBahga, Vijay Madiseti, " Internet of Things: A Hands-on-Approach" VPT First Edition, 2014
4. C. M. Krishna and K. G. Shin, —Real-Time Systemsll , McGraw-Hill, 1997
5. Frank Vahid and Tony Givargis, —Embedded System Design: A Unified Hardware/Software Introductionll, John Wiley & Sons.
6. Jane.W.S. Liu, —Real-Time systemsll, Pearson Education Asia.
7. Michael J. Pont, —Embedded Cl, Pearson Education , 2007.
8. Steve Heath, —Embedded SystemDesignll , Elsevier, 2005
9. Wayne Wolf, —Computers as Components:Principles of Embedded Computer System Designll, Elsevier, 2006.

COURSE OUTCOME(S):

- CO304-1. 1 Understand different architectures of embedded processor, microcontroller and peripheral devices.
- CO304-1. 2 Interface memory and peripherals with embedded systems.
- CO304-1. 3 Work with embedded network environment.
- CO304-1. 4 Understand challenges in Real time operating systems

CO304-1.5 Design and analyze applications on embedded systems

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO304-1.1	2	1		1		1					2	3
CO304-1.2	2	1		1		1					2	3
CO304-1.3	2	2		1		1					2	2
CO304-1.4	3	2		1		1					1	2
CO304-1.5	2	1	3	2		1					2	2

1→Low 2→Medium 3→High

19NE3706 PROTOCOLS AND ARCHITECTURES FOR WIRELESS**L T P C****SENSOR NETWORKS****3 0 0 3****OBJECTIVES:**

1. To understand the concepts of wireless sensor networks
2. To understand the protocols for WSN
3. To get exposure on WSN environment with TinyOS and like
4. To understand the layered approach in sensor networks
5. To design WSN and analyse performance

PRE-REQUISITE:

- Computer Networks

UNIT I WIRELESS SENSOR NETWORK ARCHITECTURE**9**

Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.

UNIT II DATA LINK LAYER**9**

MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols - SMAC, BMAC, TRAMA, Link Layer protocols – fundamentals task and requirements, error control, framing, link management, Naming and addressing – address assignment, unique, Content-based and geographical addressing.

UNIT III NETWORK LAYER**9**

Routing protocols – Requirements, Taxonomy - Data-centric routing – SPIN, Directed Diffusion, Energy aware routing, Gradient-based routing – COUGAR, ACQUIRE, Hierarchical Routing – LEACH,

CO304-2. 5 To employ the tools for WSN.

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO304-2. 1	3		3									
CO304-2. 2		3			3							
CO304-2. 3			3		3							
CO304-2. 4	3		3	2							1	2
CO304-2. 5	3				2						1	2

1→Low 2→Medium 3→High

19NE3707

INFORMATION STORAGE MANAGEMENT

L T P C
3 0 0 3

OBJECTIVES:

1. To understand the storage architecture and available technologies.
2. To learn to establish & manage datacenter.
3. To learn security aspects of storage & data center.

PRE-REQUISITE:

- Cloud Computing

UNIT I STORAGE TECHNOLOGY

9

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 center infrastructure, role of each element in supporting business activities.

UNIT II STORAGE SYSTEMS ARCHITECTURE

9

Hardware and software components of the host environment, Key protocols and concepts used by each component ,Physical and logical components of a connectivity environment ,Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, 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, Compare and contrast integrated and modular storage systems ,High-level architecture and working of an intelligent storage system.

UNIT III INTRODUCTION TO NETWORKED STORAGE

9

Evolution of networked storage, Architecture, components, and technologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the need for long-term archiving

solutions and describe how CAS full fill the need, understand the appropriateness of the different networked storage options for different application environments.

UNIT IV INFORMATION AVAILABILITY, MONITORING & MANAGING

DATACENTERS

9

List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime -Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identifysingle PO9nts of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery toPO12ogies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center.

UNIT V SECURING STORAGE AND STORAGE VIRTUALIZATION

9

Information security, Critical security attributes for information systems, Storage security domains,List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes.

Total: 45 Periods

REFERENCE BOOK(S):

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010.
2. Marc Farley, —Building Storage Networks, Tata McGraw Hill ,Osborne, 2001.
3. Robert Spalding, —Storage Networks: The Complete Reference—, Tata McGraw Hill , Osborne, 2003.

COURSE OUTCOME(S):

- CO304-3. 1 Select from various storage technologies to suit for required application
- CO304-3. 2 Apply security measures to safeguard storage & farm.
- CO304-3. 3 Analyse QoS on Storage
- CO304-3. 4 Analyze Key metrics to monitor for different components in a storage infrastructure
- CO304-3. 5 Analyze the Virtualization technologies

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO304-3. 1	3			2								
CO304-3. 2	3	2	3		3							3
CO304-3. 3	3		1	2		1						1
CO304-3. 4	2			2							2	2
CO304-3. 5	2	3	3	2	2						2	2

1→Low 2→Medium 3→High

19NE3708

CLOUD COMPUTING AND BIG DATA

L T P C

3 0 0 3

OBJECTIVES:

1. To understand the various issues in cloud computing
2. To be able to set up a private cloud
3. To understand the competitive advantages of big data analytics
4. To understand the big data frameworks
5. To learn data analysis methods
6. To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

PRE-REQUISITE:

- Grid Computing

UNIT I CLOUD PLATFORM ARCHITECTURE

9

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery – Architectural Design Challenges - Public Cloud Platforms : GAE,AWS – Inter-cloud Resource Management.

UNIT II PROGRAMMING MODEL

9

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus.

UNIT III INTRODUCTION TO BIG DATA

9

Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.

UNIT IV DATA ANALYSIS

9

Statistical Methods:Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.

UNIT V BIG DATA FRAMEWORKS

9

Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries.

Total: 45 Periods

REFERENCE BOOK(S):

1. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010
2. Danielle Ruest, Nelson Ruest, —Virtualization: A Beginner's Guidel, McGraw-Hill Osborne Media, 2009.
3. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
5. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.
6. Bill Franks, —Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analyticsl, Wiley and SAS Business Series, 2012.
7. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
8. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
9. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of PO12yglot Persistence", Addison-Wesley Professional, 2012.
10. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis, , O'Reilly Media, 2013.

COURSE OUTCOME(S):

- CO304-4.1 Identify the architecture, infrastructure and delivery models of cloud computing
- CO304-4.2 Develop services using Cloud computing.
- CO304-4.3 Understand how to leverage the insights from big data analytics
- CO304-4.4 Analyze data by utilizing various statistical and data mining approaches.
- CO304-4.5 Understand the various NoSql alternative database models

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO304-4. 1	3										1	2
CO304-4. 2	3		2								1	2
CO304-4. 3	3										1	2
CO304-4. 4	3	3		2							1	2
CO304-4. 5	3			2	3						1	2

1→Low 2→Medium 3→High

19NE3709**SOCIAL NETWORK ANALYSIS**

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OBJECTIVES:

1. To understand the components of the social network.
2. To model and visualize the social network.
3. To mine the users in the social network.
4. To understand the evolution of the social network.
5. To know the applications in real time systems

PRE-REQUISITE:

- Web Technology

UNIT I INTRODUCTION**9**

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

UNIT II MODELING AND VISUALIZATION**9**

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality-Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix- Based Representations-Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

UNIT III MINING COMMUNITIES**9**

Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks -

Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

UNIT IV EVOLUTION

9

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.

UNIT V APPLICATIONS

9

A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection.

Total: 45 Periods

REFERENCE BOOK(S):

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, —Computational Social Network Analysis: Trends, Tools and Research Advances, Springer, 2012.
2. Borko Furht, —Handbook of Social Network Technologies and Applications, Springer, 1st edition, 2011.
3. Charu C. Aggarwal, —Social Network Data Analytics, Springer; 2014.
4. Giles, Mark Smith, John Yen, —Advances in Social Network Mining and Analysis, Springer, 2010.
5. Guandong Xu , Yanchun Zhang and Lin Li, —Web Mining and Social Networking – Techniques and applications, Springer, 1st edition, 2012.
6. Peter Mika, —Social Networks and the Semantic Web, Springer, 1st edition, 2007.
7. Przemyslaw Kazienko, Nitesh Chawla, Applications of Social Media and Social Network Analysis, Springer, 2015.

COURSE OUTCOME(S):

- CO305-1. 1 Work on the internal components of the social network.
- CO305-1. 2 Model and visualize the social network
- CO305-1. 3 Mine the behaviour of the users in the social network
- CO305-1. 4 Predict the possible next outcome of the social network

CO305-1. 5 Apply social network in real time applications.

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO305-1. 1	2		3								2	2
CO305-1. 2	2		3		1						2	2
CO305-1. 3	1										2	2
CO305-1. 4	2										2	2
CO305-1. 5	2		2	2							3	1

1→Low 2→Medium 3→High

19NE3710

WEB ENGINEERING

L T P C
3 0 0 3

OBJECTIVES:

1. Understand the characteristics of web applications
2. Learn to Model web applications
3. Be aware of Systematic design methods
4. Be familiar with the testing techniques for web applications

PRE-REQUISITE:

- Web Technology

UNIT I INTRODUCTION TO WEB ENGINEERING

9

Motivation, Categories of Web Applications, Characteristics of Web Applications. Requirements of Engineering in Web Applications- Web Engineering-Components of Web Engineering-Web Engineering Process-Communication-Planning.

UNIT II WEB APPLICATION ARCHITECTURES & MODELLING WEB APPLICATIONS

9

Introduction- Categorizing Architectures- Specifics of Web Application Architectures, Components of a Generic Web Application Architecture- Layered Architectures, 2-Layer Architectures, N-Layer Architectures-Data-aspect Architectures, Database-centric Architectures- Architectures for Web Document Management- Architectures for Multimedia Data- Modeling Specifics in Web Engineering, Levels, Aspects, Phases Customization, Modeling Requirements, Hypertext Modeling, Hypertext Structure Modeling Concepts, Access Modeling Concepts, Relation to Content Modeling, Presentation Modeling, Relation to Hypertext Modeling, Customization Modeling, Modelling Framework-Modeling

languages- Analysis Modeling for Web Apps-The Content Model-The Interaction Model-Configuration Model.

UNIT III WEB APPLICATION DESIGN 9

Design for WebApps- Goals-Design Process-Interactive Design- Principles and Guidelines- Workflow-Preliminaries-Design Steps- Usability- Issues- Information Design- Information Architecture-structuring- Accessing Information-Navigation Design- Functional Design-Wep App Functionality-Design Process- Functional Architecture- Detailed Functional Design.

UNIT IV TESTING WEB APPLICATIONS 9

Introduction-Fundamentals-Test Specifics in Web Engineering-Test Approaches- Conventional Approaches, Agile Approaches- Testing concepts- Testing Process -Test Scheme- Test Methods and Techniques- Link Testing- Browser Testing-Usability Testing- Load, Stress, and Continuous Testing, Testing Security, Test-driven Development, -Content Testing-User Interface testing-Usability Testing-Compatibility Testing-Component Level Testing-Navigation Testing-Configuration testing-Security and Performance Testing- Test Automation.

UNIT V PROMOTING WEB APPLICATIONS AND WEB PROJECT MANAGEMENT 9

Introduction-challenges in launching the web Application-Promoting Web Application- Content Management-Usage Analysis-Web Project Management-Challenges in Web Project Management-Managing Web Team- Managing the Development Process of a Web Application- Risk, Developing a Schedule, Managing Quality, Managing Change, Tracking the Project. Introduction to node JS - web sockets.

Total: 45 Periods

REFERENCE BOOK(S):

1. Chris Bates, —Web Programming: Building Internet Applications, Third Edition, Wiley India Edition, 2007.
2. Gerti Kappel, Birgit Proll, —Web Engineering, John Wiley and Sons Ltd, 2006.
3. Guy W. Lecky-Thompson, —Web Programming, Cengage Learning, 2008.
4. John Paul Mueller, —Web Development with Microsoft Visual Studio 2005, Wiley Dream tech, 2006.
5. Roger S. Pressman, David Lowe, —Web Engineering, Tata McGraw Hill Publication, 2007.

COURSE OUTCOME(S):

- CO305-2. 1 Describe syntax and semantics of programming languages.
- CO305-2. 2 Explain data, data types, and basic statements of programming languages.

CO305-2.3 Design and implement subprogram constructs, Apply object - oriented, concurrency, pro and event handling programming constructs

CO305-2.4 Develop programs in LISP, ML, and Prolog

CO305-2.5 Analyze the challenges in launching web applications.

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO305-2.1	3	3	2	2	1	2						3
CO305-2.2	3	3		2		2						3
CO305-2.3			2		1							3
CO305-2.4	2	1	3	2	2							2
CO305-2.5	3	3		2		2						3

1→Low 2→Medium 3→High

19NE3711

ETHICAL HACKING

L T P C
3 0 0 3

OBJECTIVES:

1. To understand and analyse Information security threats & counter measures
2. To perform security auditing & testing
3. To understand issues relating to ethical hacking
4. To study & employ network defense measures
5. To understand penetration and security testing issues

PRE-REQUISITE:

- Cyber security

UNIT I ETHICAL HACKING OVERVIEW

9

Introduction to Hacking – Importance of Security – Elements of Security – Phases of an Attack – Types of Hacker Attacks – Hacktivism – Vulnerability Research – Introduction to Footprinting – Information Gathering Methodology – Footprinting Tools – WHOIS Tools – DNS Information Tools – Locating the Network Range – Meta Search Engines.

UNIT II SCANNING AND ENUMERATION

9

Introduction to Scanning – Objectives – Scanning Methodology – Tools – Introduction to Enumeration – Enumeration Techniques – Enumeration Procedure – Tools

UNIT III SYSTEM HACKING

9

Introduction – Cracking Passwords – Password Cracking Websites – Password Guessing – Password Cracking Tools – Password Cracking Counter measures – Escalating Privileges – Executing Applications – Keyloggers and Spyware.

UNIT IV PROGRAMMING FOR SECURITY PROFESSIONALS 9

Programming Fundamentals – C language – HTML – Perl – Windows OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures – Linux OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures.

UNIT V PENETRATION TESTING 9

Introduction – Security Assessments – Types of Penetration Testing- Phases of Penetration Testing – Tools – Choosing Different Types of Pen-Test Tools – Penetration Testing Tools.

Total: 45 Periods

REFERENCE BOOK(S):

1. EC-Council, —Ethical Hacking and Countermeasures: Attack Phases, Delmar Cengage Learning, 2009.
2. Jon Erickson, —Hacking: The Art of Exploitation, No Starch Press, Second Edition, 2008.
3. Michael T. Simpson, "Hands-on Ethical Hacking & Network Defense", Course Technology, 2010
4. Patrick Engebretson, —The Basics of Hacking and Penetration Testing – Ethical Hacking and Penetration Testing Made Easy, Syngress Media, Second Revised Edition, 2013.
5. RajatKhare, "Network Security and Ethical Hacking", Luniver Press, 2006
6. Ramachandran V, BackTrack 5 Wireless Penetration Testing Beginner's Guide 3rd ed.. Packt Publishing, 2011
7. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003.

COURSE OUTCOME(S):

- | | | | | |
|------------|-------------------------------------------------------------|------------|----|----------|
| CO305-3. 1 | Understand vulnerabilities, vulnerabilities/threats/attacks | mechanisms | to | identify |
| CO305-3. 2 | Perform penetration & security testing | | | |
| CO305-3. 3 | Become a professional ethical hacker | | | |
| CO305-3. 4 | Employ network defense measures | | | |
| CO305-3. 5 | Analyze the cracking tools | | | |

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO305-3. 1	3		2				2				3	
CO305-3. 2		2		1	3	1			1			1
CO305-3. 3	3			3				3		3	2	
CO305-3. 4	2		3	2	2							1
CO305-3. 5	2		3	2	2							1

1→Low 2→Medium 3→High

19NE3712

DIGITAL FORENSICS

L T P C
3 0 0 3

OBJECTIVES:

1. Have an understanding of the fundamental concepts of forensic science.
2. Have a basic understanding of the application of forensic science principles to digital evidence examinations.
3. Be able to articulate the steps of the forensic process as applied to digital evidence.
4. Be able to draft a Standard Operating Procedure.
5. Conduct rudimentary digital forensic examinations.

PRE-REQUISITE:

- Network Security

UNIT I INTRODUCTION 9

Introduction - Digital Forensics - Digital Evidence - Increasing Awareness of Digital Evidence - Digital Forensics: Past, Present, and Future – Principles - Challenging Aspects of Digital Evidence – Cyber trail - Language of Computer Crime Investigation - Role of Computers in Crime

UNIT II EVIDENCE AND INVESTIGATIONS 9

Evidence in the Courtroom - Duty of Experts – Admissibility - Levels of Certainty in Digital Forensics - Direct versus circumstantial evidence - Scientific Evidence - Presenting Digital Evidence - Conducting Digital Investigations - Digital Investigation Process Models - Scaffolding for Digital Investigations - Applying the Scientific Method in Digital Investigations - Investigative Scenario: Security Breach

UNIT III OPEN SOURCE EXAMINATION PLATFORM 9

Open Source Examination Platform - Using Linux and Windows as the Host, Disk and File System Analysis, Media Analysis Concepts , Sleuth Kit, Partitioning and Disk Layouts, Special Containers, Hashing

UNIT IV DISK AND FILE SYSTEM ANALYSIS 9

Imaging, Internet Artifacts, Browser & Mail Artifacts, File Analysis, Image, Audio, Video, Archives, Documents, Graphical Investigation Environments, PyFLAG, Fiwalk, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition.

UNIT V**LAWS AND ACTS****9**

Laws and Ethics, Digital Evidence Controls, Evidence Handling Procedures, Basics of Indian Evidence ACT IPC and CrPC , Electronic Communication Privacy ACT, Legal Policies.

Total: 45 Periods**REFERENCE BOOK(S):**

1. Cory Altheide and Harlan Carvey, —Digital Forensics with Open Source Tools| Elsevier publication, 3rd Edition, April 2011
2. Eoghan Casey , —Digital Evidence and Computer Crime", Forensic Science, Computers, and the Internet, Elsevier, 3rd Edition, 2011
3. Kevin Mandia, Chris Prosise, Matt Pepe, —Incident Response and Computer Forensics —, TataMcGraw -Hill, New Delhi, 2006
4. Nelson Phillips and Enfinger Steuart, —Computer Forensics and Investigations|, Cengage Learning, New Delhi, 2009.
5. Robert M Slade,| Software Forensics|, Tata McGraw - Hill, New Delhi, 2005.

COURSE OUTCOME(S):

- CO305-4. 1 Have an idea regarding the fundamental concepts of forensic science.
- CO305-4. 2 Can apply the concepts and will be able to collect digital evidence.
- CO305-4. 3 Able to Implement the forensic concepts in open platform
- CO305-4. 4 Able to apply the Standard Operating Procedure.
- CO305-4. 5 Present the forensic evidence in terms of Legal procedure

PO vs CO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO305-4. 1	3	1			1		1				1	
CO305-4. 2			3	3		2		2		2		3
CO305-4. 3	3		2	1			1	3		1	2	
CO305-4. 4	3					3				1	3	
CO305-4. 5	2	3	3			2					1	2

1→Low 2→Medium 3→High