

# Francis Xavier Engineering College

(An Autonomous Institution)

Tirunelveli 627 003

Tamil Nadu India

## Department of Computer Science and Engineering

### **Curriculum and Syllabi-2021-PG CHOICE BASED CREDIT SYSTEM AND OBE**

#### **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.**

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## Programme Educational Outcomes (PEOs)

PEO1:Engineering basics: To communicate deep knowledge on basic sciences and applications of basic sciences in engineering.

PEO2: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.

PEO3:Leadership responsibilities: To develop interpersonal skills to strengthen team work, leadership quality and to promote awareness about continual learning not limited to higher studies.

PEO4:Professional qualification: To boost professionalism in problem solving through moral and professional ethics shouldering social task.

## Programme Specific Objectives (PSOs)

PSO 1: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.

# Programme Outcomes(POs)

**Engineering Graduates will be able to:**

- 1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. 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.
- 3. 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.
- 4. 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.
- 5. 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.
- 6. 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.
- 7. 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.
- 8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10. 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.
- 11. 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.

**12. 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.

### Mapping with PO Vs PEO, PSO

PO	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1	3	3			3		
2	3					3	
3	3				3	3	
4	3	3					
5	2					2	3
6	3		2	3		1	
7		3	1			2	
8				3	3		
9			3				
10						2	1
11	2		2			3	
12	2	3					2

**FRANCIS XAVIER ENGINEERING COLLEGE**

**M.E. – Computer Science and Engineering**

**(With Specialization in Networks)**

**Choice Based Credit System and Outcome Based Education**

**SUMMARY OF CREDIT DISTRIBUTION**

S.No	Category	Credits Per Semester				Total Credits	Credits in %
		I	II	III	IV		
1	FC	4				4	5.714%
2	PC	18	14			32	45.714%
3	PE		6	9		15	21.429%
4	EEC		1	6	12	19	27.143%

**Minimum Number of Credits to be Acquired:70**

FC - Foundation Course

PC - Professional Core

PE - Professional Elective

EEC - Employability Enhancement Course

**FRANCIS XAVIER ENGINEERING COLLEGE****M.E. – Computer Science and Engineering****(With Specialization in Networks)****Choice Based Credit System and Outcome Based Education****I-VIII Semester Curricula and Syllabi****SEMESTER I**

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
<b>Theory Courses</b>								
1	21CP1201	Mathematical Foundation for Computer Science	FC	60	4	0	0	4
2	21NE1601	Advanced Data Structures and Algorithms	PC	60	4	0	0	4
3	21NE1602	Advanced Software Engineering	PC	45	3	0	0	3
4	21NE1603	Advanced Operating Systems	PC	45	3	0	0	3
5	21NE1604	Machine Learning Techniques	PC	45	3	0	0	3
6	21NE1605	Advanced Network Standards and Protocols	PC	45	3	0	0	3
<b>Practical Courses</b>								
1	21NE1611	Data Structures Laboratory	PC	60	0	0	4	2
<b>Total</b>				<b>360</b>	<b>20</b>	<b>0</b>	<b>4</b>	<b>22</b>

**SEMESTER II**

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
<b>Theory Courses</b>								
1	21NE2601	Network Design and Programming	PC	45	3	0	0	3
2	21NE2602	Network Security	PC	45	3	0	0	3
3	21NE2603	Internet of Things	PC	45	3	0	0	3
4	21NE2604	Wireless Technologies	PC	45	3	0	0	3
5		Professional Elective –I	PC	45	3	0	0	3
6		Professional Elective –II	PC	45	3	0	0	3
<b>Practical Courses</b>								
1	21NE2611	Network Design and Programming Laboratory	PC	60	0	4	2	2
2	21NE2912	Term Paper Writing and Seminar	EEC	30	0	2	1	1
<b>Total</b>				<b>360</b>	<b>18</b>	<b>0</b>	<b>6</b>	<b>21</b>

**SEMESTER III**

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
<b>Theory Courses</b>								
1		Professional Elective -III	PE	45	3	0	0	3
2		Professional Elective -IV	PE	45	3	0	0	3
3		Professional Elective -V	PE	45	3	0	0	3
<b>Practical Courses</b>								
1	21NE3911	Project Phase - I	EEC	180	0	0	12	6
<b>Total</b>				<b>315</b>	<b>9</b>	<b>0</b>	<b>12</b>	<b>15</b>

**SEMESTER IV**

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
<b>Practical Courses</b>								
1	21NE4911	Project Phase - II	EEC	360	0	0	24	12
<b>Total</b>				<b>360</b>	<b>0</b>	<b>0</b>	<b>24</b>	<b>12</b>

**List of Foundation Courses**

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
<b>Theory Courses</b>								
1	21CP1201	Mathematical Foundation for Computer Science	FC	60	4	0	0	4



**List of Professional Core Courses**

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
<b>Theory Courses</b>								
1	21NE1601	Advanced Data Structures and Algorithms	PC	60	4	0	0	4
2	21NE1602	Advanced Software Engineering	PC	45	3	0	0	3
3	21NE1603	Advanced Operating Systems	PC	45	3	0	0	3
4	21NE1604	Machine Learning Techniques	PC	45	3	0	0	3
5	21NE1605	Advanced Network Standards and Protocols	PC	45	3	0	0	3
6	21NE2601	Network Design and Programming	PC	45	3	0	0	3
7	21NE2602	Network Security	PC	45	3	0	0	3
8	21NE2603	Internet of Things	PC	45	3	0	0	3
9	21NE2604	Wireless Technologies	PC	45	3	0	0	3
<b>Practical Courses</b>								
1	21NE1611	Data Structures Laboratory	PC	60	0	0	4	2
2	21NE2611	Network Design and Programming Laboratory	PC	60	0	0	4	2

**List of Employability Enhancement Course**

S.No	Course Code	Course Name	Category	Contact Periods	L	T	P	C
<b>Theory Courses</b>								
1	21NE2912	Term Paper Writing and Seminar	EEC	30	0	0	2	1
2	21NE3911	Project Work Phase – I	EEC	180	0	0	12	6
3	21NE4911	Project Work Phase – II	EEC	360	0	0	24	12

### List of Professional Electives Courses

S.No	Course Code	Course Name	Semester	L	T	P	C	Stream/Domain
<b>Professional Elective I</b>								
1	21NE2701	Software Architectures and Design	II	3	0	0	3	Architecture
2	21NE2702	Optical Networks	II	3	0	0	3	Networking
3	21NE2703	Web Security	II	3	0	0	3	Web Application
4	21NE2704	Block Chain Technology	II	3	0	0	3	Distributed Security
<b>Professional Elective II</b>								
1	21NE2705	Multimedia Communication Networks	II	3	0	0	3	Multimedia
2	21NE2706	Mobile and Pervasive Computing	II	3	0	0	3	Mobile Computing
3	21NE2707	Simulation of Computer Systems and Networks	II	3	0	0	3	Networks
4	21NE2708	High Speed Switching Architectures	II	3	0	0	3	Networks
<b>Professional Elective III</b>								
1	21NE3701	Satellite Communication	III	3	0	0	3	Satellite
2	21NE3702	Network Performance Analysis	III	3	0	0	3	Networks
3	21NE3703	Next Generation Networks	III	3	0	0	3	Networks
4	21NE3704	Software Defined Networks and Network Function Virtualization (SDN and NFV)	III	3	0	0	3	Networks
<b>Professional Elective IV</b>								
1	21NE3705	Embedded Software Development	III	3	0	0	3	Embedded system
2	21NE3706	Protocols and Architectures for Wireless Sensor Networks	III	3	0	0	3	Architecture
3	21NE3707	Information Storage Management	III	3	0	0	3	Storage System
4	21NE3708	Cloud Computing and Big Data	III	3	0	0	3	Cloud Computing
<b>Professional Elective V</b>								
1	21NE3709	Social Network Analysis	III	3	0	0	3	Web analysis
2	21NE3710	Web Engineering	III	3	0	0	3	Web analysis
3	21NE3711	Ethical Hacking	III	3	0	0	3	Web analysis
4	21NE3712	Digital Forensics	III	3	0	0	3	Forensics

## Semester I

21CP1201	MATHEMATICAL FOUNDATION FOR COMPUTER SCIENCE	L	T	P	C
		4	0	0	4
<b>Prerequisites for the course:</b>					
<b>1. Probability</b>					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. Provide the solid foundation on topics in applied probability and various statistical methods</li> <li>2. Knowledge in many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling.</li> <li>3. Address the issues and the principles of estimation theory</li> <li>4. Testing of hypothesis</li> <li>5. Testing the multivariate analysis</li> </ol>					
<b>UNIT I</b>	<b>PROBABILITY AND RANDOM VARIABLES</b>	<b>12</b>			
Probability – Axioms of probability – Conditional probability – Baye’s theorem - Random variables Probability function – Moments – Moment generating functions and their properties – Binomial, PO9sson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.					
<b>UNIT II</b>	<b>TWO DIMENSIONAL RANDOM VARIABLES</b>	<b>12</b>			
Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.					
<b>UNIT III</b>	<b>ESTIMATION THEORY</b>	<b>12</b>			
Unbiased estimators – Method of moments – Maximum likelihood estimation - Curve fitting by principle of least squares – Regression lines					
<b>UNIT IV</b>	<b>TESTING OF HYPOTHESIS</b>	<b>12</b>			
Sampling distributions – Type I and Type II errors – Small and large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.					
<b>UNIT V</b>	<b>MULTIVARIATE ANALYSIS</b>	<b>12</b>			
Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components - Population principal components – Principal components from standardized variables.					
<b>Total Periods</b>					<b>60</b>
<b>Suggestive Assessment Methods</b>					
<b>Continuous Assessment Test (30 Marks)</b>		<b>Formative Assessment Test (10 Marks)</b>		<b>End Semester Exams (60 Marks)</b>	
<b>Outcomes</b>					
<b>Upon completion of the course, the students will be able to:</b>					

**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.

#### Reference Books

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, Sultana 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, 8<sup>th</sup> Edition, 2015.
4. Richard A. Johnson and Dean W. Wichern, —Applied Multivariate Statistical Analysis, 5<sup>th</sup> Edition, Pearson Education, Asia, 2002.
5. Devore, J. L., —Probability and Statistics for Engineering and the Sciences, 8<sup>th</sup> Edition, Cengage Learning, 2014.

#### CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2										1			
2	3	2										1			
3	3	3		2	1	1			1			1			
4	3	3		2	1	1			1			1			
5	3	3			1	1						1			

21NE1601	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		4	0	0	4
<b>Prerequisites for the course:</b>					
Data Structures					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To understand the usage of algorithms in computing.</li> <li>2. To learn and use hierarchical data structures and its operations</li> <li>3. To learn the usage of graphs and its applications.</li> <li>4. To select and design data structures and algorithms that is appropriate for problems.</li> <li>5. To study about NP Completeness of problems.</li> </ol>					
<b>UNIT I</b>	<b>ROLE OF ALGORITHMS IN COMPUTING</b>	<b>12</b>			
Algorithms – Algorithms as a Technology- Insertion Sort – Analyzing Algorithms – Designing Algorithms- Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions- Recurrences: The Substitution Method – The Recursion-Tree Method.					
<b>UNIT II</b>	<b>HIERARCHICAL DATA STRUCTURES</b>	<b>12</b>			
Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red-Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B-trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.					
<b>UNIT III</b>	<b>GRAPHS</b>	<b>12</b>			
Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra’s Algorithm; All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm.					
<b>UNIT IV</b>	<b>ALGORITHM DESIGN TECHNIQUES</b>	<b>12</b>			
Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem – Elements of the Greedy Strategy- Huffman Codes.					
<b>UNIT V</b>	<b>NP COMPLETE AND NP HARD</b>	<b>12</b>			
NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems.					
<b>Total Periods</b>					<b>60</b>
<b>Suggestive Assessment Methods</b>					
<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>			

<b>Outcomes</b>		
<b>Upon completion of the course, the students will be able to:</b>		
<b>CO101.1</b> Design data structures and algorithms to solve computing problems <b>CO101.2</b> Design algorithms using graph structure to solve real-life problems. <b>CO101.3</b> Design algorithms using various string matching algorithms to solve real-life problems <b>CO101.4</b> Apply suitable design strategy for problem solving. <b>CO101.5</b> Understand NP Complete and NP Hard Problems.		
<b>Reference Books</b>		
1. Robert Sedgewick and Kevin Wayne, —ALGORITHMS, Fourth Edition, Pearson Education. 2. S.Sridhar, Design and Analysis of Algorithms, First Edition, Oxford University Press. 2014 3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, —Introduction to Algorithms, Third Edition, Prentice-Hall, 2011. 4. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, —Data Structures and Algorithms, Pearson Education, Reprint 2006.		
<b>Web Recourses</b>		
1. <a href="https://www.geeksforgeeks.org/advanced-data-structures/">https://www.geeksforgeeks.org/advanced-data-structures/</a> 2. <a href="https://www.tutorialspoint.com/advanced_data_structures/index.asp">https://www.tutorialspoint.com/advanced_data_structures/index.asp</a>		

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		2	3	1	1						1			
2	3		2	3	1	1					2	1			
3	3		2	3	1	1					2	1			
4	3	2	2	3	1	1						1			
5	3		2	3	1	1						1			

<b>21NE1602</b>	<b>ADVANCED SOFTWARE ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Prerequisites for the course</b>					
Software Engineering					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To understand Software Engineering Lifecycle Models</li> <li>2. To do project management and cost estimation</li> <li>3. To gain knowledge of the System Analysis and Design concepts.</li> <li>4. To understand software testing approaches</li> <li>5. To be familiar with DevOps practices</li> </ol>					
<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>			
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					
<b>UNIT II</b>	<b>SOFTWARE REQUIREMENT SPECIFICATION</b>	<b>9</b>			
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.					
<b>UNIT III</b>	<b>ARCHITECTURE AND DESIGN</b>	<b>9</b>			
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					
<b>UNIT IV</b>	<b>TESTING</b>	<b>9</b>			
Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking.					
<b>UNIT V</b>	<b>DEVOPS</b>	<b>9</b>			
DevOps:Motivation-Cloud as a platform-Operations- Deployment Pipeline:Overall Architecture-Building and Testing-Deployment- Case study: Migrating to Microservices.					
<b>Total Periods</b>					<b>45</b>
<b>Suggestive Assessment Methods</b>					
<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>			
<b>Outcomes</b>					
<b>Upon completion of the course, the students will be able to:</b>					

- CO102.1.** Understand the advantages of various Software Development Lifecycle Models  
**CO102..2.** knowledge on project management approaches as well as cost and schedule estimation strategies  
**CO102.3.** Perform formal analysis on specifications, Use UML diagrams for analysis and design.  
**CO102.4.** Architect and design using architectural styles and design patterns.  
**CO102.5.** Understand software testing approaches and the advantages of DevOps practices

**Reference Books**

1. Behrouz A. Forouzan, "Data Communication and Networking",Fifth Edition,Tata McGraw Hill,2017.
2. Mani Subramaniam , "Network Management Principles and practices",Pearson Education,2010
3. Jean Warland and Pravin Vareya, "High Performance Networks", Morgan Kauffman Publishers, 2002
4. Larry L. Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach",Morgan Kaufman Publishers, 2007
5. William Stallings, "SNMP, SNMPv2, SNMPv3 and RMON1 and RMON2", Third Edition,Pearson Education,2002
6. Lakshmi G. Raman, " Fundamentals of Telecommunication Network Management ", Eastern Economy Edition IEEE Press, New Delhi, 1999

**Web Recourses**

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		3	3	3	3	3								3
2	3		1	3	3	2	3								
3	3		3	2	3	3	3						3	2	
4	3		3	3	3	3	2						3		
5	3		3	2	3	3	3						3	2	



21NE1603	ADVANCED OPERATING SYSTEM	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Operating System					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>To be able to read and understand sample open source programs and header files.</li> <li>To learn how the processes are implemented in linux.</li> <li>To understand the implementation of the Linux file system.</li> <li>To study Linux memory management data structures and algorithms.</li> <li>To acquire the knowledge in the implementation of interprocess communication.</li> <li>To understand how program execution happens in Linux.</li> </ol>					
<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>			
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.					
<b>UNIT II</b>	<b>PROCESSES</b>	<b>9</b>			
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.					
<b>UNIT III</b>	<b>FILE SYSTEM</b>	<b>9</b>			
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 – File system Types - Special File systems – File sytem Type Registration – File sytem Handling - Namespaces – Mounting Un-mounting - Implementation of VFS System Calls.					
<b>UNIT IV</b>	<b>MEMORY MANAGEMENT</b>	<b>9</b>			
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.					
<b>UNIT V</b>	<b>PROCESS COMMUNICATION AND PROGRAM EXECUTION</b>	<b>9</b>			
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.					
<b>Total Periods</b>					<b>45</b>

**Suggestive Assessment Methods**

<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>

**Outcomes**

**Upon completion of the course, the students will be able to:**

**CO103.1** To explain the functionality of a large software system by reading its source.

**CO103.2** To revise any algorithm present in a system.

**CO103.3** To design a new algorithm to replace an existing one.

**CO103.4** To use appropriate algorithm for memory management.

**CO103.5** To appropriately modify and use the data structures of the Linux kernel for a different software system.

**Reference Books**

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, 1<sup>st</sup> 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, 3<sup>rd</sup> Edition, Addison-Wesley, 2010

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	2						1	1	2		
2	3	3	3	3	3						1	1	2		
3	3	3	3	3	3	1					1	1	2		
4	3	3	3	3	3						1	1	2	2	
5	3	3	3	3	3						1	1	2	2	

21NE1604	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Artificial Intelligence					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To introduce students to the basic concepts and techniques of Machine Learning.</li> <li>2. To have a thorough understanding of the Supervised and Unsupervised learning techniques</li> <li>3. To understand the concepts of linear modeling techniques</li> <li>4. To study the various probability based learning techniques</li> <li>5. To understand graphical models of machine learning algorithms</li> </ol>					
<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>			
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.					
<b>UNIT II</b>	<b>LINEAR MODELS</b>	<b>9</b>			
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.					
<b>UNIT III</b>	<b>TREE AND PROBABILISTIC MODELS</b>	<b>9</b>			
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.					
<b>UNIT IV</b>	<b>DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS</b>	<b>9</b>			
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.					
<b>UNIT V</b>	<b>GRAPHICAL MODELS</b>	<b>9</b>			
Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods.					
<b>Total Periods</b>					<b>45</b>

**Suggestive Assessment Methods****Continuous Assessment Test  
(30 Marks)****Formative Assessment Test  
(10 Marks)****End Semester Exams  
(60 Marks)****Outcomes****Upon completion of the course, the students will be able to:****CO104.1** Distinguish between, supervised, unsupervised and semi-supervised learning**CO104.2** the appropriate machine learning strategy for any given problem**CO104.3** Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem.**CO104.4** Design systems that uses the appropriate graph models of machine learning**CO104.5** Modify existing machine learning algorithms to improve classification efficiency.**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

**CO Vs PO Mapping and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3										1	2	3	2	
2	2	3	3	3							1	2	3	2	
3	2	3	2	3							1	2	3	2	
4	3	2	3	3	2	1					1	2	3	2	2
5	2	3	3	3							1	2	3	2	2

21NE1605	ADVANCED NETWORK STANDARDS AND PROTOCOLS	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
<ul style="list-style-type: none"> <li>Digital Systems</li> <li>Computer Networks</li> </ul>					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>To Understand the concept of TCP/IP protocols and allocation of internet addressing</li> <li>To understand the working principles protocols like ARP, RARP, ICMP, UDP, TCP.</li> <li>To understand the IP routing algorithms</li> <li>To learn the socket interface and DNS</li> <li>To clearly understand the protocols in transmission and firewall for security purpose.</li> </ol>					
<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>			
The TCP/IP internet-Internet Services- Internetworking Concept and Architectural Model- TCP/IP 5- Layer Reference Model - Protocol layering Principle - IP datagram -IP Forwarding algorithm - Internet addresses: Classful Addressing and Classless Addressing					
<b>UNIT II</b>	<b>TCP/IP PROTOCOLS</b>	<b>9</b>			
ARP message format and Implementation - RARP - The ICMP message formats - User Datagram protocol (UDP) -Reliable Stream Transport Service (TCP): Segment format, Establishing and closing TCP connections- TCP state machine- Silly window syndrome - Karn's algorithm and Timer Backoff.					
<b>UNIT III</b>	<b>IP ROUTING</b>	<b>9</b>			
Routing Architecture: Cores, Peers, and Algorithms -Routing between Peers (BGP): Characteristics, Message header, Functionality and Message types- Routing within an Autonomous System (RIP, OSPF): RIP message format(IPv4 and IPv6)-OSPF message format-IGMP					
<b>UNIT IV</b>	<b>SOCKET INTERFACE</b>	<b>9</b>			
Virtual Private Networks -Network Address Translation -Client-Server Model -The Socket API: Socket operations -Bootstrap and Auto configuration (DHCP) -The Domain Name System: Name Syntax and type- Mapping domain names to addresses- Domain name Resolution- Message format.					
<b>UNIT V</b>	<b>PROTOCOLS AND FIREWALL DESIGN</b>	<b>9</b>			
Electronic Mail (SMTP, POP, IMAP, MIME) -World Wide Web HTTP) -Voice and Video Over IP(RTP, RSVP, QoS) -Network Management(SNMP): Message format- Encoded SNMP message-Security in SNMP3- IP Security- Firewalls. FOR FURTHER READING Internet of Things- Software Defined Networking- Multicast Routing Protocols-Other Remote Access Technologies- Proposed IPv6 Address Space Assignment					
<b>Total Periods</b>					<b>45</b>

**Suggestive Assessment Methods**

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)

**Outcomes**

**Upon completion of the course, the students will be able to:**

**CO106.1.** Identify the basic concepts of internetworking, protocol layering and internet addressing in TCP/IP

**CO106.2.** Analyze the protocols used to deliver the datagram and report error information

**CO106.3.** Analyze the protocols and algorithms used for exchanging routing information

**CO106.4.** Analyze the interaction between client-server using sockets API.

**CO106.5.** Create an application using SMTP, IMAP, HTTP and RTP protocols Articulation Matrix

**Reference Books**

1. Douglas E.Comer, Internetworking with TCP/IP Principles, Protocols and Architecture, Sixth Edition Vol.1 PHI, 2014
2. Behrouz A.Forouzan, TCP/IP protocol suite, Fourth edition, TMH, 2010
3. Kevin R.Fall, W. Richard Stevens, TCP/IP Illustrated, Volume 1: The Protocols, 2/EPearson Education, 2011
4. Dr.Sidnie Feit, TCP/IP, 2/Education, TMH, 2008

**Web Recourses**

1. [www.nptel.ac.in](http://www.nptel.ac.in)
2. [https://en.wikipedia.org/wiki/Internet\\_protocol\\_suite](https://en.wikipedia.org/wiki/Internet_protocol_suite)

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3														
2	3														
3	3	3				3						2	2	3	
4	3	3				2						2	3	3	
5	3	3				2						2	3	3	

21NE1611	Data Structures Laboratory	L	T	P	C
<b>Prerequisites for the course</b>					
Data Structures					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To acquire the knowledge of using advanced tree structures.</li> <li>2. To learn the usage of heap structures.</li> <li>3. To understand the usage of graph structures and spanning trees</li> </ol>					
S.No	List of Experiments	CO			
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.				
<b>Total Periods :60</b>					
<b>Suggestive Assessment Methods</b>					
<b>Lab Components Assessments (50 Marks)</b>			<b>End Semester Exams (50 Marks)</b>		
<b>Outcomes</b>					
<p><b>Upon completion of the course, the students will be able to:</b></p> <p>CO107.1 Design and implement basic data structures extensively</p> <p>CO107.2 Design and implement advanced data structures extensively</p> <p>CO107.3 Design and implement graph traversals</p> <p>CO107.4 Design algorithms using graph structures</p> <p>CO107.5 Design and develop efficient algorithms with minimum complexity using design techniques</p>					

**Laboratory Requirements**

1. Java or C / C++

**Reference Books**

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

**Web Recourses**

1. <https://www.oreilly.com/library/view/advanced-data-structures/9781788624213/>

## CO Vs PO Mapping and CO Vs PSO Mapping

C	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO1	PO	PO1	PS	PSO2	PSO3
O	1	2	3	4	5	6	7	8	9	0	11	2	O1		
1	3	2	3		3							1	2	1	
2	3	2	3		3							1	2	1	
3	3	2	3		3							1		2	
4	3	2	3		3							1		2	
5	3	2	3		3							1		2	

21NE2601	NETWORK DESIGN AND PROGRAMMING	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
1. Computer Networks					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To understand the basic networking principles</li> <li>2. To explore various networking devices and protocols required for network design and management</li> <li>3. To understand the logical addressing and routing with algorithms</li> <li>4. To study two novel networking technologies: SDN and DTN</li> <li>5. To learn network programming in UNIX C</li> </ol>					
<b>UNIT I</b>	<b>NETWORKING PRINCIPLES</b>	<b>9</b>			



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.

<b>UNIT II</b>	<b>PHYSICAL NETWORK DESIGN</b>	<b>9</b>
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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.

<b>UNIT III</b>	<b>LOGICAL DESIGN AND MANAGEMENT</b>	<b>9</b>
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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.

<b>UNIT IV</b>	<b>INNOVATIVE NETWORKS</b>	<b>9</b>
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Software Defined Networks – Evolution of switches and control planes – Centralized and distributed data and control planes – Open Flow 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

<b>UNIT V</b>	<b>NETWORK PROGRAMMING IN UNIX C</b>	<b>9</b>
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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

<b>Total Periods</b>	<b>45</b>
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### Suggestive Assessment Methods

<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>

### Outcomes

**Upon completion of the course, the students will be able to:**

**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

**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.

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		3	3		3	3						3	2	
2	3	3	3	3		3	3						3	2	
3	3		3	3		3	3						3	2	
4	3		3	3		3	3						3	2	
5	3		3	3		3	3						3	2	

21NE2602	NETWORK SECURITY			
	L	T	P	C
	3	0	0	3

**Prerequisites for the course**

1. Cryptography and Network Security

**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

UNIT I	INTRODUCTION	10
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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.

<b>UNIT II</b>	<b>BLOCK CIPHERS &amp; PUBLIC KEY ENCRYPTION</b>	<b>10</b>
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.		
<b>UNIT III</b>	<b>HASH FUNCTIONS AND DIGITAL SIGNATURES</b>	<b>9</b>
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.		
<b>UNIT IV</b>	<b>E-MAIL, IP &amp; WEB SECURITY</b>	<b>8</b>
E-mail Security: Pretty Good Privacy-S/MIME. IP Security: 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).		
<b>UNIT V</b>	<b>SYSTEM SECURITY</b>	<b>8</b>
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.		
<b>Total Periods</b>		<b>45</b>
<b>Suggestive Assessment Methods</b>		
<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>
<b>Outcomes</b>		
<b>Upon completion of the course, the students will be able to:</b>		
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		
<b>REFERENCE BOOK(S):</b>		
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.

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2										2	3	2	
2	3		2	2							2	2	3	2	
3	3	3									2	2	3	2	2
4	3	3									2	2	3	2	2
5	3											2	3	2	2

21NE2603	INTERNET OF THINGS	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Networks					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To understand the fundamentals of Internet of Things</li> <li>2. To understand IoT architecture</li> <li>3. To learn about the basics of IOT protocols</li> <li>4. To build a small low cost embedded system using Raspberry Pi.</li> <li>5. To apply the concept of Internet of Things in the real world scenario.</li> </ol>					
<b>UNIT I</b>	<b>INTRODUCTION TO IoT</b>	<b>9</b>			
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					
<b>UNIT II</b>	<b>IoT ARCHITECTURE</b>	<b>10</b>			
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.					
<b>UNIT III</b>	<b>IoT PROTOCOLS</b>	<b>9</b>			

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.

<b>UNIT IV</b>	<b>BUILDING IoT WITH RASPBERRY PI &amp; ARDUINO</b>	<b>8</b>
Building IOT with RASPBERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & EndPO9nts - IoT Device -Building blocks -Raspberrry Pi -Board - Linux on Raspberrry Pi - Raspberrry Pi Interfaces -Programming Raspberrry Pi with Python - Other IoT Platforms – Arduino		
<b>UNIT V</b>	<b>CASE STUDIES AND REAL-WORLD APPLICATIONS</b>	<b>9</b>
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.		
<b>Total Periods</b>		<b>45</b>

### Suggestive Assessment Methods

<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>

### Outcomes

**Upon completion of the course, the students will be able to:**

**CO203.1** Analyze various protocols for IoT

**CO203.2** Develop web services to access/control IoT devices.

**CO203.3** Design a portable IoT using Raspberrry Pi

**CO203.4** Deploy an IoT application and connect to the cloud.

**CO203.5** Analyze applications of IoT in real time scenario

### 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 Ho" ller, 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.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2		2		1					1	2	3	2	
2	3		3			1					1	2	3	2	
3	3				3	1					1	2	3	2	2
4	3	2		2	2	1					1	2	3	2	2
5	3					1					1	2	3	2	2

<b>21NE2604</b>	<b>WIRELESS TECHNOLOGIES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Prerequisites for the course**

1. Networks Mobile Computing

**Objectives**

1. To understand the concepts of various wireless technologies WLAN and WPAN
2. To review the concepts of wireless Internet
3. To explore the emerging Adhoc Sensor networks
4. To understand the 3G networks
5. To understand the 4G technology like LTE

**UNIT I**

**WIRELESS LAN and PAN**

**9**

Introduction, fundamentals of WLAN –technical issues, network architecture, IEEE 802.11-physical layer, Mac layer mechanism, CSMA/CARTS/CTS, Polling, Bluetooth- User scenarios, Architecture, Radio layer, Baseband layer, Link manager protocol, L2CAP, Security, SDP, IEEE 802.15.3. 19

**UNIT II**

**WIRELESS INTERNET**

**10**

Introduction –wireless internet, address mobility, inefficiency of transport layer and Application layer protocol, mobile IP – simultaneous binding, route optimization, mobile IP variations, handoffs, IPv6 advancements, IP for wireless domain, security in mobile IP, TCP in wireless domain – TCP over wireless , TCPs -traditional, snoop, indirect, mobile, transaction- oriented, impact of mobility.

**UNIT III**

**AD-HOC SENSOR NETWORK**

**9**

Wireless Sensor Network – Applications, design Challenges, Protocol stack, comparisons with MANET node architecture, network architecture, MAC protocols-requirements, IEEE 802.15.4 MAC protocol, Routing Protocol –energy aware routing, Location based routing, clustering, aggregation, QoS, security protocol, Zigbee standard.

**UNIT IV**

**3G NETWORKS**

**8**

Overview of LTE Networks - Need for LTE- From LTE to LTE-Advanced SAE :- LTE Architecture, Radio Protocol stack , Interfaces, Concept of HetNET, Quality of Service and Bandwidth Reservation - QoS metrics, Signaling for Bandwidth Requests and Grants, Bandwidth Allocation and Traffic Handling, Mobility Management, Security Protocols

UNIT V	4G - LTE	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.		
<b>Total Periods</b>		<b>45</b>
<b>Suggestive Assessment Methods</b>		
<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>
<b>Outcomes</b>		
<b>Upon completion of the course, the students will be able to:</b>		
<p><b>CO204. 1</b> To design the various wireless networks.</p> <p><b>CO204. 2</b> To be able to design the 4G and LTE networks</p> <p><b>CO204. 3</b> To design application sensor networks</p> <p><b>CO204. 4</b> To design Heterogeneous networks</p> <p><b>CO204. 5</b> To analyze the security protocols</p>		
<b>REFERENCE BOOK(S):</b>		
<ol style="list-style-type: none"> <li>1. Abd-Elhamid M. Taha and Hossam S. Hassanein and Najah Abu Ali, —LTE, LTE-Advanced and Wimax towards IMT-advanced networks   John Wiley &amp; Sons , 2012.</li> <li>2. HarriHolma and Antti Toskala, —HSDPA/HSUPA for UMTS  , John Wiley &amp; Sons, 2006.</li> <li>3. Holger Karl and Andreas Willing, —Protocols and Architecture for Wireless Sensor Network  , John Wiley &amp; Sons, 2007.</li> <li>4. Jochen Schiller, —Mobile Communication  , Pearson education, 2nd edition 2005.</li> <li>5. JuhaKorhonen, —Introduction to 3G Mobile Communication  , Artech House, 2003.</li> <li>6. Larry J. Greenstein, Andrea J. Goldsmith, —Principles of Cognitive Radi  , Cambridge University press, 2013.</li> <li>7. Vijay. K. Garg, —Wireless Communication and Networking  , Morgan Kaufmann Publishers, 2007.</li> </ol>		

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		3								2	2	3	2	
2	3		3								2	2	3	2	
3	3		3								2	2	3	2	2
4	3		3								2	2	3	2	2
5	3			2	3						1	2	3	2	2

21NE2611	NETWORK DESIGN AND PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2
<b>Prerequisites for the course</b>					
1. Computer Networks					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>To practice LAN and WAN design</li> <li>To learn network programming in UNIX C and Python</li> <li>Establish a LAN with a switch/hub with 3 PCs and check the connectivity and configuration</li> <li>Establish a internetwork with 2 routers and two or more LANs using static routes and check the connectivity and configuration</li> <li>Establish a dynamic routing based internetwork with 2 routers and two or more LANs using RIP/OSPF and check the connectivity and configuration</li> </ol>					
S.No	List of Experiments	CO			
1	Develop a C program that demonstrates inter process communication	C01			
2	Develop a TCP client/server application	C01			
3	Develop a UDP client/server application	C01			
4	Develop an Iterative UDP server with 2 or 3 clients	C02			
5	Develop a concurrent TCP server with 2 or 3 clients	C02			
6	Develop a multiprotocol server with TCP and UDP and 2 clients	C02			
7	Develop simple Python programs that use frequently used syntactic constructs	C03			
8	Develop a Socket based application in Python	C03			
9	Build client applications for major APIs (Amazon S3, Twitter etc) in Python	C03			
10	Develop an application that interacts with e-mail servers in python	C03			
<b>Total Periods :60</b>					
<b>Suggestive Assessment Methods</b>					
<b>Lab Components Assessments (50 Marks)</b>			<b>End Semester Exams (50 Marks)</b>		



<b>Outcomes</b>
<b>CO207. 1</b> Design and implement LANs <b>CO207. 2</b> Design and implement TCP protocols <b>CO207. 3</b> Design and implements UDP Protocols <b>CO207. 4</b> Design and implement socket programming <b>CO207. 5</b> Develop network based applications in UNIX C and Python
<b>Reference Books</b>

### CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		3	3							2	2	3	2	
2	3		3	3							2	2	3	2	
3	3		3	3	3						2	2	3	2	
4	3		3	3	3						2	2	3	2	
5	3		3	3	3						2	2	3	2	

21NE2912	TERM PAPER WRITING AND SEMINAR	L	T	P	C
		0	0	2	1

#### Prerequisites for the course

NIL

#### Objectives

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

Activity	Instructions	Submission	Evaluation
tion of area of interest and	ou are requested to select an	2 <sup>nd</sup> week	

Topic Stating an Objective	area of interest, topic and state an objective		ed on clarity of thought, current relevance and clarity in writing
Collecting Information about your area & topic	<ol style="list-style-type: none"> <li>1. List 1 Special Interest Groups or professional society</li> <li>2. List 2 journals</li> <li>3. List 2 conferences, symposia or workshops</li> <li>4. List 1 thesis title</li> <li>5. List 3 web presences (mailing lists, forums, news sites)</li> <li>6. List 3 authors who publish regularly in your area</li> <li>7. Attach a call for papers (CFP) from your area.</li> </ol>	3 <sup>rd</sup> week	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"> <li>• You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar</li> <li>• When picking papers to read - try to: <ul style="list-style-type: none"> <li>• Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them,</li> <li>• Favour papers from well-known journals and conferences,</li> <li>• Favour —first   or —foundational   papers in the field (as indicated in other people’s survey paper),</li> <li>• Favour more recent papers,</li> </ul> </li> </ul>	4 <sup>th</sup> week	<b>6%</b> ( the list of standard papers and reason for selection)

	<ul style="list-style-type: none"> <li>● Pick a recent survey of the field so you can quickly gain an overview,</li> <li>● Find relationships with respect to each other and to your topic area (classification scheme/categorization)</li> <li>● Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered</li> </ul>		
Reading and notes for first 5 papers	<p>Reading Paper Process</p> <ul style="list-style-type: none"> <li>● For each paper</li> <li>● What is the main topic of the article?</li> <li>● What was/were the main issue(s) the author said they want to discuss?</li> <li>● Why did the author claim it was important?</li> <li>● How does the work build on other's work, in the author's opinion?</li> <li>● What simplifying assumptions does the author claim to be making?</li> <li>● What did the author do?</li> <li>● How did the author claim they were going to evaluate their work and compare it to others?</li> <li>● What did the</li> </ul>	5 <sup>th</sup> week	<p><b>8%</b></p> <p>( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)</p>

	<p>author say were the limitations of their research?</p> <ul style="list-style-type: none"> <li>• What did the author say were the important directions for future research?</li> </ul> <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 <sup>th</sup> week	<b>8%</b> ( 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 <sup>th</sup> week	<b>8%</b> ( 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 <sup>th</sup> week	<b>8%</b> ( this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9 <sup>th</sup> week	<b>6%</b> (Clarity, purpose and conclusion) <b>6%</b> Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10 <sup>th</sup> week	<b>5%</b> ( clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram	11 <sup>th</sup> week	<b>10%</b> (this component will be evaluated based on the linking and classification

	in keeping with the goals of your survey		among the papers)
Your conclusions	Write your conclusions and future work	12 <sup>th</sup> week	5% ( conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13 <sup>th</sup> week	10% (formatting, English, Clarity and linking) 4% Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14 <sup>th</sup> & 15 <sup>th</sup> week	10% (based on presentation and Viva-voce)

21NE2701	SOFTWARE ARCHITECTURES AND DESIGN	L	T	P	C
		3	0	0	3

**Prerequisites for the course**

Distributed Systems

**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.

<b>UNIT I</b>	<b>INTRODUCTION TO SOFTWARE ARCHITECTURE</b>	<b>9</b>
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).		
<b>UNIT II</b>	<b>OBJECT-ORIENTED PARADIGM</b>	<b>9</b>
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 )		
<b>UNIT III</b>	<b>DISTRIBUTED ARCHITECTURE</b>	<b>9</b>
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.		
<b>UNIT IV</b>	<b>USER INTERFACES CONTAINERS</b>	<b>9</b>

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.

<b>UNIT V</b>	<b>ASPECT ORIENTED ARCHITECTURES</b>	<b>9</b>
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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.

<b>Total Periods</b>	<b>45</b>
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#### Suggestive Assessment Methods

<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>

#### Outcomes

**Upon completion of the course, the students will be able to:**

- 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

#### 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.

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3										1	2	3	2	
2	3			2							1	2	3	2	
3	3		2								1	2	3	2	2
4	3			2							1	2	3	2	2
5	3			2							1	2	3	2	2

21NE2702	OPTICAL NETWORKS	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Computer Networks					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To study about the various optical fiber modes</li> <li>2. To gain knowledge about configuration and transmission characteristics of optical fibers.</li> <li>3. To learn about the various optical sources, detectors and transmission techniques</li> <li>4. To explore various idea about optical fiber measurements and various coupling techniques</li> <li>5. To enrich the knowledge about optical communication systems and networks</li> </ol>					
<b>UNIT I</b>	<b>INTRODUCTION TO OPTICAL FIBERS</b>	<b>9</b>			
Introduction-general optical fiber communication system- basic optical laws and definitions of optical modes and configurations -mode analysis for optical propagation through fibers modes in planar wave guide-modes in cylindrical optical fiber-transverse electric and transverse magnetic modes- fiber materials-fiber fabrication techniques-fiber optic cables classification of optical fiber-single mode fiber-graded index fiber.					
<b>UNIT II</b>	<b>TRANSMISSION CHARACTERISTIC OF OPTICAL FIBER</b>	<b>9</b>			
Attenuation-absorption –scattering losses-bending losses-core and cladding losses-signal dispersion –inter symbol interference and bandwidth-intra model dispersion-material dispersion- waveguide dispersion-polarization mode dispersion-intermodal dispersion dispersion optimization of single mode fiber-characteristics of single mode fiber-R-I Profile cutoff wave length-dispersion calculation-mode field diameter.					
<b>UNIT III</b>	<b>OPTICAL SOURCES AND DETECTORS</b>	<b>9</b>			
Sources: Intrinsic and extrinsic material-direct and indirect band gaps-LED-LED structures surface emitting LED-Edge emitting LED-quantum efficiency and LED power-light source materials-modulation of LED-LASER diodes-modes and threshold conditions-Rate equations-external quantum efficiency-resonant frequencies-structures and radiation patterns-single mode laser-external modulation-temperature effort-Detectors: PIN photo detector-Avalanche photo diodes-Photo detector noise-noise sources-SNR-detector response time-Avalanche multiplication noise-temperature effects comparisons of photo detectors.					
<b>UNIT IV</b>	<b>OPTICAL RECEIVER, MEASUREMENTS AND COUPLING</b>	<b>9</b>			
Fundamental receiver operation-preamplifiers-digital signal transmission-error sources-Front end amplifiers-digital receiver performance-probability of error-receiver sensitivity-quantum limit. Optical power measurement-attenuation measurement-dispersion measurement- Fiber Numerical Aperture Measurements- Fiber cut- off Wave length Measurements- Fiber diameter measurements-Source to Fiber Power Launching-Lensing Schemes for Coupling Management-Fiber to Fiber Joints-LED Coupling to Single Mode Fibers-Fiber Splicing Optical Fiber connectors.					
<b>UNIT V</b>	<b>OPTICAL COMMUNICATION SYSTEMS AND NETWORKS</b>	<b>9</b>			
System design consideration Point – to –Point link design –Link power budget –rise time budget, WDM –Passive DWDM Components-Elements of optical networks-SONET/SDH Optical Interfaces-SONET/SDH Rings and Networks-High speed light wave Links-OADM configuration-Optical					

ETHERNET-Soliton.

<b>Total Periods</b>	<b>45</b>
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**Suggestive Assessment Methods**

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)

**Outcomes****Upon completion of the course, the students will be able to:****CO207 1.1:** Realize basic elements in optical fibers, different modes and configurations.**CO207 1.2** Analyze the transmission characteristics associated with dispersion and polarization techniques.**CO207 1.3:** Design optical sources and detectors with their use in optical communication system.**CO207 1.4:** Construct fiber optic receiver systems, measurements and coupling techniques.**CO207 1.5:** Design optical communication systems and its networks.**Text Books**

1. P Chakrabarti, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited, 2016 (UNIT I, II, III)
2. Gred Keiser, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013. (UNIT I, IV, V)

**Reference Books**

1. John M.Senior, —Optical fiber communication, Pearson Education, second edition.2007.
2. Rajiv Ramaswami, —Optical Networks — , Second Edition, Elsevier , 2004.
3. J.Gower, —Optical Communication System, Prentice Hall of India, 2001.
4. Govind P. Agrawal, —Fiber-optic communication systems, third edition, John Wiley & sons, 2004.

**Web Recourses**

1. [www.nptel.ac.in](http://www.nptel.ac.in)
2. <https://en.wikipedia.org/wiki/>

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3												3	2	
2	3	3											3	2	
3	3	3	3									2	3	2	



4	3	3	3								2	3	2	2
5	3	3	3								2	3	2	2

<b>21NE2703</b>	<b>WEB SECURITY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Prerequisites for the course**

Internet Programming

**Objectives**

1. To inspire the students with interest, excitement, and urge to learn the subject of web technology.
2. To understand the fundamental concepts and implementation of web related issues and resolution.
3. To introduce the purpose of learning important subjects in web technology for meeting the requirement of various web based threats
4. To understand database vulnerabilities
5. To learn about firewalls

**UNIT I****INTRODUCTION****9**

Web application security- Key Problem factors – Core defence mechanisms- Handling user access- handling user input- Handling attackers- web spidering – Discovering hidden content Transmitting data via the client – Hidden form fields – HTTP cookies – URL parameters – Handling client-side data securely

**UNIT II****AUTHENTICATION MECHANISM****9**

Attacking authentication – design flaws in authentication mechanisms – securing authentication- Attacking access controls – Common vulnerabilities

**UNIT III****DATABASE SECURITY****9**

SQL Injection - How it happens - Dynamic string building – Insecure-Database Configuration - finding SQL injection – Exploiting SQL injection –Common techniques-Platform level defenses - Using run time protection -web application Firewalls - Using ModSecurity - Intercepting filters

**UNIT IV****FIREWALL****9**

Web server filters - application filters – securing the database – Locking down the application data – Locking down the Database server. Mod Security - Blocking common attacks – HTTP finger printing – Blocking proxied requests – Cross-site scripting- Cross-site request forgeries – Shell command execution attempts

**UNIT V****HACKING****9**

– Null byte attacks – Source code revelation-Directory traversal attacks – Blog- spam – Website defacement – Brute force attack – Directory indexing –Detecting the real IP address of an attacker- Web server Hacking - Source code disclosure – Canonicalization attacks –Denial of service-Web application hacking – Web crawling-Database-Hacking – Database discovery – Database vulnerabilities

		<b>Total Periods</b>	<b>45</b>
<b>Suggestive Assessment Methods</b>			
<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>	
<b>Outcomes</b>			
<b>Upon completion of the course, the students will be able to:</b>			
<p><b>CO305-3.1:</b> To understand the basic concepts of web technologies and their implementation</p> <p><b>CO305-3.2:</b> To apply authentication mechanism for securing authentication</p> <p><b>CO305-3.3:</b> To study and use web application firewall for database security</p> <p><b>CO305-3.4:</b> To use and study about the HTTP web server hacking</p> <p><b>CO305-3.5:</b> To explore the ethical hacking system</p>			
<b>Text Books</b>			
<p>1. Dafydd Stuttard, Marcus Pinto, The Web Application Hacker's Handbook, 2nd Edition, Wiley Publishing, Inc.</p> <p>2. Justin Clarke, SQL Injection Attacks and Defense, 2004 , Syngress Publication Inc</p>			
<b>Reference Books</b>			
<p>1. Magnus Mischel , ModSecurity 2.5, Packt Publishing</p> <p>2. Stuart McClure Joel, ScambRay, George Kurtz, Hacking Exposed 7: Network Security Secrets &amp; Solutions, Seventh Edition, 2012, The McGraw-Hill Companies</p>			

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3												3		
2	3	3	3									2	3	2	
3	3	3	3									2	3	2	
4	3	3	3									2	3	2	
5	3	3	3									2	3	2	

21NE2704	BLOCK CHAIN TECHNOLOGY	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Artificial Intelligence					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To provide conceptual understanding of the function of Block chains</li> <li>2. Understand how blockchain systems (mainly Bitcoin and Ethereum) work</li> <li>3. To securely interact with them</li> <li>4. Design, build, and deploy smart contracts and distributed applications,</li> <li>5. Integrate ideas from blockchain technology into their own projects.</li> </ol>					
<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>			
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).					
<b>UNIT II</b>	<b>CRYPTO CURRENCY</b>	<b>9</b>			
cryptographic basics for cryptocurrency - a short overview of Hashing, signature schemes, encryption schemes and elliptic curve cryptography.					
<b>UNIT III</b>	<b>BITCOIN</b>	<b>9</b>			
Bitcoin - Wallet - Blocks - Merkle Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin.					
<b>UNIT IV</b>	<b>CRYPTO CURRENCY REGULATION</b>	<b>9</b>			
Ethereum - Ethereum Virtual Machine ( EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts.					
<b>UNIT V</b>	<b>SNARK</b>	<b>9</b>			
Zero Knowledge proofs and protocols in Blockchain - Succinct non interactive argument for Knowledge ( SNARK) - pairing on Elliptic curves - Zcash.					
<b>Total Periods</b>					<b>45</b>
<b>Suggestive Assessment Methods</b>					
<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>			
<b>Outcomes</b>					
<b>Upon completion of the course, the students will be able to:</b>					

- 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.

#### Text Books

1. Dennis Roddy, “Satellite Communication”, 4th Edition, Mc Graw Hill International, 2017
2. Timothy,Pratt,Charles,W.Bostain,JeremyE.Allnutt,"SatelliteCommunication",2nd Edition, Wiley Publications,2002

#### Reference Books

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 VOL 9057, ( VOLII ), pp 281-310.
4. R.Pass et al, Analysis of Blockchain protocol in Asynchronous networks , EUROCRYPT 2017.

#### CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3										3	2	3		
2	3	3		3							3	2	3	2	
3	3										3	2	3	2	
4	3		3	3							3	2	3	2	
5	2	3		3	1						2	2	3	2	

<b>21NE2705</b>	<b>MULTIMEDIA COMMUNICATION NETWORKS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Prerequisites for the course</b>					
Computer Networks					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To understand the multimedia communication models</li> <li>2. To study the multimedia transport in wireless networks</li> <li>3. To explore real-time multimedia network applications</li> <li>4. To understand multicasting</li> <li>5. To explore multimedia streaming</li> </ol>					
<b>UNIT I</b>	<b>MULTIMEDIA COMMUNICATION MODELS</b>	<b>9</b>			
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.					
<b>UNIT II</b>	<b>BEST EFFORT AND GUARANTEED SERVICE MODEL</b>	<b>9</b>			
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.					
<b>UNIT III</b>	<b>MULTIMEDIA ON IP NETWORKS</b>	<b>9</b>			
QoS aware routing-RSVP-Integrated and Differentiated services-MPLS-Multicasting-IGMP-PIMDVMRP					
<b>UNIT IV</b>	<b>TRANSPORT LAYER SUPPORT FOR MULTIMEDIA</b>	<b>9</b>			
Multimedia over TCP-Significance of UDP- Multimedia Streaming- Audio and Video Streaming Interactive and non Interactive Multimedia-RTP/RTCP-SIP-RTSP					
<b>UNIT V</b>	<b>MULTIMEDIA QOS ON WIRELESS NETWORKS</b>	<b>9</b>			
IEEE 802.11e, IEEE 802.16, 3G networks-UMTS, 3GPP, 4G networks-LTE-IMS					
<b>Total Periods</b>					<b>45</b>
<b>Suggestive Assessment Methods</b>					
<b>Continuous Assessment Test (30 Marks)</b>		<b>Formative Assessment Test (10 Marks)</b>		<b>End Semester Exams (60 Marks)</b>	
<b>Outcomes</b>					
<b>Upon completion of the course, the students will be able to:</b>					

- 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

**Reference Books**

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

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3			3							1	1	3		
2	3		2								2	2	3	2	
3	3		2	2							2	2	3	2	
4	3		2	2							2	2	3	2	
5	3		2	2							2	2	3	2	

21NE2706	MOBILE AND PERVASIVE COMPUTING	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Mobile Computing					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To learn the basic architecture and concepts till Third Generation Communication systems.</li> <li>2. To understand the latest 4G Telecommunication System Principles.</li> <li>3. To introduce the broad perspective of pervasive concepts and management</li> <li>4. To explore the HCI in Pervasive environment</li> <li>5. To apply the pervasive concepts in mobile environment</li> </ol>					
<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>			
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.					
<b>UNIT II</b>	<b>OVERVIEW OF A MODERN 4G TELECOMMUNICATIONS</b>	<b>9</b>			

<b>SYSTEM</b>		
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.		
<b>UNIT III</b>	<b>PERVASIVE CONCEPTS AND ELEMENTS</b>	<b>9</b>
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		
<b>UNIT IV</b>	<b>HCI IN PERVASIVE COMPUTING</b>	<b>9</b>
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.		
<b>UNIT V</b>	<b>PERVASIVE MOBILE TRANSACTIONS</b>	<b>9</b>
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.		
<b>Total Periods</b>		<b>45</b>
<b>Suggestive Assessment Methods</b>		
<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>
<b>Outcomes</b>		
<b>Upon completion of the course, the students will be able to:</b>		
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		
<b>Reference Books</b>		

5. Alan Colman, Jun Han, and Muhammad Ashad Kabir, Pervasive Social Computing Socially-Aware Pervasive Systems and Mobile Applications, Springer, 2016.
6. J.Schiller, –Mobile Communication||, Addison Wesley, 2000.
7. Juha Korhonen, –Introduction to 4G Mobile Communications|| , Artech House Publishers, 2014.
8. Kolomvatsos, Kostas, Intelligent Technologies and Techniques for Pervasive Computing, IGI Global, 2013.
9. M. Bala Krishna, Jaime Lloret Mauri, –Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G Networks||, CRC 2016.
10. Minyi Guo, Jingyu Zhou, Feilong Tang, Yao Shen, – Pervasive Computing: Concepts, Technologies and Applications || CRC Press, 2016.

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2							2	2	3		
2	2	2		2	2						2	2	3	2	
3	2	2	2	2							2	2	3	2	
4	3		3	2							2	2	3	2	
5	3										2	2	3	2	

21NE2707	SIMULATION OF COMPUTER SYSTEMS AND NETWORKS	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Computer Networks					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To understand how simulators are built.</li> <li>2. To understand the statistical models used in simulations.</li> <li>3. To learn different ways of generating random numbers.</li> <li>4. To learn modeling of the data given as input to simulators.</li> <li>5. To understand how computer networks are simulated using case studies.</li> </ol>					
<b>UNIT I</b>	<b>STATISTICAL AND QUEUING MODELS</b>				<b>9</b>
Statistical models – Discrete, continuous and empirical distributions – Characteristics of Queuing systems – Measures of performance of queuing systems – Markovian models					
<b>UNIT II</b>	<b>RANDOM NUMBER AND RANDOM VARIATE GENERATION</b>				<b>9</b>
Properties of random numbers – Generating uniform random numbers – Generating non-uniform random numbers - Tests for random numbers – Random-variate generation					



<b>UNIT III</b>	<b>ANALYSIS OF SIMULATION DATA</b>	<b>9</b>
Input modeling – Identifying the distribution – Parameter estimation – Goodness-of-fit tests – Multivariate and time-series input models – Verification and validation of simulation models		
<b>UNIT IV</b>	<b>SIMULATION OF COMPUTER NETWORKS</b>	<b>9</b>
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.		
<b>UNIT V</b>	<b>CASE STUDIES OF NETWORK SIMULATORS</b>	<b>9</b>
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		
<b>Total Periods</b>		<b>45</b>
<b>Suggestive Assessment Methods</b>		
<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>
<b>Outcomes</b>		
<b>Upon completion of the course, the students will be able to:</b>		
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		
<b>Reference Books</b>		
<ol style="list-style-type: none"> <li>1. J. B. Sinclair, –Simulation of Computer Systems and Computer Networks: A Process-Oriented Approach  , 2004.</li> <li>2. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, –Discrete-event System Simulation, Fifth Edition, Pearson, 2010.</li> <li>3. Law, Averill, –Simulation Modeling and Analysis with Expert Software  , Mc Graw Hill, 2006.</li> <li>4. Mohammad S. Obaidat, Petros Nicopolitidis, Faouzi Zarai, –Modeling and Simulation of Computer Networks and Systems – Methodologies and Applications  , Morgan Kaufmann, 2015.</li> <li>5. Sheldon M. Ross, –Simulation  , Fifth Edition, Elsevier, 2013.</li> </ol>		

CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3										1	1	3		
2	3										2	2	3	2	

3	3	3									2	2	3	2	
4	3	3			3						2	2	3	2	
5	3	3									1	1	3	2	

<b>21NE2708</b>	<b>HIGH SPEED SWITCHING ARCHITECTURES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Prerequisites for the course</b>					
Computer Architecture					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To learn the basics of switching</li> <li>2. To explore the various space division switches</li> <li>3. To evaluate the performance of various switching architectures</li> <li>4. To study the architecture of IP routers</li> <li>5. To study about MPLS switches</li> </ol>					
<b>UNIT I</b>	<b>SWITCHING BASICS</b>	<b>9</b>			
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.					
<b>UNIT II</b>	<b>SWITCHING ARCHITECTURES</b>	<b>9</b>			
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.					
<b>UNIT III</b>	<b>PACKET QUEUES AND DELAY ANALYSIS</b>	<b>9</b>			
Little's theorem – Birth and death processes – Queuing disciplines – Markovian FIFO queuing – Non Markovian – Pollaczek-Khinchine formula – M/M/1, M/G/1 and M/D/1 models – Self similar models and Batch arrivals models – Network of queues – Burke's theorem and Jackson theorem					
<b>UNIT IV</b>	<b>P ROUTER ARCHITECTURE</b>	<b>9</b>			
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		
<b>Total Periods</b>		<b>45</b>
<b>Suggestive Assessment Methods</b>		
Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)
<b>Outcomes</b>		
<b>Upon completion of the course, the students will be able to:</b>		
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		
<b>Reference Books</b>		
<ol style="list-style-type: none"> <li>1. Damitri P Bertsekas and Gallager, —Data Networks‡, 2nd edition, PHI, 1992</li> <li>2. Elhanany, Itamar, Hamdi and Mounir, —High Performance Packet Switching Architectures‡, Springer 2007</li> <li>3. H.Jonathan Chao and Bin Liu, —High Performance Switches and Routers‡, John Wiley and Sons, 2007</li> <li>4. Howard C Berkowitz, —Designing Routing and Switching Architectures for Enterprise Networks‡, Sams, 1999</li> <li>5. Luc De Ghein, —MPLS Fundamentals‡, Cisco Press 2014.</li> </ol>		

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		3	2							2	2	3		
2	3		3	2							2	2	3	2	
3	3		3								2	2	3	2	
4	3		2								2	2	3	2	
5	3		2								2	2	3	2	

21NE3701	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Analog and digital communication systems					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. Understand the satellite segment and earth segment</li> <li>2. Analyze the various methods of satellite access</li> <li>3. Understand the applications of satellites</li> <li>4. Understand the basics of satellite Networks</li> <li>5. Explore satellite applications</li> </ol>					
<b>UNIT I</b>	<b>SATELLITE ORBITS</b>	<b>9</b>			
Kepler"s Laws, Newton"s law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse-Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.					
<b>UNIT II</b>	<b>SPACE SEGMENT</b>	<b>9</b>			
Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders-The Antenna Subsystem					
<b>UNIT III</b>	<b>SATELLITE LINK DESIGN</b>	<b>9</b>			
Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.					
<b>UNIT IV</b>	<b>SATELLITE ACCESS AND CODING METHODS</b>	<b>9</b>			
Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods, compression – encryption, Coding Schemes					
<b>UNIT V</b>	<b>SATELLITE APPLICATIONS</b>	<b>9</b>			
INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).					
<b>Total Periods</b>					<b>45</b>
<b>Suggestive Assessment Methods</b>					
<b>Continuous Assessment Test (30 Marks)</b>		<b>Formative Assessment Test (10 Marks)</b>		<b>End Semester Exams (60 Marks)</b>	
<b>Outcomes</b>					
Upon completion of the course, the students will be able to:					

- CO202-5. 1 To Analyze the satellite orbits.  
 CO202-5. 1 To Analyze the earth segment and space segment  
 CO202-5. 1 To Analyze the satellite Link design.  
 CO202-5. 1 To Analyse the coding methods  
 CO202-5. 1 To Design various satellite applications

**Text Books**

1. Dennis Roddy, "Satellite Communication", 4th Edition, Mc Graw Hill International, 2017
2. Timothy,Pratt,Charles,W.Bostain,JeremyE.Allnutt,"SatelliteCommunication",2nd Edition, Wiley Publications,2002

**Reference Books**

1. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.
2. N.Agarwal, "Design of Geosynchronous Space Craft", Prentice Hall, 1986.
3. Bruce R. Elbert, "The Satellite Communication Applications", Hand Book, Artech House Bostan London, 1997.
4. Tri T. Ha, "Digital Satellite Communication", II nd edition, 1990.
5. Emanuel Fthenakis, "Manual of Satellite Communications", Mc Graw Hill Book Co., 1984.
6. Robert G. Winch, "Telecommunication Trans Mission Systems", Mc Graw-Hill Book Co., 1983.
7. Brian Ackroyd, "World Satellite Communication and earth station Design", BSP professional Books, 1990.
8. G.B.Bleazard, "Introducing Satellite communications", NCC Publication, 1985.
9. M.Richharia, "Satellite Communication Systems-Design Principles", Macmillan 2003.

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		3								1	2	3	2	
2	3	3			2						1	2	3	2	2
3	3	3									1	2	3	2	2
4	3	3		2							1	2	3	2	2
5	3	2									1	2	3	2	2

<b>21NE3702</b>	<b>NETWORK PERFORMANCE ANALYSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Prerequisites for the course</b>					
Computer Networks					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>To understand the mathematical basis for analyzing the performance of networks.</li> <li>To understand queuing theory and queuing models.</li> <li>To analytically model traffic control protocols, and error control protocols using these concepts.</li> <li>To model performance of wired and wireless MAC such as 802.3, 802.11 and 802.16.</li> <li>To model network traffic and study the performance of different packet scheduling algorithms.</li> </ol>					
<b>UNIT I</b>	<b>MARKOV CHAINS BASICS</b>	<b>9</b>			
Overview of Random Processes, Markov Chains – Markov matrices, State transition matrix, Markov chains at equilibrium – steady state distribution vector.					
<b>UNIT II</b>	<b>REDUCIBLE AND PERIODIC MARKOV CHAINS</b>	<b>9</b>			
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.					
<b>UNIT III</b>	<b>TRAFFIC CONTROL, ERROR CONTROL AND MAC MODELING</b>	<b>9</b>			
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.					
<b>UNIT IV</b>	<b>WIFI AND WIMAX PERFORMANCE</b>	<b>9</b>			
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.					
<b>UNIT V</b>	<b>NETWORK TRAFFIC AND SCHEDULING</b>	<b>9</b>			
Modeling network traffic – Flow traffic models – Continuous time modeling, Discrete time modeling, Pareto traffic distribution, Destination traffic. Scheduling algorithms – Analysis					
<b>Total Periods</b>					<b>45</b>
<b>Suggestive Assessment Methods</b>					
<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>			
<b>Outcomes</b>					
Upon completion of the course, the students will be able to:					

**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

#### Reference Books

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.

#### CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3								1	3	2	
2	3	3	3	3								1	3	2	2
3	3	3	3	3								1	3	2	2
4	3	3	3	3								1	3	2	2
5	3			2							1	2	3	2	2

21NE3703	NEXT GENERATION NETWORKS	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Computer Networks					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To learn the technical, economic and service advantages of next generation networks.</li> <li>2. To learn the evolution of technologies of 4G and beyond.</li> <li>3. To learn Software defined Mobile Network issues and integrating challenges with LTE.</li> <li>4. To explore the NGN framework catering the services of end user with QoS provisioning.</li> <li>5. To learn about the NGM management and standards.</li> </ol>					
<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>			

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.

<b>UNIT II</b>	<b>4G and BEYOND</b>	<b>9</b>
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.		
<b>UNIT III</b>	<b>SDMN-LTE INTEGRATION</b>	<b>9</b>
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.		
<b>UNIT IV</b>	<b>NGN ARCHITECTURE</b>	<b>9</b>
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.		
<b>UNIT V</b>	<b>NGN MANAGEMENT AND STANDARDIZATION</b>	<b>9</b>
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.		
<b>Total Periods</b>		<b>45</b>

### Suggestive Assessment Methods

<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>

### Outcomes

**Upon completion of the course, the students will be able to:**

- 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

### Reference Books

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 Playvyk, –Next generation Telecommunication Networks, Services and Management||, Wiley & IEEE Press Publications, 2010.

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1			2		2	2						2	3	2	
2		2											3	2	2
3		2											3	2	2
4	2												3	2	2
5	2		2								1	2	3	2	2

21NE3704	SOFTWARE DEFINED NETWORKS AND NETWORK FUNCTION VIRTUALIZATION (SDN AND NFV)	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Computer Networks, Cloud Computing					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To understand the concepts of software defined networks</li> <li>2. To learn the interface between networking devices and the software controlling them</li> <li>3. To learn network virtualization and tools</li> <li>4. To explore modern approaches like VMware, openflow, openstack</li> <li>5. To study virtual networks and overlay networks</li> </ol>					
<b>UNIT I</b>	<b>SOFTWARE DEFINED NETWORK (SDN)</b>	<b>9</b>			
Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework.					
<b>UNIT II</b>	<b>VIRTUALIZATION BASICS</b>	<b>9</b>			
Primer on Virtualization, Benefits of virtual machines, Hypervisors, Managing Virtual resources, Virtualized cloud/data center					
<b>UNIT III</b>	<b>NETWORK FUNCTIONS VIRTUALIZED</b>	<b>9</b>			
Virtualize a Network, virtualizing appliances, virtualizing core networking functions, scalability and performance.					
<b>UNIT IV</b>	<b>MODERN NETWORKING APPROACHES</b>	<b>9</b>			
Openflow, VMware NSX, OpenDayLight project-ODL architecture & controller platform, control network, Business case for SDN					

<b>UNIT V</b>	<b>SECURITY &amp; VISIBILITY</b>		<b>9</b>
Security-Preventing Data leakage, Logging and auditing, Encryption in Virtual Networks Visibility-Overlay networks, Network management tools, Monitoring Traffic			
<b>Total Periods</b>			<b>45</b>
<b>Suggestive Assessment Methods</b>			
<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>	
<b>Outcomes</b>			
<b>Upon completion of the course, the students will be able to:</b>			
CO303-4. 1 To identify/design software defined network for the required application/platform			
CO303-4. 2 To deploy network virtualization tool & design			
CO303-4. 3 To equip in various network security measures and tackle			
CO303-4. 4 To employ modern networking approaches			
CO303-4. 5 To employ network management tools			
<b>Reference Books</b>			
<ol style="list-style-type: none"> <li>1. Jim Doherty,"SDN and NFV Simplified", Addison Wesley, 2016</li> <li>2. SiamakAzodoimolky, "Software Defined Networking with OpenFlow", Packt Publishing Limited, 2013</li> <li>3. Thomas D.Nadeau and Ken Gray, –SDN – Software Defined Networks  , O"Reilly Publishers, 2013.</li> </ol>			

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2		2										3	2	
2					3								3	2	2
3	2												3	2	2
4	2	2									1	2	3	2	2
5	3										1	2	3	2	2

21NE3705	EMBEDDED SOFTWARE DEVELOPMENT	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Embedded Systems					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>To understand the architecture of embedded processor, microcontroller and peripheral devices.</li> <li>To interface memory and peripherals with embedded systems.</li> <li>To study the embedded network environment.</li> <li>To understand challenges in Real time operating systems.</li> <li>To study, analyze and design applications on embedded systems</li> </ol>					
<b>UNIT I</b>	<b>EMBEDDED PROCESSORS</b>	<b>9</b>			
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					
<b>UNIT II</b>	<b>EMBEDDED COMPUTING PLATFORM</b>	<b>9</b>			
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.					
<b>UNIT III</b>	<b>EMBEDDED NETWORK ENVIRONMENT</b>	<b>9</b>			
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.					
<b>UNIT IV</b>	<b>REAL-TIME CHARACTERISTICS</b>	<b>9</b>			
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.					
<b>UNIT V</b>	<b>SYSTEM DESIGN TECHNIQUES</b>	<b>9</b>			
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.					
<b>Total Periods</b>					<b>45</b>
<b>Suggestive Assessment Methods</b>					
<b>Continuous Assessment Test</b>		<b>Formative Assessment Test</b>		<b>End Semester Exams</b>	

<b>(30 Marks)</b>	<b>(10 Marks)</b>	<b>(60 Marks)</b>

**Outcomes**

**Upon completion of the course, the students will be able to:**

**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

**Reference Books**

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 guide||, 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 Systems|| , McGraw-Hill, 1997
5. Frank Vahid and Tony Givargis, –Embedded System Design: A Unified Hardware/Software Introduction||, John Wiley & Sons.
6. Jane.W.S. Liu, –Real-Time systems||, Pearson Education Asia.
7. Michael J. Pont, –Embedded C||, Pearson Education , 2007.
8. Steve Heath, –Embedded SystemDesign|| , Elsevier, 2005
9. Wayne Wolf, –Computers as Components:Principles of Embedded Computer System Design||, Elsevier, 2006.

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1		1		1					2	3	3	2	
2	2	1		1		1					2	3	3	2	2
3	2	2		1		1					2	2	3	2	2
4	3	2		1		1					1	2	3	2	2
5	2	1	3	2		1					2	2	3	2	2

21NE3706	PROTOCOLS AND ARCHITECTURES FOR WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Computer Networks					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To understand the concepts of wireless sensor networks</li> <li>2. To understand the protocols for WSN</li> <li>3. To get exposure on WSN environment with TinyOS and like</li> <li>4. To understand the layered approach in sensor networks</li> <li>5. To design WSN and analyse performance</li> </ol>					
<b>UNIT I</b>	<b>WIRELESS SENSOR NETWORK ARCHITECTURE</b>	<b>9</b>			
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.					
<b>UNIT II</b>	<b>DATA LINK LAYER</b>	<b>9</b>			
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.					
<b>UNIT III</b>	<b>NETWORK LAYER</b>	<b>9</b>			
Routing protocols – Requirements, Taxonomy - Data-centric routing – SPIN, Directed Diffusion, Energy aware routing, Gradient-based routing – COUGAR, ACQUIRE, Hierarchical Routing – LEACH, PEGASIS, Location Based Routing – GAF, GEAR, Data aggregation – Various aggregation techniques, Localization and positioning – Properties, Approaches, Mathematical basics for single hop and multi-hop environment.					
<b>UNIT IV</b>	<b>TRANSPORT LAYER</b>	<b>9</b>			
Transport Protocol, Coverage and deployments - Sensing models, Coverage measures, Random deployments: Poisson model, Boolean sensing model, general sensing model, Coverage determination, grid deployment, Reliable data transport, Single packet delivery, Block delivery, Congestion control and rate control, Time synchronization – Issues and protocol – Sender/Receiver, Security – protocols and Key Distribution Techniques.					
<b>UNIT V</b>	<b>TOOLS FOR WSN</b>	<b>9</b>			
TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming.					
<b>Total Periods</b>					<b>45</b>
<b>Suggestive Assessment Methods</b>					
<b>Continuous Assessment Test</b>		<b>Formative Assessment Test</b>		<b>End Semester Exams</b>	

(30 Marks)	(10 Marks)	(60 Marks)

**Outcomes**

**Upon completion of the course, the students will be able to:**

- CO304-2. 1** To design energy efficient WSNs.  
**CO304-2. 2** To design and implement protocols in TinyOS and Contiki.  
**CO304-2. 3** To design application dependent WSNs.  
**CO304-2. 4** To analyze the protocols and Key Distribution Techniques  
**CO304-2. 5** To employ the tools for WSN.

**Reference Books**

1. Anna Hac, –Wireless Sensor Network Design||, John Wiley & Sons, 2003.
2. C.S.Raghavendra Krishna, M.Sivalingam and Taribznati, –Wireless Sensor Networks||, Springer Publication, 2004
3. Holger Karl , Andreas willig, –Protocol and Architecture for Wireless Sensor Networks||, John Wiley Publication, 2006.
4. KazemSohraby, Daniel Minoli and TaiebZnati, –Wireless Sensor Networks TechnologyProtocols and Applications||, John Wiley & Sons, 2007.
5. Paolo Santi, –Topology Control in Wireless Adhoc and Sensor Networks||, John Wiley & Sons, 2005.
6. Philip Levis, David Gay, "TinyOS Programming", Cambridge University Press, 2009 Contiki - Open Source Operating System for IOT - <http://www.contiki-os.org/>

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		3										3	2	
2		3			3								3	2	2
3			3		3								3	2	2
4	3		3	2							1	2	3	2	2
5	3										1	2	3	2	2

21NE3706	INFORMATION STORAGE MANAGEMENT SENSOR NETWORKS	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Cloud Computing					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>To understand the storage architecture and available technologies.</li> <li>To learn to establish &amp; manage data center</li> <li>To learn security aspects of storage &amp; data center</li> <li>To analyse common threats</li> <li>To learn about networked storage system</li> </ol>					
<b>UNIT I</b>	<b>STORAGE TECHNOLOGY</b>	<b>9</b>			
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.					
<b>UNIT II</b>	<b>STORAGE SYSTEMS ARCHITECTURE</b>	<b>9</b>			
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.					
<b>UNIT III</b>	<b>INTRODUCTION TO NETWORKED STORAGE</b>	<b>9</b>			
Evolution of networked storage, Architecture, components, and 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.					
<b>UNIT IV</b>	<b>INFORMATION AVAILABILITY, MONITORING &amp; MANAGING DATACENTERS</b>	<b>9</b>			
List of reasons for planned/unplanned outages and the impact of downtime, Impact of downtime - Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identify single points of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery technologies, 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.					
<b>UNIT V</b>	<b>SECURING STORAGE AND STORAGE VIRTUALIZATION</b>	<b>9</b>			
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 Periods

45

**Suggestive Assessment Methods****Continuous Assessment Test  
(30 Marks)****Formative Assessment Test  
(10 Marks)****End Semester Exams  
(60 Marks)****Outcomes****Upon completion of the course, the students will be able to:****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**Reference Books**

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.

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3			2									3	2	
2	3	2	3		3							3	3	2	2
3	3		1	2		1						1	3	2	2
4	2			2							2	2	3	2	2
5	2	3	3	2	2						2	2	3	2	2



21NE3708	CLOUD COMPUTING AND BIG DATA	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Grid Computing					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>To understand the various issues in cloud computing</li> <li>To be able to set up a private cloud</li> <li>To understand the competitive advantages of big data analytics</li> <li>To understand the big data frameworks and data analysis methods</li> <li>To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.</li> </ol>					
<b>UNIT I</b>	<b>CLOUD PLATFORM ARCHITECTURE</b>	<b>9</b>			
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.					
<b>UNIT II</b>	<b>PROGRAMMING MODEL</b>	<b>9</b>			
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.					
<b>UNIT III</b>	<b>INTRODUCTION TO BIG DATA</b>	<b>9</b>			
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.					
<b>UNIT IV</b>	<b>DATA ANALYSIS CENTERS</b>	<b>DATA</b>	<b>9</b>		
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					
<b>UNIT V</b>	<b>BIG DATA FRAMEWORKS</b>	<b>9</b>			
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.					
<b>Total Periods</b>					<b>45</b>
<b>Suggestive Assessment Methods</b>					

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)

**Outcomes**

**Upon completion of the course, the students will be able to:**

**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

**Reference Books**

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 Guide||, 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 Analytics||, 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.

**CO Vs PO Mapping and CO Vs PSO Mapping**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3										1	2	3	2	
2	3		2								1	2	3	2	2
3	3										1	2	3	2	2
4	3	3		2							1	2	3	2	2
5	3			2	3						1	2	3	2	2

<b>21NE3708</b>	<b>SOCIAL NETWORK ANALYSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Prerequisites for the course</b>					
1. Web Technology					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>To understand the components of the social network.</li> <li>To model and visualize the social network.</li> <li>To mine the users in the social network.</li> <li>To understand the evolution of the social network.</li> <li>To know the applications in real time systems</li> </ol>					
<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>			
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.					
<b>UNIT II</b>	<b>MODELING AND VISUALIZATION</b>	<b>9</b>			
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.					
<b>UNIT III</b>	<b>MINING COMMUNITIES</b>	<b>9</b>			
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					
<b>UNIT IV</b>	<b>EVOLUTION</b>	<b>9</b>			
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.					
<b>UNIT V</b>	<b>APPLICATIONS</b>	<b>9</b>			
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					
<b>Total Periods</b>					<b>45</b>
<b>Suggestive Assessment Methods</b>					
<b>Continuous Assessment Test</b>	<b>Formative Assessment Test</b>	<b>End Semester Exams</b>			

(30 Marks)	(10 Marks)	(60 Marks)

**Outcomes**

**Upon completion of the course, the students will be able to:**

**CO305-1. 1** Work on the internals 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.

**Reference Books**

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, 1<sup>st</sup> 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.  
Przemyslaw Kazienko, Nitesh Chawla,||Applications of Social Media and Social Network Analysis||, Springer,2015

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2		3								2	2	3	2	
2	2		3		1						2	2	3	2	2
3	1										2	2	3	2	2
4	2										2	2	3	2	2
5	2		2	2							3	1	3	2	2

21NE3708	WEB ENGINEERING	L	T	P	C
		3	0	0	3
<b>Prerequisites for the course</b>					
Web Technology					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. Understand the characteristics of web applications</li> <li>2. Learn to Model web applications</li> <li>3. Be aware of Systematic design methods</li> <li>4. Be familiar with the testing techniques for web applications</li> <li>5. To learn about managing web development, quality and change</li> </ol>					
<b>UNIT I</b>	<b>INTRODUCTION TO WEB ENGINEERING</b>	<b>9</b>			
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					
<b>UNIT II</b>	<b>WEB APPLICATION ARCHITECTURES &amp; MODELLING WEB APPLICATIONS</b>	<b>9</b>			
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.					
<b>UNIT III</b>	<b>WEB APPLICATION DESIGN</b>	<b>9</b>			
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					
<b>UNIT IV</b>	<b>TESTING WEB APPLICATIONS</b>	<b>9</b>			
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.					
<b>UNIT V</b>	<b>PROMOTING WEB APPLICATIONS AND WEB PROJECT MANAGEMENT</b>	<b>9</b>			
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.

<b>Total Periods</b>	<b>45</b>
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### Suggestive Assessment Methods

Continuous Assessment Test (30 Marks)	Formative Assessment Test (10 Marks)	End Semester Exams (60 Marks)

### Outcomes

**Upon completion of the course, the students will be able to:**

**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.

### Reference Books

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.

### CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	1	2						3	3	2	
2	3	3		2		2						3	3	2	2
3			2		1							3	3	2	2
4	2	1	3	2	2							2	3	2	2
5	3	3		2		2						3	3	2	2

<b>21NE3711</b>	<b>ETHICAL HACKING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Prerequisites for the course</b>					
Cyber security					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. To understand and analyse Information security threats &amp; counter measures</li> <li>2. To perform security auditing &amp; testing</li> <li>3. To understand issues relating to ethical hacking</li> <li>4. To study &amp; employ network defense measures</li> <li>5. To understand penetration and security testing issues</li> </ol>					
<b>UNIT I</b>	<b>ETHICAL HACKING OVERVIEW</b>	<b>9</b>			
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.					
<b>UNIT II</b>	<b>SCANNING AND ENUMERATION</b>	<b>9</b>			
Introduction to Scanning – Objectives – Scanning Methodology – Tools – Introduction to Enumeration – Enumeration Techniques – Enumeration Procedure – Tools					
<b>UNIT III</b>	<b>SYSTEM HACKING</b>	<b>9</b>			
Introduction – Cracking Passwords – Password Cracking Websites – Password Guessing – Password Cracking Tools – Password Cracking Counter measures – Escalating Privileges – Executing Applications – Keyloggers and Spyware.					
<b>UNIT IV</b>	<b>PROGRAMMING FOR SECURITY PROFESSIONALS</b>	<b>9</b>			
Programming Fundamentals – C language – HTML – Perl – Windows OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures – Linux OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures.					
<b>UNIT V</b>	<b>PENETRATION TESTING</b>	<b>9</b>			
Introduction – Security Assessments – Types of Penetration Testing- Phases of Penetration Testing – Tools – Choosing Different Types of Pen-Test Tools – Penetration Testing Tools.					
<b>Total Periods</b>					<b>45</b>
<b>Suggestive Assessment Methods</b>					
<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>			
<b>Outcomes</b>					
<b>Upon completion of the course, the students will be able to:</b>					

- CO305-3. 1** Understand vulnerabilities, mechanisms to identify vulnerabilities/threats/attacks  
**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

#### Reference Books

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.

#### CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3		2				2				3		3	2	
2		2		1	3	1			1			1	3	2	2
3	3			3				3		3	2		3	2	2
4	2		3	2	2							1	3	2	2
5	2		3	2	2							1	3	2	2



<b>21NE3712</b>	<b>DIGITAL FORENSICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Prerequisites for the course</b>					
Network Security					
<b>Objectives</b>					
<ol style="list-style-type: none"> <li>1. Have an understanding of the fundamental concepts of forensic science.</li> <li>2. Have a basic understanding of the application of forensic science principles to digital evidence examinations.</li> <li>3. Be able to articulate the steps of the forensic process as applied to digital evidence.</li> <li>4. Be able to draft a Standard Operating Procedure.</li> <li>5. Conduct rudimentary digital forensic examinations.</li> </ol>					
<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>			
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					
<b>UNIT II</b>	<b>EVIDENCE AND INVESTIGATIONS</b>	<b>9</b>			
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					
<b>UNIT III</b>	<b>OPEN SOURCE EXAMINATION PLATFORM</b>	<b>9</b>			
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					
<b>UNIT IV</b>	<b>PROGRAMMING FOR SECURITY PROFESSIONALS</b>	<b>9</b>			
Programming Fundamentals – C language – HTML – Perl – Windows OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures – Linux OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures.					
<b>UNIT V</b>	<b>LAWS AND ACTS</b>	<b>9</b>			
Laws and Ethics, Digital Evidence Controls, Evidence Handling Procedures, Basics of Indian Evidence ACT IPC and CrPC , Electronic Communication Privacy ACT, Legal Policies.					
<b>Total Periods</b>					<b>45</b>
<b>Suggestive Assessment Methods</b>					
<b>Continuous Assessment Test (30 Marks)</b>	<b>Formative Assessment Test (10 Marks)</b>	<b>End Semester Exams (60 Marks)</b>			

**Outcomes****Upon completion of the course, the students will be able to:**

**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

**Reference Books**

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 Prorise, Matt Pepe, —Incident Response and Computer Forensics —, TataMcGraw -Hill, New Delhi, 2006
4. Nelson Phillips and Enfinger Stuart, —Computer Forensics and Investigations|, Cengage Learning, New Delhi, 2009.
5. Robert M Slade,| Software Forensics, Tata McGraw - Hill, New Delhi, 2005

## CO Vs PO Mapping and CO Vs PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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2		2		1	3	1			1			1	3	2	2
3	3			3				3		3	2		3	2	2
4	2		3	2	2							1	3	2	2
5	2		3	2	2							1	3	2	2