GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)

Coimbatore – 641 013

Curriculum and Syllabi For

M.E. COMPUTER SCIENCE AND ENGINEERING

(Full Time)

2016

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS

GOVERNMENT COLLEGE OF TECHNOLOGY

THADAGAM ROAD, COIMBATORE-641 013

VISION AND MISSION OF THE INSTITUTION

VISION

To emerge as a centre of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind.

MISSION

- To achieve academic excellence through innovative teaching and learning practices.
- To enhance employability and entrepreneurship
- To improve the research competence to address societal needs
- To inculcate a culture that supports and reinforces ethical, professional behaviours for a harmonious and prosperous society

VISION AND MISSION OF THE DEPARTMENT

VISION

To be in the frontier of Computer Science and Engineering and to produce globally competent graduates with moral values committed to build a vibrant nation.

MISSION

- To strengthen the core competence in Computer Science and Engineering through analytical learning.

- To produce successful graduates with personal and professional responsibilities and commitment to lifelong learning.

- To uplift innovative research in Computer Science and Engineering to serve the needs of Industry, Government and Society.

PROGRAMME EDUCATIONAL OBJECTIVES

The Programme Educational Objectives of M.E. Computer Science and Engineering programme are:

PEO1: Graduates will be employed in computing profession as experts in providing solutions to complex design problems by their depth of knowledge in advanced computing.

PEO2: Graduates with an aptitude in lifelong research will be either pursuing or completed doctoral programme and engaged in advanced research and development

PEO 3: Graduates will be able to apply critical, lateral thinking and use reflective learning to analyze, conceptualize and evaluate the potential solutions for conducting theoretical and practical research.

PEO4: Graduates will demonstrate Ethical and intellectual integrity in their professional practices

PROGRAMME OUTCOMES

Students of M.E. Computer Science and Engineering Programme at the time of graduation will be able to:

PO1: Exhibit higher order knowledge formation with wider and global perspective on Computer Science and Engineering.

PO2: Apply critical thinking to analyze, improve, create, evaluate and improve information for the conduct of research in Computer Science and Engineering.

PO3: Create and conceptualize optimal solutions for Computer Engineering and IT Problems by lateral thinking with awareness of public health safety, culture, society and environmental factors.

PO4: Perform exhaustive survey to familiarize with problems and rightly mix research methodologies and tools to design and conduct experiments for the development of scientific/technological knowledge.

PO5: Select, create if needed, and apply with the knowledge of limitations, the state of the art techniques and IT tools for complex engineering problems.

PO6: Recognize and use opportunities to contribute positively for collaborative-multi disciplinary scientific research to achieve common goals.

PO7: Practise engineering and management principles including economical and financial factors.

PO8: Communicate effectively and confidently.

PO9: Engage in lifelong learning to improve knowledge and competence.

PO10: Practise code of ethics in professional accomplishments and research for sustainable societal development.

PO11: Learn by observation and examination of the outcomes achieved, including mistakes, without external feedback.

Curriculum

CURRICULUM FOR CANDIDATES ADMITTED
DURING 2016-2017 AND ONWARDS
TWO YEAR M.E PROGRAMME
BRANCH: M.E COMPUTER SCENCE AND ENGINEERING

CHOICE BASED CREDIT SYSTEM

CURRICULUM

FIRST SEMESTER

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
Theory								
1	16CSFC01	Mathematical Foundations of Computer Science	Foundation Core	4	2	2	0	3
2	16CSPC01	Formal Languages, Machines and Computations	Professional Core	4	2	2	0	3
3	16CSPC02	High Performance Computer Architecture	Professional Core	3	3	0	0	3
4	16CSPC03	Algorithms and Complexity Analysis	Professional Core	4	2	2	0	3
5	16CSPC04	Advances in Operating Systems	Professional Core	3	3	0	0	3
Practical								
6	16CSPC05	Advanced Algorithms Lab	Professional Core	4	0	0	4	2
Total				**22**	**12**	**6**	**4**	**17**

SECOND SEMESTER

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
Theory								
1	16CSPC06	Cloud Computing	Professional Core	5	3	0	2	4
2	16CSPC07	Advanced Database Systems	Professional Core	3	3	0	0	3
3	16CSPC08	Machine Learning	Professional Core	5	3	0	2	4
4	16CSPC09	Network Science	Professional Core	3	3	0	0	3
5	16CSPEXX	Professional Elective – I	Professional Elective	3	3	0	0	3
6	16CSPEXX	Professional Elective – II	Professional Elective	3	3	0	0	3
Practical								
7	16CSPC10	Advanced Computer Networks Lab	Professional Core	4	0	0	4	2
Total				**26**	**18**	**0**	**8**	**22**

THIRD SEMESTER

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
Theory								
1	16CSPC11	Theory of Modern Compilers	Professional Core	5	3	0	2	4
2	16CSPEXX	Professional Elective – III	Professional Elective	3	3	0	0	3
3	16CSPEXX	Professional Elective – IV	Professional Elective	3	3	0	0	3
4	16CSIEXX	Industry Offered Elective	Professional Elective	3	3	0	0	3
Project								
5	16CSEE01	Project Phase – I	Employability Enhancement Course	12	0	0	12	6
Total				**26**	**12**	**0**	**14**	**19**

FOURTH SEMESTER

S.No	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	16CSEE02	Project Phase - II	Employability Enhancement Course	24	0	0	24	12
Total				**24**	**0**	**0**	**24**	**12**

ONE CREDIT COURSES

1	16CSOC01	One Credit Course	Employability Enhancement Course	1	1	0	0	1
2	16CSOC02	One Credit Course	Employability Enhancement Course	1	1	0	0	1

TOTAL CREDITS: 70

CURRICULUM DESIGN

S.No	Code	Course	Category	Contact Periods	L	T	P	C
LIST OF FOUNDATION COURSE FOR M.E COMPUTER SCIENCE AND ENGINEERING								
1	16CSFC01	Mathematical Foundations of Computer Science	Foundation Course	4	2	2	0	3
TOTAL CREDITS: 3								
LIST OF PROFESSIONAL CORES FOR M.E COMPUTER SCIENCE AND ENGINEERING								
S.No	**Code**	**Course**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1	16CSPC01	Formal Languages, Machines and Computations	Professional Core	4	2	2	0	3
2	16CSPC02	High Performance Computer Architecture	Professional Core	3	3	0	0	3
3	16CSPC03	Algorithms and Complexity Analysis	Professional Core	4	2	2	0	3
4	16CSPC04	Advances in Operating Systems	Professional Core	3	3	0	0	3
5	16CSPC05	Advanced Algorithms Lab	Professional Core	4	0	0	4	2
6	16CSPC06	Cloud Computing	Professional Core	5	3	0	2	4
7	16CSPC07	Advanced Database Systems	Professional Core	3	3	0	0	3
8	16CSPC08	Machine Learning	Professional Core	5	3	0	2	4
9	16CSPC09	Network Science	Professional Core	3	3	0	0	3
10	16CSPC10	Advanced Computer Networks Lab	Professional Core	4	0	0	4	2
11	16CSPC11	Theory of Modern Compilers	Professional Core	5	3	0	2	4
TOTAL CREDITS: 34								
LIST OF PROFESSIONAL ELECTIVES FOR M.E COMPUTER SCIENCE AND ENGINEERING								
S.No	**Code**	**Course**	**Category**	**Contact Periods**	**L**	**T**	**P**	**C**
1	16CSPE01	Theory and Applications of Ontology	Professional Elective	3	3	0	0	3
2	16CSPE02	Software Defined Networking	Professional Elective	3	3	0	0	3
3	16CSPE03	Big Data Analytics	Professional Elective	3	3	0	0	3

4	16CSPE04	Cryptography and Network Security	Professional Elective	3	3	0	0	3
5	16CSPE05	Soft Computing	Professional Elective	3	3	0	0	3
6	16CSPE06	Internet of Things	Professional Elective	3	3	0	0	3
7	16CSPE07	Mining Massive Datasets	Professional Elective	3	3	0	0	3
8	16CSPE08	Pattern Recognition	Professional Elective	3	3	0	0	3
9	16CSPE09	Information Retrieval	Professional Elective	3	3	0	0	3
10	16CSPE10	Parallel Algorithms	Professional Elective	3	3	0	0	3
11	16CSPE11	Social Networks	Professional Elective	3	3	0	0	3
12	16CSPE12	Cyber Forensics	Professional Elective	3	3	0	0	3
13	16CSPE13	Network Optimization Techniques	Professional Elective	3	3	0	0	3
14	16CSPE14	Virtualization Techniques	Professional Elective	3	3	0	0	3
15	16CSPE15	Digital Image Processing	Professional Elective	3	3	0	0	3
16	16CSPE16	Embedded Systems	Professional Elective	3	3	0	0	3
17	16CSPE17	Computer Network Engineering and Management	Professional Elective	3	3	0	0	3
18	16CSPE18	Fuzzy Logic and Neural Networks	Professional Elective	3	3	0	0	3
19	16CSPE19	Distributed Network Algorithms	Professional Elective	3	3	0	0	3
20	16CSPE20	Pervasive Computing	Professional Elective	3	3	0	0	3
							TOTAL CREDITS:	15

LIST OF EMPLOYABILITY ENHACEMENT COURSES FOR M.E COMPUTER SCIENCE AND ENGINEERING

S.No	Code	Course	Category	Contact Periods	L	T	P	C
1	16CSEE01	Project Phase – I	Employability Enhancement course	12	0	0	12	6
2	16CSEE02	Project Phase – II	Employability Enhancement course	24	0	0	24	12
3	16CSOC01	One Credit Course (First Semester)	Employability Enhancement course	2	2	0	0	1*

4	16CSOC02	One Credit Course (Third Semester)	Employability Enhancement course	2	2	0	0	1*
TOTAL CREDITS: 18 * Not included for CGPA								
TOTAL CREDITS : 70								

CURRICULUM DESIGN

S.No	Course Work Subject Area	No of Credits	Percentage
1.	Foundation Course	3	4.29%
2.	Professional Cores	34	48.57%
3.	Professional Electives	15	21.43%
4.	Employability Enhancement Courses	18	25.71%
Total Credits		**70**	**100%**

Syllabi

16CSFC01 MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

	L	T	P	C
	2	2	0	3

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- *Random variables and discrete and continuous distributions.*
- *Queuing models.*
- *Tests of sampling.*
- *Correlation and regression analysis.*

COURSE OUTCOMES*:*

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

CO1*:* Explain random variables and their distributions and also moments and moment generating functions for their mean and variance.***[Familiarity]***

CO2: Explain probable values of queues with single and multi-server models. ***[Familiarity]***

CO3. Explain tests of sampling for large and small samples. ***[Familiarity]***

CO4: Explain probability distributions of discrete and continuous random variables. ***[Familiarity]***

CO5: Calculate coefficient of correlation, regression coefficients, multiple and partial correlation including regression plane. ***[Usage]***

UNIT I RANDOM VARIABLES	**L(6)+T(6)**

Random variables- Binomial, Geometric, Poisson, Uniform, Exponential, Erlang and Normal distributions- Functions of a Random variable - Moments and Moment generating function.

UNIT II MARKOVIAN QUEUEING MODELS	**L(6)+T(6)**

Markovian models- Birth and Death Queuing models- steady state results: Single and multiple server queuing models-queue with finite waiting rooms-Finite source- Finite source models- Little's formula.

UNIT III NON-MARKOVIAN QUEUES AND QUEUE NETWORKS	**L(6)+T(6)**

M/G/1 queue- Pollazack-Khintchine formula, series queues-open and closed networks.

UNIT IV TESTING OF HYPOTHESIS	**L(6)+T(6)**

Sampling distributions – Estimation of parameters- Statistical hypothesis- Tests based on Normal, t, Chi Square and F distributions for mean, variance and proportion.

UNIT V CORRELATION AND REGRESSION ANALYSIS	**L(6)+T(6)**

Coefficient of correlation – rank correlation – regression lines – Multiple and Partial correlation – Partial regression - regression planes (Problems only).

	LECTURE: 30 TUTORIAL: 30 PRACTICAL: 0 TOTAL: 60
Reference Books	
1	Veerarajan T, **"Probability and Random Processes (with Queueing Theory and Queueing Networks)"**, Fourth Edition ,McGraw Hill Education(India) Pvt Ltd., New Delhi, 2016.
2	Medhi J, **"Introduction to Queuing Systems and applications"**, 1st edition, New Age International(P) Ltd, New Delhi, 2015.
3	Gross D and Harris C. M, **"Fundamentals of Queuing theory"**, John Wiley and Sons, New York, 1998.
4	Gupta S.C and Kapoor V.K, **"Fundamentals of Mathematical Statistics"**, Sultan Chand & Sons, New Delhi, 2015.
5	Gupta S.P, **"Statistical Methods"**, Sultan Chand & Sons, New Delhi, 2015.
6	Veerarajan T, **"Higher Engineering Mathematics"**, Yes Dee Publishing Pvt Ltd, Chennai,2016.
7	Kandasamy P, Thilagavathy K and Gunavathy K, **"Probability and Queueing Theory"**, S. Chand & Co, Ramnagar, New Delhi, Reprint 2013.

16CSPC01 FORMAL LANGUAGES, MACHINES AND COMPUTATIONS				
	L	**T**	**P**	**C**
	2	**2**	**0**	**3**

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- *Regular Languages and applications.*
- *Context Free Languages and applications.*
- *Turing Machines and applications.*
- *Computability and un-computability.*
- *Cost models and alternate models of computation*

COURSE OUTCOMES*:*

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

CO1: Identify, use and apply Regular and Context Free Languages. ***[Assessment]***
CO2: Solve given problem by constructing appropriate Automata.***[Usage]***
CO3. Construct Turing Machine for the given problem/function.***[Usage]***
CO4: Provide solution model for computable functions.***[Assessment]***
CO5: Identify and prove unsolvable problems.***[Assessment]***
CO6: Classify the problems based on the cost analysis.***[Assessment]***
CO7: Use alternate models of computation such as Approximation algorithms, probabilistic and parallel algorithms and Interactive proof system.***[Usage]***

UNIT I REGULAR LANGUAGES AND APPLICATIONS	**L(6)+T(6)**
Regular Expressions and applications – Regular languages, properties and applications – Finite Automata, variants and applications – Pumping lemma for RL.	

UNIT II CONTEXT FREE LANGUAGES	**L(6)+T(6)**
Grammars – Context Free Languages, properties and applications – Stack machines – Context free frontier – Stack machines applications – Pumping lemma for CFL.	

UNIT III TURING MACHINES	**L(6)+T(6)**
Turing machine basics – Simple TMs – Language define by TM – Variants of TMs and their equivalence – Universal TM – Recursive, Recursively Enumerable languages and properties.	

UNIT IV COMPUTABILITY AND UNCOMPUTABILITY	**L(6)+T(6)**
Turing computable functions – Functions and languages – TM random access – Church-Turing thesis – Infinite models, finite machines – Halting problem – Reducibility – Rice's theorem – Grammars and Computability – Computable functions - Mathematical uncomputabilities.	

UNIT V COST MODELS AND ALTERNATE ALGORITHMS	**L(6)+T(6)**
Asymptotic notations, properties and functions – TM cost model – Time complexity classes – Space complexity classes – Higher complexity classes – Verification methods – NP, NP hard and NP Complete problems – Approximation algorithms, probabilistic and parallel algorithms –	

Interactive proof system.	
LECTURE: 30 TUTORIAL: 30 PRACTICAL: 0 TOTAL: 60	
Reference Books	
1	John E Hopcroft, Rajeev Motwani, Jeffrey D Ullman, **"Introduction to Automata Theory, Languages and Computation"**, Third Edition, Pearson, 2013.
2	John C. Martin, **"Introduction to languages and the theory of computation"**, Third edition, McGrawHil, 2015
3	Michael Sipser, **"Introduction to Theory of Computation"**, Third Edition, Cengage learning, 2013.
4	Adam Brooks Webber, **"Formal languages: a practical introduction"**, Jim Leisy, 2008

16CSPC02 HIGH PERFORMANCE COMPUTER ARCHITECTURE				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- *Fundamentals of Computer Organization and performance laws*
- *Concepts and issues in instruction level parallelism*
- *Multiprocessor architecture and synchronization issues in multiprocessors*
- *Memory organization and peripheral devices*
- *Multi core organization and its design issues*

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

CO1: Compare RISC and CISC processors and analyze metrics for improving performance of processors. ***[Usage]***

CO2: Analyze structural, data and control hazards and exploit instruction level parallelism. ***[Assessment]***

CO3: Analyze design issues of distributed shared memory and explain multiprocessor Architectures. ***[Assessment]***

CO4: Explain types of memory hierarchy and issues of cache, virtual and secondary memory. ***[Familiarity]***

CO5: State the significance of RAID levels. ***[Familiarity]***

CO6: Compare SMT and CMT architectures and their performance. ***[Usage]***

CO7: List advantages of multi core processors and explain Intel x86 multi core organizations. ***[Familiarity]***

UNIT I BASIC ORGANIZATION AND ARCHITECTURAL TECHNIQUES	**L(9)**

RISC processors - Characteristics of RISC processors, RISC vs CISC, Classification of Instruction Set Architectures - Review of performance measurements - Metrics and measures for parallel programs, Speedup performance laws, scalability analysis approaches, Amdahl's law, limitation, Benchmark, SIMD, MIMD Performance.

UNIT II INSTRUCTION LEVEL PARALLELISM	**L(9)**

Basic concepts of pipelining - Arithmetic pipelines , Instruction pipelines, Hazards in a pipeline: structural, data, and control hazards - Overview of hazard resolution techniques - Dynamic instruction scheduling - Branch prediction techniques - Instruction-level parallelism using software approaches - Superscalar techniques - Speculative execution - Review of modern processors - Pentium Processor and ARM Processor

UNIT III THREAD LEVEL PARALLELISM	**L(9)**

Centralized vs. distributed shared memory - Interconnection topologies - Multiprocessor architecture - Symmetric multiprocessors - Cache coherence problem - Synchronization - Memory consistency - Review of modern multiprocessors - Multicore Processors and their Performance.

UNIT IV MEMORY HIERACHIES AND PERIPHERAL DEVICES	**L(9)**
Basic concept of hierarchical memory organization - Main memories - Cache memory design and implementation - Virtual memory design and implementation - Secondary memory technology – RAID. Peripheral Devices: Bus structures and standards - Synchronous and asynchronous buses - Types and uses of storage devices - Interfacing I/O to the rest of the system - Reliability and availability - I/O system design.	
UNIT V MULTICORE ARCHITECTURE	**L(9)**
Multithreading - SMT and CMP - Architectures - Limitations of Single Core Processors - Multicore era - Hardware Performance Issues - Software Performance Issues – Multicore Organization - Intel x86 Multicore Organization	
LECTURE: 45 TUTORIAL: 0 PRACTICAL: 0 TOTAL: 45	

Reference Books

1	John L. Hennessey and David A. Patterson, "**Computer Architecture – A Quantitative Approach**", Morgan Kaufmann / Elsevier, Fifth edition, 2012.
2	William Stallings, "**Computer Organization and Architecture**", Pearson Education, Ninth Edition, 2013
3	Kai Hwang, "**Advanced Computer Architecture**", Tata McGraw-Hill Education, Second Edition, 2003
4	Richard Y. Kain, "**Advanced Computer Architecture a Systems Design Approach**", Prentice Hall, Second Edition, 2011.
5	David E. Culler, Jaswinder Pal Singh, "**Parallel Computing Architecture : A Hardware/ Software Approach**" , Morgan Kaufmann / Elsevier, 2005

16CSPC03 ALGORITHMS AND COMPLEXITY ANALYSIS				
	L	**T**	**P**	**C**
	2	**2**	**0**	**3**

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- *Algorithm design, probabilistic analysis and amortized analysis of algorithms.*
- *Divide and Conquer, Dynamic programming and Greedy Algorithms techniques.*
- *Graph algorithms and Matrix operations.*
- *Multithreaded algorithms and Linear programming and polynomial multiplication using Fast Fourier Transforms.*
- *String matching, computational geometry, Notions of NP-Completeness and approximation algorithms.*

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

CO1: Design and analyze algorithms using divide and conquer, dynamic programming, greedy algorithms. **[Usage]**

CO2: Perform probabilistic analysis and amortized analysis of algorithms. **[Familiarity]**

CO3: Use minimum spanning trees, shortest path algorithm, and Maximum flow in graphs to solve problems in networking.**[Usage]**

CO4: Solve problems using multithreaded algorithms and linear programming.**[Usage]**

CO5: Solve polynomial multiplication using Fast Fourier Transforms. **[Usage]**

CO6: Apply String matching algorithms, Computational geometry algorithms to solve problem.**[Usage]**

CO7: Identify problems that are NP-Complete and generate near-optimal solutions. **[Familiarity]**

UNIT-I INTRODUCTION	**L(6)+T(6)**

Role of Algorithms in Computing – Analyzing algorithms – Designing algorithms – Growth of functions – Divide and Conquer – Probabilistic analysis – Randomized algorithms

UNIT-II DESIGN AND ANALYSIS TECHNIQUES	**L(6)+T(6)**

Dynamic programming : Rod cutting, Matrix-chain multiplication, Elements of dynamic programming, Optimal binary search trees– Greedy Algorithms: An activity-selection problem, Elements of the greedy strategy, Huffman codes – Amortized Analysis.

UNIT-III GRAPH ALGORITHMS	**L(6)+T(6)**

Elementary Graph Algorithms – Minimum Spanning trees: Kruskal and Prims Algorithm – Single source shortest paths: – All pairs shortest paths: Floyd-Warshall algorithm, Johnson's algorithm for sparse graphs – Maximum Flow

UNIT-IV ADVANCED ALGORITHMS I	**L(6)+T(6)**

Multithreaded algorithms: Multithreaded matrix multiplication, Multithreaded merge sort – Matrix operations: Solving systems of linear equations, Inverting matrices, Symmetric positive-

definite matrices and least-squares approximation – Linear programming – Polynomials and FFT.	
UNIT-V ADVANCED ALGORITHMS II	**L(6)+T(6)**
String matching: Naive string-matching algorithm, Rabin-Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm– Computational Geometry – NP-Completeness – Approximation algorithms	
LECTURE: 30 TUTORIAL: 30 PRACTICAL: 0 TOTAL: 60	
Reference Books	
1	Thomas H. Cormen, Charles E. Leiseron, Ronald L.Rivest, Clifford Stein, "**Introduction to Algorithms**", Third Edition, PHI learning Pvt. Ltd., 2011.
2	Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, "**Fundamentals of Computer Algorithms**", Galgotia Publications Pvt. Ltd., 2008.
3	Michael R. Garey, D. S. Johnson, "**Computers and Intractability: A Guide to the Theory of NP-Completeness**", W. H. Freeman, 1979.
4	Aho. A.V., Hopcroft. J.E. and Ullman .J.D., "**The Design and Analysis of Algorithms**", Addison-Wesley, 1974.

16CSPC04 ADVANCES IN OPERATING SYSTEMS

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- *Fundamentals of Operating Systems*
- *Distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols*
- *Distributed resource management components*
- *Real time and Sensor operating systems*
- *Mobile Operating Systems*

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

CO1: Discuss the various synchronization, scheduling and memory management issues***[Familiarity]***

CO 2: Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system. ***[Usage]***

CO 3:Discuss the various resource management techniques for distributed systems***[Familiarity]***

CO 4: Identify the different features of real time operating systems [***Assessment]***

CO 5: Explain the features of sensor operating systems***[Familiarity]***

CO 6: Describe the characteristics of Mobile Operating Systems***[Usage]***

UNIT I FUNDAMENTALS OF OPERATING SYSTEMS **L(9)**

Linux System: Design Principles - Kernel Modules - Process Management Scheduling - Memory Management - Input-Output Management - File System.

UNIT II DISTRIBUTED OPERATING SYSTEMS **L(9)**

Issues in Distributed Operating System – Architecture – Communication Primitives – Lamport's Logical clocks – Causal Ordering of Messages – Distributed Mutual Exclusion Algorithms – Centralized and Distributed Deadlock Detection Algorithms – Agreement Protocols.

UNIT III DISTRIBUTED RESOURCE MANAGEMENT **L(9)**

Distributed File Systems – Design Issues - Distributed Shared Memory – Algorithms for Implementing Distributed Shared memory–Issues in Load Distribution – Scheduling Algorithms – Synchronous and Asynchronous Check Pointing and Recovery – Fault Tolerance – Two-Phase Commit Protocol – Non-blocking Commit Protocol – Security and Protection.

UNIT IV REAL TIME AND SENSOR OPERATING SYSTEMS **L(9)**

Basic Model of Real Time Systems – Characteristics- Applications of Real Time Systems – Real Time Task Scheduling – Handling Resource Sharing- Wireless Sensor Operating Systems – Embedded Operating Systems – Structure of the Operating System and Protocol stack – Dynamic Energy and Power management – Programming Paradigms and Application Programming Interface – Case Study: Tiny OS and nesC.

UNIT V MOBILE OPERATING SYSTEMS	**L(9)**
Mobile Operating Systems –Micro Kernel Design – Client Server Resource Access – Processes and Threads – Memory Management – File system. Case Study: iOS and Android- Architecture and SDK Framework – Media Layer – Services Layer – Core OS Layer – File System.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL: 0 TOTAL: 45	

Reference Books

1	Daniel P Bovet and Marco Cesati, "**Understanding the Linux kernel**", 3rd edition, O'Reilly, 2005.
2	Mukesh Singhal and Niranjan G. Shivaratri, "**Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems**", Tata McGraw-Hill, 2001.
3	Rajib Mall, "**Real-Time Systems: Theory and Practice**", Pearson Education India, 2006
4	Holger Karl & Andreas Willig, "**Protocols And Architectures for Wireless Sensor Networks**", John Wiley, 2005.
5	Neil Smyth, "**iPhone iOS 4 Development Essentials – Xcode**", Fourth Edition, Payload media, 2011.
6	Reto Meier, "**Professional Android 4 Application Development**", Wiley, 2012.

16CSPC05 ADVANCED ALGORITHMS LAB

	L	T	P	C
	0	0	4	2

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- *Design of algorithms using Divide and Conquer, Dynamic programming approach.*
- *Design of algorithms using Greedy and Back Tracking Techniques.*
- *Implementation of Graph algorithms and Matrix operations.*
- *Implementation of String matching, computational geometry and approximation algorithms.*

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

CO1: Design and analyze algorithms using divide and conquer, dynamic programming, greedy algorithms. **[Usage]**

CO2: Perform probabilistic analysis and amortized analysis of algorithms. **[Assessment]**

CO3: Use minimum spanning trees, shortest path algorithm, and Maximum flow in graphs to solve problems in networking. **[Usage]**

CO4: Solve problems using multithreaded algorithms and linear programming. **[Usage]**

CO5: Solve polynomial multiplication using Fast Fourier Transforms. **[Usage]**

CO6: Apply String matching algorithms, Computational geometry algorithms to solve problem. **[Usage]**

LIST OF EXPERIMENTS

1. Implement an algorithm that combines k sorted lists in time O(n log k) where n is the total number of elements.
2. Implement an algorithm to solve Matrix Multiplication problem and Maximum value contiguous subsequence using dynamic programming approach.
3. Implement an algorithm based on greedy approach to solve knapsack problem and Activity Selection Problem.
4. Implement Merge Sort algorithm using Divide and Conquer approach.
5. Implement stack operations and calculate the amortized cost.
6. Implement Graph Traversal algorithms.
7. Implement algorithms to construct Minimum Spanning Trees.
8. Implement shortest path and Maximum Flow algorithms.
9. Implement String Matching Algorithms.
10. Implement Computational Geometry algorithms.

LECTURE: 0 TUTORIAL: 0 PRACTICAL: 60 TOTAL: 60

16CSPC06 CLOUD COMPUTING

	L	T	P	C
	3	0	2	4

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- *Basic underlying concepts, Characteristics, issues and challenges of cloud computing.*
- *Cloud computing architecture and virtualization.*
- *Cloud application program and the ANEKA platform.*
- *The security issues of cloud computing.*
- *The various real-world cloud applications.*

COURSE OUTCOMES: Upon completion of this course, the students will be able to:

CO1: Explain and discuss the basic concepts, the fundamental issues and challenges of Cloud Computing and the paradigms of computing. ***[Familiarity]***

CO2: Explain the basic architecture of cloud computing and virtualization techniques. ***[Familiarity]***

CO3: Design and implement some basic cloud application using Aneka framework. ***[Usage]***

CO4: Ability to explain the core issues of cloud computing such as security, privacy, and interoperability. ***[Familiarity]***

CO5: Ability to provide the appropriate cloud computing solutions and recommendations according to the applications used. [**Usage**]

UNIT I INTRODUCTION TO CLOUD COMPUTING **L(9)+P(6)**

Overview of Computing Paradigm : Recent trends in Computing - Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing - Introduction to Cloud Computing - Cloud issues and challenges- Cloud Computing (NIST Model) - History of Cloud Computing, - Cloud service providers Properties, Characteristics & Disadvantages - Pros and Cons of Cloud Computing, Benefits of Cloud Computing - Role of Open Standards .

UNIT II CLOUD COMPUTING ARCHITECTURE AND VIRTUALIZATION **L(9)+P(6)**

Cloud computing stack - Comparison with traditional computing architecture (client/server), Services provided at various levels - Role of Networks in Cloud computing, protocols used, Role of Web services- Service Models (XaaS)- Infrastructure as a Service (IaaS) -Platform as a Service (PaaS) - Cloud Platform and Management – Software as a Service (SaaS)- Web services - Web 2.0 - Deployment Models -Public cloud -Private cloud -Hybrid cloud -Community cloud - Virtualization concepts - Introduction to virtualization - Types of Virtualization- Introduction to Various Hypervisors - High Availability (HA)/Disaster Recovery (DR) using Virtualization, Moving VMs

UNIT III CLOUD APPLICATION PROGRAMMING AND THE ANEKA PLATFORM	L(9)+P(6)
Aneka - Framework overview - anatomy of the Aneka container - Building Aneka clouds - Cloud programming and management - Programming applications with threads - Multithreading with Aneka - Programming applications with Aneka threads - Task computing - Task-based application models - Aneka task-based programming - Data-Intensive Computing - Aneka MapReduce programming	
UNIT IV CLOUD SECURITY	**L(9)+P(6)**
Infrastructure Security - Network level security, Host level security, Application level security - Data security and Storage - Data privacy and security Issues, Jurisdictional issues raised by Data location - Identity & Access Management - Access Control - Trust, Reputation, Risk , Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations.- Cloud Reliability and fault-tolerance -privacy - policy and compliance -Cloud federation, interoperability and standards.	
UNIT V CLOUD APPLICATIONS AND CASE STUDY	**L(9)+P(6)**
Scientific applications : Healthcare – Biology – Geoscience - Business and consumer applications: CRM and ERP – Productivity - Social networking - Media applications - Multiplayer online gaming - Case Study on Open Source & Commercial Clouds – Eucalyptus - Microsoft Azure - Amazon EC2 - Google AppEngin..	
LECTURE: 45 TUTORIAL : 0 PRACTICAL: 30 TOTAL: 75	

Reference Books

1	Barrie Sosinsky, "**Cloud Computing Bible**" , Wiley-India, 2010
2	Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, "**Distributed and cloud computing from Parallel Processing to the Internet of Things**", Morgan Kaufmann, 2012.
3	Rajkumar Buyya, Christian Vecchiolaand S. Thamarai Selvi ," **Mastering Cloud Computing Foundations andApplications Programming**", Morgan Kaufmann, 2013
4	Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, **" Cloud Computing: Principles and Paradigms**", Wiley, 2011
5	Nikos Antonopoulos, Lee Gillam ," **Cloud Computing: Principles, Systems and Applications**" Springer, 2012
6	Ronald L. Krutz, Russell Dean Vines," **Cloud Security: A Comprehensive Guide to Secure Cloud Computing**", Wiley-India, 2010.

16CSPC07 ADVANCED DATABASE SYSTEMS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- *Data base design with ER Model and Relational Model*
- *Data storage and Retrieval Techniques*
- *Query Processing and Transaction Management*
- *Parallel and distributed databases*
- *Enhanced Data models*
- *NoSQL databases*

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

CO1: Design and develop a relational data model. **[Usage]**
CO2: Understand the storage and data access mechanisms. **[Familiarity]**
CO3: Use Query processing and transaction management techniques. **[Familiarity]**
CO4: Apply Concurrency control and Query Optimization algorithms in Parallel and Distributed data models. **[Usage]**
CO5: Use Enhanced data models. [**Usage**]
CO6: Explain and Use NoSQL databases[**Usage]**

UNIT I DATABASE DESIGN	**L(9)**

Data Models, ER Model: Constraints, ER-Diagrams, Extended ER Features, Relational Database Design: Good Relational designs, Normal Forms, Functional Dependencies, Decomposition algorithms, Modeling Temporal Data, Application Design and Development- Performance Tuning.

UNIT II STORAGE, QUERYING AND TRANSACTION MANAGEMENT	**L(9)**

Indexing and Hashing, Query Processing and Optimization, Transaction Management: Concurrency and Recovery, Advanced Transaction Processing.

UNIT III PARALLEL AND DISTRIBUTED DATABASES	**L(9)**

Database system Architecture- Parallel Databases: Parallelism, Query Optimization and design of Parallel system-Distributed Databases: Distributed Storage and Transactions, Concurrency Control, Query Processing, Cloud based databases, Directory Systems.

UNIT IV DATABASE SECURITY AND ENHANCED DATA MODELS	**L(9)**

Database Security: Issues, Access Control Mechanisms, SQL injection, Statistical Database security – Advanced Data models: Active Database, Temporal Database, Multimedia Database, Spatial and Deductive Databases, XML.

UNIT V NoSQL DATABASES	**L(9)**

Emergence-Aggregate data models- Distribution models-consistency-Key value databases-

Document databases-Column family stores-Graph databases-Schema Migration- polyglot Persistence	
LECTURE: 45 TUTORIAL: 0 PRACTICAL: 0 TOTAL: 45	
Reference Books	
1	Abraham Silberschatz , Henry F. Korth and S. Sudarshan, "**Database System Concepts**", Sixth Edition, McGraw-Hill, 2012
2	Pramod J. Sadalage and Martin Fowler, "**NoSQL Distilled- A Brief Guide to the Emerging world of Polyglot Persistence"**, Pearson Education,2013
3	R. Elmasri and S. Navethe, " **Fundamentals of Database Systems**", Seventh Edition,Pearson Education, 2015
4	Raghu Ramakrishnan and Gehrke, "**Database Management Systems**", Third Edition, McGraw Hill, 2003
5	Thomas Cannoly and Carolyn Begg, **"Database Systems, A Practical Approach to Design, Implementation and Management"** Addison- Wesley Professional, 2012
6	Tamer Ozsu M., Patrick Valdurriez, "**Principles of Distributed Database Systems**", Third Edition, Springer, 2011

16CSPC08 MACHINE LEARNING				
	L	**T**	**P**	**C**
	3	**0**	**2**	**4**

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- The characteristics of machine learning that make it useful to real-world problems and the basic underlying concepts, Characteristics of supervised machine learning algorithms.
- Unsupervised algorithms for clustering, Instance-based learning and Principal Component Analysis.
- The inference and learning algorithms for the hidden Markov model and Bayesian networks and few machine learning tools.
- Reinforcement learning algorithms.
- Various advanced machine learning algorithms in a range of real-world applications.

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

CO1: Explain and discuss the basic concepts, fundamental issues and challenges of machine learning algorithms and the paradigms of supervised learning. ***[*Familiarity*]***.

CO2: Explain and discuss the basic concepts of un-supervised machine learning. ***[*Familiarity*]***.

CO3: Design and implement some basic machine learning algorithms using Machine learning tools. ***[Usage],***

CO4: Explain and discuss the basic concepts and architecture of reinforcement learning algorithms ***[*Familiarity*]***.

CO5: Design and implement various advanced machine learning algorithms in a range of real-world applications. ***[Usage]***

UNIT I INTRODUCTION	**L(9)+P(6)**

Introduction- Well-Posed learning problems, Basic concepts, Designing a learning system, Issues in machine learning. Types of machine learning: Learning associations, Supervised learning : Classification and Regression Trees, Support vector machines - Model Selection and feature selection – Decision trees-Ensemble methods :Bagging - Boosting - Real-world applications.

UNIT II UNSUPERVISED LEARNING	**L(9)+P(6)**

Unsupervised learning : Clustering, Instance-based learning- K-nearest Neighbor, Locally weighted regression, Radial Basis Function - EM- Mixtures of Gaussians - The Curse of Dimensionality - Dimensionality Reduction - Factor analysis -Principal Component Analysis - Probabilistic PCA-Independent components analysis.

UNIT III PROBABILISTIC GRAPHICAL MODELS	**L(9)+P(6)**

Graphical Models -Undirected graphical models - Markov Random Fields - Directed Graphical Models -Bayesian Networks - Conditional independence properties - Inference – Learning - Generalization - Hidden Markov Models – Machine learning tools – R, Scikit Learn, Octave,

BigML , WEKA.	
UNIT IV REINFORCEMENT LEARNING	**L(9)+P(6)**
Reinforcement Learning – Introduction -Elements of Reinforcement Learning – Learning Task – Q-learning – k-armed Bandit Elements – Model-Based learning – Value Iteration – Policy iteration – Temporal Difference Learning - Exploration Strategies – non-deterministic rewards and actions	
UNIT V ADVANCED MACHINE LEARNING	**L(9)+P(6)**
Introduction to learning theory - Modeling structured outputs: multi-label classification, introduction to Conditional Random Fields (CRFs)- Spectral clustering- Semi-supervised learning - Recommendation systems - Active Learning - Learning from streaming data, online-learning - Deep learning.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL: 30 TOTAL: 75	

Reference Books

1	Tom Mitchell, **"Machine Learning"**, McGraw-Hill, 1997
2	Christopher Bishop, "**Pattern Recognition and Machine Learning",** Springer, 2006
3	Richard Sutton and Andrew Barto, **Reinforcement Learning: An introduction",** MIT Press,1998
4	Kevin P. Murphy, **"Machine Learning: A Probabilistic Perspective"**, MIT Press, 2012
5	Trevor Hastie, Robert Tibshirani, Jerome Friedman, **"The Elements of Statistical Learning"**, Second Edition ,Springer, 2011
6	Ethem Alpaydin, **"Introduction to Machine Learning"**, Third Edition, MIT Press, 2014.
7	http://DeepLearning.net.
8	http://active-learning.net.

16CSPC09 NETWORK SCIENCE				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- *Technological networks*
- *Fundamentals of network theory*
- *Computer algorithms for Networks*
- *Models of network information*
- *Processes on networks*

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

CO1:** Explain the technological networks such as Internet, Distribution, Social and Biological networks **[Familiarity]

CO2:** Represent the networks using appropriate data structure **[Assessment]

CO3:** Write algorithms for degree, degree distribution and graph partitioning **[Usage]

CO4:** Identify suitable model for network information **[Assessment]

CO5:** Write algorithms for percolation and network resilience **[Usage]

CO6:**Write algorithms to search web and distributed databases.**[Usage]

UNIT I THE EMPIRICAL STUDY OF NETWORKS	**L(6)**
Introduction - Technological Networks: The Internet, The telephone Network, Power Grids, Transportation Networks, Delivery and distribution networks – Social Networks – Networks of Information – Biological Networks.	

UNIT II FUNDAMENTALS OF NETWORK THEORY	**L(10)**
Mathematics of Networks – Networks and their representation – Measures and metrics – The large scale structure of the networks: Components, shortest path and small world effect , degree distribution, Power laws and scale free networks, distributions of other centrality measures, Clustering coefficients, Assortative mixing.	

UNIT III COMPUTER ALGORITHMS	**L(9)**
Basic concepts of algorithms - Running time and computational complexity, Storing network data, adjacency matrix and list, trees, heaps – Fundamental network algorithms – Matrix algorithms and graph partitioning.	

UNIT IV NETWORK MODELS	**L(10)**
Random graphs – Random graphs with general degree distributions – Models of network information – Other network models – small world model, exponent random graphs.	

UNIT V PROCESSES ON NETWORKS	**L(10)**
Percolation and network resilience –Percolation, Uniform random removal of vertices, non uniform removal of vertices, percolation in real world networks, computer algorithms for	

percolation – Epidemics on networks – dynamical systems on networks – network search.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL: 0 TOTAL: 45	
Reference Books	
1	Mark Newman, **"Networks: An introduction",** Oxford University Press, 2010.
2	UlrikBandes, Thomas Erlebach, **"Network Analysis: Methodological foundations",** Springer, 2004.
3	David Easey, John Kleinberg, **"Networks, Crowds and markets: Reasoning about a highly connected world"**, Cambridge University Press, 2010.
4	Matthew O Jackson, **"Social and Economic Networks"**, Princeton university press, 2010.
5	Albert-Laszlo Barabasi, Mark Newman, Duncan J.Watts, **"The structure and Dynamics of Networks"**, Princeton University Press, 2006.

16CSPC10 ADVANCED COMPUTER NETWORKS LAB

	L	T	P	C
	0	0	4	2

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- Local Area networks
- Routing protocols
- Access Control Lists and Virtual Control Lists
- Dynamic Host Configuration Protocols
- Wireless Local Area Networks such as WLAN, WiMAX and WSN.

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

CO1: Implement a Local Area Network and measuring its network performance in NS3 network simulator / NS2 / Packet Tracer ***[Assessment]***

CO2*:* Implement routing protocols in NS3 network simulator /NS2 / Packet Tracer. **[Usage]**

CO3*:* Implement Access Control Lists (ACL) in Packet Tracer **[Usage]**

CO4: Implement Virtual Local Area Networks (VLANs) **[Usage]**

CO5: Implement Dynamic Host Configuration Protocol (DHCP) in Packet Tracer. **[Usage]**

CO6: Implement Wireless LAN, WiMAX Network and Wireless Sensor Network in NS3 network simulator. **[Usage]**

LIST OF EXPERIMENTS

Experiment 1: Simulating a Local Area Network

In-lab Activities : Local Area Network | LAN Topologies | MAC Protocols | Taking turns | Ethernet | Ethernet Frame Structure | Ethernet Versions | Simulating a LAN using Network Simulator 3

Experiment 2: Measuring Network Performance

In-lab Activities: Network Performance Evaluation | Performance Evaluation Metrics | Parameters Affecting the Performance of Networks | Performance Evaluation Techniques | Network Performance Evaluation using NS-3.

Experiment 3: Access Control Lists (ACL) Part1

In-lab Activities : Configuring Standard ACLs |Configuring an ACL on VTY Lines | Configuring Named Standard ACLs

Experiment 4 : Access Control Lists (ACL) Part 2

In-lab Activities : Configuring Extended ACLs 1 | Configuring Extended ACLs 2 | Configuring Named Extended ACLs | Troubleshooting ACLs

Experiment 5 : Network Address Translation for IPv4 (NAT)

In-lab Activities : Investigating NAT Operation | Implementing Static and Dynamic

NAT Configuring NAT Pool Overload and PAT

Experiment 6 : Virtual Local Area Networks (VLANs)
In-lab Activities : Basic VLAN Configuration | Troubleshooting a VLAN Implementation

Experiment 7 : Inter-VLAN Routing
In-lab Activities : Configuring traditional inter-VLAN routing | Configuring router-on-a-stick inter-VLAN routing | Troubleshooting Inter-VLAN Routing

Experiment 8 : Spanning Tree Protocol (STP)
In-lab Activities : Configuring STP

Experiment 9 : Dynamic Host Configuration Protocol (DHCP)
In-lab Activities : Configuring DHCP

Experiment 10 : Simulating a Wireless LANs
In-lab Activities : Wi-Fi Networks | IEEE 802.11 Standards | Hardware Requirements for Wi-Fi | How to connect to the Wi-Fi Networks? | Advantages of Wi-Fi | Limitations | MAC Protocols | Use of RTS/CTS to Exchange Data | Issues in Wi-Fi Networks | The Hidden Terminal Problem | Solution of Hidden Terminal Problem | Exposed Terminal Problem | Solution to the Exposed Terminal Problem | Simulating a Wi-Fi using Network Simulator 3

Experiment 11 : Simulating a WiMAX Network
In-lab Activities : WiMAX Network | Standards | Comparison of Wi-Fi and WiMAX | How WiMAX works ? | Limitations of WiMAX | Modulation Schemes | Difference between low symbol rate and high symbol rate | WiMAX module for NS-3 | How to download and install patch for WiMAX? | Addressing Format in ns2 | The Default address format | The Hierarchical address format | Wireless (New) Trace File Format | Description of New Trace File Format | Wireless Trace File Format

Experiment 12: Simulating a Wireless Sensor Network
In-lab Activities : Wireless Sensor Networks | Basic Characteristics of WSNs | Operating Systems for WSNs | Differences with Mobile Ad hoc Networks | Types of Wireless Sensor Networks | Routing protocols for WSNs | Clusters and Cluster heads in WSNs | The LEACH Protocol | Operation of LEACH | Discussions on LEACH | Applications of WSNs | Simulating a WSN using Network Simulator 3

LECTURE: 0 TUTORIAL: 0 PRACTICAL: 60 TOTAL: 60

16CSPC11 THEORY OF MODERN COMPILERS				
	L	**T**	**P**	**C**
	3	**0**	**2**	**4**

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- *Intermediate Representations*
- *Control and Data flow analysis*
- *Early and loop Optimization*
- *Procedure optimization and scheduling*
- *Interprocedural analysis and memory hierarchy optimization*

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

CO1:** Explain the phases of compilers. **[Familiarity]
CO 2:** Generate Intermediate representations. **[Usage]
CO 3:** Perform control and data flow analysis. **[Usage]
CO 4:** Eliminate redundancy from IR and Target Code. **[Usage]
CO 5:** Optimize loops, Procedures and Memory Hierarchy. **[Usage]
CO 6:** Generate target code. **[Usage]

UNIT I INTERMEDIATE REPRESENTATIONS	**L(9)+P(6)**

Introduction to compiler technologies - Review of compiler Structure - Intermediate Representations - Run Time Support: Data representations and Instructions, Register Usage, The local stack frame, Run time Stack, Parameter Passing, Procedure Prologues, Epilogues, Call and returns, Code sharing and position independent code - Producing Code Generators Automatically.

UNIT II FLOW ANALYSIS	**L(9)+P(6)**

Control Flow Analysis -Data Flow Analysis: Iterative data flow analysis, Lattices of flow functions, Control tree based data flow analysis, Structural analysis, Interval analysis - Dependence Analysis and Dependence Graph-Alias Analysis.

UNIT III EARLY OPTIMIZATIONS AND LOOP OPTIMIZATIONS	**L(9)+P(6)**

Introduction to optimization, Importance of Individual optimizations, Order and repetition of optimizations - Early Optimization: Constant folding, Scalar replacement of aggregates, Algebraic simplifications and Reassociation, Value Numbering, Copy and Constant Propagation-Redundancy Elimination-Loop Optimizations

UNIT IV PROCEDURE OPTIMIZATION AND SCHEDULING	**L(9)+P(6)**

Procedure Optimizations-Register Allocation - Code Scheduling –Control-Flow and Low- Level Optimizations: Unreachable code elimination, Straightening, If and Loop simplification, Loop inversion, Unswitching, Branch Optimizations, Tail merging, Conditional moves, deadcode elimination, Branch prediction.

UNIT V INTERPROCEDURAL ANALYSIS AND MEMORY HIERARCHY OPTIMIZATION	L(9)+P(6)
InterProcedural Analysis and Optimizations: Control flow, Dataflow and Alias analysis, Constant Propagation, Optmization and Register allocation – Optimization for the Memory Hierarchy: Impact of data and Instruction caches and Optimizations	
LECTURE: 45 TUTORIAL : 0 PRACTICAL:30 TOTAL: 75	

EXPERIMENTS

1. Write a program to generate Intermediate representation from the given high level input code.
2. Write a program to implement Automatic Code Generator from the given high level input code.
3. Write a program to perform data and code dependency analysis from the given IR.
4. Write a program to perform Alias Analysis from the given IR.
5. Write a program to perform Local Optimization on the given IR
6. Write a program to illustrate Code scheduling.
7. Write a program to illustrate Interprocedural analysis on the given IR.
8. Write a program to illustrate Global Optimization

Reference Books

1	A V Aho, Monical Lam, R Sethi, J D Ullman ,***"Compilers: Principles, Techniques, and Tools"***,Second Edition ,2008
2	Steven Muchnick.,***"Advanced Compiler Design and Implementation"***,MorganKaufmman Publishers, Elsevier,2008.
3	Randy Allen &KenKennedy**, "***Optimizing Compilers for Modern Architectures"*** ,**Morgan Kaufmann,Elsevier,2002.
4	Andrew W. Appel, Jens Palsberg, ***"Modern Compiler Implementation in Java"***, Second Edition, Cambridge University Press, 2002

16CSPE01 THEORY AND APPLICATIONS OF ONTOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- *Usage of semi structured data and Description Logics.*
- *Modeling Languages used in from least expressive to most expressive.*
- *Usage of OWL and various Semantic web Software Tools.*
- *Application of ontology for different application areas*

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

CO1: Explain Knowledge representation using logic and inference [**Familiarity]**
CO2: Use semantic Languages such as RDF, RDFS and OWL.**[Usage]**
CO3: Define OWL Lite Classes and describe OWL Lite Property Characteristics **[Usage]**
CO4: Write their own ontologies in OWL**.[Usage]**
CO6: Use Semantic web software tools **[Usage]**
CO7: Understand the application areas of ontologies. **[Familiarity]**

UNIT I INTRODUCTION **L(9)**

Knowledge Representation - Logic and Inference: Monotonic and Non Monotonic Rules - Syntax and Semantics- Rule Markup in XML- Ontology: Definition-Features-Development Issues-Describing Semantics-Ontology Languages- XML - RDF: Features, Data Model

UNIT II ONTOLOGY LANGUAGES **L(9)**

RDF/XML-RDFS- Overview-Species-Encoding OWL Ontology-Defining Basic OWL lite Classes and Properties-Describing OWL Lite Property Characteristics

UNIT III OWL **L(9)**

Deriving OWL Lite Classes – Describing Individuals- OWL DL: Restrictions-Complex Classes/ Expressions –OWL Full - OWL Dialect Selection

UNIT IV TECHNOLOGIES **L(9)**

Methods for ontology Development – Ontology Sources : Meta Data , Upper Ontologies – Semantic Web Software Tools : Metadata and Ontology Editors

UNIT V APPLICATIONS **L(9)**

Case Study: Horizontal Information Products at Elsevier , Data Integration at Audi - e-learning – web services- Business Ontologies -Ontologies in Biology- Medical Ontologies- Language Processing- Ubiquitous Computing Applications - Ontology Engineering

LECTURE: 45 TUTORIAL: 0 PRACTICAL: 0 TOTAL: 45

Reference Books	
1	Lee W. Lacy, **"Owl: Representing Information Using the Web Ontology Language"**, Trafford Publishing, 2005.
2	Poli, Roberto, Healy, Michael, Kameas, Achilles, **"Theory and Applications of Ontology: Computer Applications"**, Springer, 2010
3	K.K. Breitman, M.A. Casanova and W. Truszkowski, **"Semantic Web: Concepts, Technologiesand Applications"**, Springer, 2007
4	Dragan Gasevic · Dragan Djuric Vladan Devedzic, **"Model Driven Architecture and Ontology Development"**, Springer Berlin Heidelberg,2006.
5	Grigoris Antoniou and Frank van Harmelen, **"A Semantic Web Primer"**, MIT Press, USA, 2012
6	Dean Allemang and Jim Hendler, **"Semantic Web for the Working Ontologist – Effective modeling in RDFS and OWL"** ,Second Edition, Morgan Kaufman, 2011.

16CSPE02 SOFTWARE DEFINED NETWORKING				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITES:

- **16CSPC09 NETWORK SCIENCE**

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- *The basics of SDN, the difference between control and data plane, functions performed by each plane, infrastructure that supports the control plane and the data plane and challenges of separation.*
- *The basics of Network Virtualization, in-depth architectures and deployment models for SDN-based network virtualization and SDN controllers.*
- *The control plane, data plane, Testing and verification and security of SDN.*
- *SDN Programming concepts using the python and Network Functions Virtualization (NFV)*
- *Basic architectural principles, fundamental mechanisms and technical challenges arising from SDNs as well as the potential issues in applying SDNs to data centers, security and other applications and contexts.*

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

CO1: Explain and discuss the basic concepts and architecture of SDN [**Familiarity**]
CO2: Compare and contrast conventional networking approaches and SDN [**Assessment**]
CO3: Analyze and apply implementation of SDN through Open Flow Switches [**Usage**]
CO4: Apply the SDN programming concepts using Python [**Usage**]
CO5: Implement, troubleshoot and debug SDNs through hands on illustrations [**Usage**]
CO6: Critically evaluate the pros and cons of applying SDN in WAN and data centers [**Assessment**]

UNIT I INTRODUCTION	**L(9)**

History and Evolution of Software Defined Networking (SDN): Separation of Control Plane and Data Plane, IETF Forces, Active Networking. Control and Data Plane Separation - Concepts, Advantages and Disadvantages, OpenFlow protocol Fundamentals - OpenFlow - Enabling Innovation in Campus Networks.

UNIT II NETWORK VIRTUALIZATION AND CONTROL PLANE	**L(9)**

Network Virtualization: Concepts, Architectural approaches, Applications, Existing NetworkVirtualization Framework (VMWare , VirtualBox and others), Mininet and the Mininet Python API based examples. Control Plane: Overview, Existing SDN Controllers including Floodlight ,ODL, ONOS, Ryu, POX and OpenDaylight.

UNIT III DATA PLANE AND LANGUAGE DESIGN	**L(9)**

Customization of Control Plane: Switching and Firewall Implementation using SDN Concepts. Data Plane: Software-based and Hardware-based; Programmable Network Hardware. Language

Design - Testing and Verification - Security - Challenges - Opportunities.	
UNIT IV PROGRAMMING SDNs	**L(9)**
Programming SDNs: Motivation for Programming SDNs - Northbound Application Programming Interface, Current Languages and Tools - Frenetic - Procera, Composition of SDNs - Pyretic, Event-Driven SDN. Network Functions Virtualization (NFV) and Software DefinedNetworks: Concepts, Implementation and Applications.	
UNIT V SDN APPLICATIONS THROUGH USE CASES	**L(9)**
Data Center Networks: Packet, Optical and Wireless Architectures, Network Topologies. Use Cases of SDNs: Data Centers and cloud, Internet Exchange Points, Backbone Networks, Home Networks, Traffic Engineering.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL: 0 TOTAL: 45	
Reference Books	
1	Thomas D. Nadeau, Ken Gray, **"SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies"**, O'Reilly Media, August 2013.
2	Paul Goransson and Chuck Black, **"Software Defined Networks: A Comprehensive Approach"**, Morgan Kaufmann, June 2014.
3	Open Networking Foundation (ONF) Documents, https://www.opennetworking.org, 2015.
4	Open Flow standards, http://www.openflow.org, 2015.
5	Online Reading Lists, including: http://www.nec-labs.com/~lume/sdn-reading-list.html, 2015.
6	Vivek Tiwari, **"SDN and OpenFlow for Beginners"**, ASIN, 2013.

16CSPE03 BIG DATA ANALYTICS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- *Statistical methods*
- *Bayesian, Support Vector and Kernel Methods*
- *Time Series Analysis and Rule Induction*
- *Neural networks and Fuzzy Logic*
- *Visualization Techniques*

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

CO1: *Explain the statistical concepts and methods.* ***[Familiarity]***
CO2: *Use Bayesian, support vector and kernel Methods.* ***[Usage]***
CO3: *Perform Time series analysis.* ***[Usage]***
CO4: *Use Rule induction.* ***[Usage]***
CO5: *Apply Neural network and Fuzzy logic.* ***[Usage]***
CO6: *Use Stochastic search methods.[****Usage****]*
CO7: *Explain Visualization Techniques. [****Familiarity****]*

UNIT I STATISTICAL CONCEPTS AND METHODS	**L(9)**
Statistical Concepts: Probability, Sampling and Sampling Distributions, Statistical Inference , Prediction and Prediction Errors–Resampling- Statistical Method: Linear Models, Regression Modeling, Multivariate Analysis.	

UNIT II BAYESIAN METHODS AND SUPPORT VECTOR AND KERNEL METHODS	**L(9)**
Bayesian Methods: Bayesian Paradigm, modeling, inference and networks – Support Vector and Kernel Methods: Kernel Perceptron, Overfitting and Generalization Bounds, Support Vector Machines, Kernel PCA and CCA.	

UNIT III TIME SERIES ANALYSIS AND RULE INDUCTION	**L(9)**
Analysis of time series: linear systems analysis, nonlinear dynamics, Delay Coordinate Embedding - Rule induction: Propositional Rule Learning, Rule Learning as search, Evaluating quality of rules, Propositional rule induction, First order rules-ILP systems.	

UNIT IV NEURAL NETWORKS AND FUZZY LOGIC	**L(9)**
Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees.	

UNIT V STOCHASTIC SEARCH METHODS AND VISUALIZATION	**L(9)**
Stochastic Search Methods: Stochastic Search by Simulated Annealing, Adaptive Search by	

Evolution- Evolution Strategies- Genetic Algorithms & Programming- Visualization : Classification of Visual Data Analysis Techniques, Data Type to be Visualized, Visualization Techniques, Interaction Techniques and Specific Visual Data Analysis Techniques	
LECTURE: 45 TUTORIAL: 0 PRACTICAL : 0 TOTAL: 45	
Reference Books	
1	Michael Berthold, David J. Hand, "**Intelligent Data Analysis-An Introduction**", Second Edition, Springer, 2007.
2	Bill Franks, "**Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analystics**", John Wiley & sons, 2012.
3	Jimmy Lin and Chris Dyer, "**Data Intensive Text Processing using Map Reduce**", Morgan and Claypool Publishers, 2010.
4	Tom White, "**Hadoop: The Definitive Guide**", O`Reilly Publishers, 2012
5	David Loshin, "**Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph**", Morgan Kaufmann, 2013.
6	Paul Zikopoulos, Chris Eaton, "**Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data**" , McGraw-Hill Education, 2011.

16CSPE04 CRYPTOGRAPHY AND NETWORK SECURITY				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

PREREQUISITES:

- **16CSPC09 NETWORK SCIENCE**

COURSE OBJECTIVES: Upon completion of this course, the students will be familiar with:

- *The mathematics of the cryptographic algorithms*
- *The working of different existing public-key cryptographic algorithms*
- *The Authentication algorithms, Digital Signature and Certificates.*
- *The network security, services, attacks, mechanisms, types of attacks on TCP/IP protocol suite and network layer security protocols, Transport layer security protocols and Web security protocols.*
- *Software attacks, security and the wireless network security threats.*

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

CO1: Explain the basic concepts, attack and mode of operation of Cryptography and build a new unbreakable cryptosystem with DES, AES. ***[Usage]***

CO2: Design and implement some public –key cryptographic algorithms with the existing communication protocols. ***[Usage]***

CO 3: Explain the basic concepts of authentication algorithms, Digital Signature and Certificates. ***[Familiarity]***.

CO4: Explain the basic concepts and architecture used in Network security and web security protocols. ***[Familiarity]***.

CO5: Design a security solution for a given system or real-world applications. ***[Usage]***

UNIT I INTRODUCTION	**L(9)**

Classical Cryptography -Types of attack: Chosen Message Attack (CMA) – Chosen Plaintext Attack (CPA) – Chosen Cipher text Attack (CCA)- Shannon's Theory -One Time Passwords (OTP) - Pseudo random bit generators - stream ciphers and RC4 -Block ciphers **-**Modes of operation - DES and its variants – AES - Linear and differential cryptanalysis.

UNIT II PUBLIC-KEY CRYPTOGRAPHY	**L(9)**

Introduction to Public-key Cryptography - Number Theory: Euclidean Algorithm - Chinese Remainder Theorem - RSA Cryptosystem -Implementing RSA- Attacks On RSA - Rabin Cryptosystem - Factoring Algorithms - ElGamal Cryptosystem and Discrete Logs - Finite Field and Elliptic Curve Systems - Key Distribution and Key Agreement : Blom's Scheme - Diffie-Hellman Key Predistribution – Kerberos - Diffie-Hellman Key Agreement scheme.

UNIT III AUTHENTICATION ALGORITHMS, DIGITAL SIGNATURE AND CERTIFICATES	**L(9)**

Authentication: Requirements - Functions - Message authentication codes - Hashing: Functions - Security of Hash Functions and MACs - MD5 message Digest algorithm - Secure Hash Algorithm - Digital signature schemes - Digital Signature Standard - X.509 Certificate

UNIT IV NETWORK SECURITY AND WEB SECURITY PROTOCOLS	**L(9)**
Network Security, Security services, attacks, Security Issues in TCP/IP suite- Sniffing, spoofing, buffer overflow, ARP poisoning, ICMP Exploits, IP address spoofing, IP Fragment attack, routing exploits, UDP exploits, TCP exploits - Network Security Protocols:IP Security - AH and ESP - SSL/TLS - SSH. Web Security Protocols: HTTPS - DNS Security - Electronic Mail Security (PGP, S/MIME).	
UNIT V SOFTWARE ATTACKS AND SECURITY	**L(9)**
Intruders - Viruses - Worms - Trojan horses - Distributed Denial-Of-Service (DDoS) - Honey nets and Honey pots. Security Systems: Firewalls – IDS - Wireless Security: Issues and threats in Wireless networks. Wireless LAN Security: WEP – WPA.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL : 0 TOTAL: 45	
Reference Books	
1	Douglas R. Stinson. "**Cryptography: Theory and Practice**", Third edition, Chapman & Hall/CRC, 2010.
2	W. Stallings, "**Cryptography and Network Security: Principles and Practice**", 6/E, Prentice Hall, 2014.
3	Atul Kahate, "**Cryptography and Network Security**", Tata McGraw-Hill, 2003.
4	Bruce Schneier," **Applied Cryptography**", Second Edition, John Wiley & Sons, 1996.
5	Wenbo Mao ," **Modern Cryptography: Theory and Practice**", First Edition, Pearson Education,2004.

16CSPE05 SOFT COMPUTING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES: Upon completion of this course the students will be familiar with:

- *Classifier of Neutral network*
- *Fuzzy sets and rules*
- *Neuro Fuzzy modelling techniques*
- *Heuristic techniques*
- *Integration of hybrid systems.*

***COURSE OUTCOMES*-Upon completion of this course the students will be able to:**

CO1*:** Analyze various neural network architectures. [Assessment***]

CO2: Analyze the ideas of Neural networks, fuzzy logic and use of heuristics. [***Assessment***]

CO3: Explain Fuzzy sets and rules. [***Familiarity]***

CO4: Analyze and gain insight onto Neuro Fuzzy modeling and control. [***Assessment***]

CO5: Analyze the genetic algorithms and their applications. [***Assessment]***

CO6: Implement soft computing techniques and their applications. [***Usage]***

UNIT I NEURAL NETWORKS **L(9)**

Supervised Learning Neural Networks- Perceptrons- Adaline-Back propagation-Multilayer perceptrons-Radial Basis Function Networks- Unsupervised Learning and Other Neural Networks-Competitive Learning Networks-Kohonen Self- Organizing Networks-Learning Vector Quantization-Hebbian Learning.

UNIT II FUZZY SET THEORY **L(9)**

Fuzzy Sets-Basic Definition and Terminology- Set-theoretic operations-Member Function-Fuzzy Rules and Fuzzy Reasoning-Extension principle and Fuzzy Relations- Fuzzy If-Then Rules-Fuzzy Reasoning- Fuzzy Inference Systems-Mamdani Fuzzy Models-Sugeno Fuzzy Models-Defuzzification.

UNIT III NEURO FUZZY MODELING **L(9)**

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

UNIT IV GENETIC ALGORITHMS **L(9)**

Traditional optimization and search methods-Simple Genetic Algorithm-Reproduction-Crossover-Mutation-Schemata-Schema Theorem-Two and K-arm Bandit Problem-Improvements in basic Techniques-Selection Schemes-Scaling Mechanisms-Ranking Procedures

UNIT V HYBRID SYSTEMS	L(9)
Integration of neural networks, fuzzy logic and genetic algorithms	
LECTURE: 45 TUTORIAL: 0 PRACTICAL : 0 TOTAL: 45	

Reference Books

1	Jang J. S. R., Sun C.T. and Mizutani E, "**Neuro - Fuzzy and Soft Computing** ", Pearson Education, 2009.
2	Timothy J. Ross, "**Fuzzy Logic with Engineering Applications**", John Wiley and sons Pvt.Ltd. 2010.
3	Zimmermann. H. J, "**Fuzzy Set Theory and its Applications**", Fourth Edition , Kluwer Academic Publishers, 2013.
4	James J. Buckley and Esfandiar Eslami, "**Advances in Soft Computing-An Introduction to Fuzzy Logic and Fuzzy Sets**", Springer International Edition, 2011.
5	Davis E. Goldberg, "**Genetic Algorithms: Search, Optimization and Machine Learning**" Addison Wesley, N.Y.,1989.
6	S. Rajasekaran and G.A.V. Pai, "**Neural Networks, Fuzzy Logic and Genetic Algorithms**", PHI, 2003.
7	Elaine Rich, Kevin Knight, "**Artificial Intelligence**", Third Edition ,Tata McGraw Hill, 2011.

16CSPE06 INTERNET OF THINGS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES :Upon completion of this course the students will be familiar with:

- *Fundamental characteristics of IoT and its applications*
- *Standardization efforts for IoT*
- *Data link and network layer functionality of IoT*
- *Communication between things and data discovery among IoT devices*
- *Security issues concerning IoT*

***COURSE OUTCOMES*-Upon completion of this course the students will be able to:**

CO1: Define things and understand the functional building blocks of IoT. ***[Familiarity]***
CO2: Explain domain specific applications of IoT and levels of IoT. ***[Familiarity]***
CO3: Analyze the need for standardization and explain the functional architecture of IoT. ***[Assessment]***
CO4: Use semantic, data and organizational interoperability to resolve heterogeneity Issues. ***[Usage]***
CO5: List protocols for data link layer in IoT and their functionalities and compare their Performance. ***[Assessment]***
CO6: List protocols for network layer in IoT and their functionalities and compare their Performance. ***[Assessment]***
CO7: Use COAP in the application layer for device to device interaction. ***[Usage]***
CO8: Exploit data processing in IoT through light weight service discovery Protocol. ***[Assessment]***
CO9: Define security principles for IoT. ***[Familiarity]***

UNIT I INTRODUCTION TO INTERENT OF THINGS	**L(9)**

Definition and Characteristics – Physical Design of IoT – Things in IoT – Logical Design of IoT- IoT Functional blocks, communication model and enabling technologies. Applications of domain specific IoT systems such as smart environment, smart energy, smart agriculture and smart health, IoT levels. IoT Vs M2M, SDN and NVF for IoT.

UNIT II IoT STANDARDIZATION AND INTEROPERABILITY	**L(9)**

Defining a common architecture, iCore functional architecture, M2M service level standardizations, OGC sensor web for IoT, Data Interoperability, Semantics Interoperability, Organizational Interoperability and Eternal Interoperability, IoT testing methodologies, Semantics as an interoperability enabler.

UNIT III DATA LINK AND THE NETWORK LAYER	**L(9)**

The data link layer for IoT - EEE 802.15.4 and the Internet of things – Low Power Link

Layer Security for IoT: Implementation and Performance Analysis, RFIDIoT: RFID as the data link layer for the internet of things. The network layer for IoT - Routing protocols in Internet of Things - An Improved AOMDV Routing Protocol for Internet of Things	
UNIT IV COMMUNICATION AND SERVICE DISCOVERY	**L(9)**
Communication protocols for IoT - Service oriented protocols (COAP) - Communication protocols based on the exchange of messages (MQTT) - Analysis on IoT communication protocol. Service discovery protocols - The data processing for IoT - Lightweight service discovery protocols for constrained environment - Organization of data processing for the Internet of Things.	
UNIT V SECURITY AND FUTURE RESEARCH	**L(9)**
Security in the Internet of Things – A review. Big data in IoT, platforms for Big data in IoT - Cloud computing – issues of incorporating cloud in IoT - Fog computing. Case study – Smarter Classrooms.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL : 0 TOTAL: 45	
References	
1	Arshdeep Bahga, Vijay Madisetti, **"Internet of Things A Hands on Approach"**, 2014.
2	Ovidiv Vermesan, Peter Friess, **"Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems"**, River publications, 2013.
3	Charalampos doucas, "Building the Internet of Things with Arduino", CreateSpace, 2002
4	Dieter Uckelmann, "Architecting the Internet of Things", Springer 2011.

16CSPE07 MINING MASSIVE DATASETS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES- Upon completion of this course the students will be familiar with:

- *Managing immense amounts of data quickly using MapReduce.*
- *Examining data for similar items.*
- *Efficient mining of data streams.*
- *Analyzing large-scale data derived from social-networks.*
- *Online advertising and Recommender systems*

COURSE OUTCOMES-Upon completion of this course the students will be able to:

CO1: Use MapReduce to handle large amount of data. **[Usage]**
CO2: Analyze similarity problem as finding sets with large intersection and also to test the degree of similarity among data. **[Assessment]**
CO3: Summarize data streams, filter it and efficiently store it for future use. **[Familiarity]**
CO4: Identify communities, similarity among nodes of a graph, measure the connectedness of community, and measure the neighborhood size of nodes in a graph. **[Familiarity]**
CO5: Use algorithms to address issues like matching problems and adwords problem.**[Usage]**
CO6: Implement Recommendation system. **[Usage]**

UNIT-I INTRODUCTION	**L(9)**
Introduction to Data Mining - Statistical limits on data mining - Introduction to Distributed File Systems- MapReduce - Algorithms using MapReduce - Communication cost model - Complexity Theory for MapReduce.	

UNIT-II SIMILARITY SEARCH	**L(9)**
Similarity Search - Applications of nearest - neighbour search - Shingling of Documents – Similarity - preserving summaries of sets - Locality - Sensitivity hashing for documents - Distance measures - Theory of locality-Sensitive functions - Applications - Methods for high degrees of similarity.	

UNIT-III MINING DATA STREAMS AND LINK ANALYSIS	**L(9)**
Mining Data streams - Stream data model - Sampling data in a Stream - Filtering streams - Counting distinct elements in a stream- Estimating moments - Link analysis – Page rank - Efficient computation of Page rank - Topic-sensitive page rank - Link spam - Hubs and Authorities.	

UNIT-IV MINING SOCIAL NETWORKS	**L(9)**
Social networks as graphs - Clustering of social-network graphs - Direct discovery of communities - Partitioning of graphs - Finding overlapping communities - Simrank - Counting triangles - Neighborhood properties of graphs.	

UNIT-V ONLINE ADVERTISING AND RECOMMENDATION SYSTEMS	**L(9)**
Advertising on Web: Issues- Online Algorithms- Matching Problems - Adwords Problem -	

Implementation – Recommendation Systems: Model – Content based Recommendation-Collaborative Filtering-Dimensionality Reduction.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL : 0 TOTAL:45	
Reference Books	
1	Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, **"Mining of massive Datasets"**, Cambridge University Press, 2014.
2	Jimmy Lin, Chris Dyer, **"Data-Intensive Text Processing with MapReduce"**, Cambridge University Press, 2013.
3	James Abello, Panos M. Pardalos, Mauricio G. C. Resende (editors), **"Handbook of Massive Data Sets"**, Kluwer Academic Publishers, 2002.
4	Lei Tang, Huan Liu, **"Community Detection and Mining in Social Media"**, Morgan & Claypool Publishers, 2010.

16CSPE08 PATTERN RECOGNITION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES: Upon completion of this course the students will be familiar with:

- *Basic concepts in pattern recognition*
- *State-of-the-art algorithms used in pattern recognition*
- *Bayes classifier and linear discriminant analysis*
- *HMM and Support Vector Machines*
- *Apply pattern recognition techniques in practical problems*

***COURSE OUTCOMES*-Upon completion of this course the students will be able to:**

CO1: Apply variety of mathematical techniques to pattern classification problems. ***[Usage]***
CO2: Explain and compare a variety of pattern classification, structural pattern recognition and pattern classifier combination techniques***. [Familiarity]***
CO3: Summarize, analyze, and relate the pattern recognition problems and Techniques. ***[Usage]***
CO4: Apply performance evaluation methods for pattern recognition, and critique comparisons of techniques. ***[Assessment]***
CO5: Apply pattern recognition techniques to real-world problems such as document analysis and recognition***. [Usage]***
CO6: Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers***. [Usage]***

UNIT I MATHEMATICAL FOUNDATIONS OF PATTERN RECOGNITION **L(9)**

Introduction – Mathematical Foundations: Basics of Probability, Random Processes and Linear Algebra - Probability: independence of events, conditional and joint probability - Random Processes: Stationary and non-stationary processes, Expectation, Autocorrelation, Cross-Correlation, spectra; Linear Algebra: Inner product, outer product, inverses, eigen values, eigen vectors - Features, Feature Vectors, and Classifiers - Supervised versus Unsupervised Pattern Recognition.

UNIT II CLASSIFIERS BASED ON BAYES DECISION THEORY **L(9)**

Introduction - Minimum-error-rate classification, Classifiers, Discriminant functions, Decision surfaces, Normal density and discriminant functions, discrete features -Parameter Estimation Methods: Maximum-Likelihood estimation: Gaussian case; Maximum a Posteriori estimation; Bayesian estimation: Gaussian case - The Nearest Neighbor Rule.

UNIT III UNSUPERVISED LEARNING AND CLUSTERING **L(9)**

Criterion functions for clustering; Algorithms for clustering: K-Means, Hierarchical and other methods; Cluster validation; Gaussian mixture models; Expectation-Maximization method for parameter estimation; Maximum entropy estimation.

UNIT IV SEQUENTIAL PATTERN RECOGNITION	**L(9)**
Hidden Markov Models (HMMs); Discrete HMMs; Continuous HMMs - Nonparametric techniques for density estimation: Parzen-window method; K-Nearest Neighbour method - Dimensionality reduction: Fisher discriminant analysis; Principal component analysis; Factor Analysis.	
UNIT V FEATURE SELECTION AND FEATURE GENERATION	**L(9)**
Linear discriminant functions: Gradient descent procedures; Perceptron; Support vector machines - Non-metric methods for pattern classification: Non-numeric data or nominal data; Decision trees: CART.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL: 0TOTAL: 45	

Reference Books

1	O.Duda, P.E.Hart and D.G.Stork, "**Pattern Classification"**, John Wiley, 2001.
2	S.Theodoridis and K.Koutroumbas, **"Pattern Recognition"**, 4th Ed., Academic Press, 2009
3	C.M.Bishop, "**Pattern Recognition and Machine Learning**", Springer, 2006.
4	Sergios Theodoridis, Aggelos Pikrakis, Konstantinos Koutroumbas, Dionisis Cavouras, **"Introduction to Pattern Recognition: A Matlab Approach",** First Edition, Elsevier 2010.

16CSPE09 INFORMATION RETRIEVAL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES- Upon completion of this course the students will be familiar with:

- *Fundamentals of Information Retrieval systems*
- *Static and Dynamic inverted indices*
- *Various language modeling and retrieval methods*
- *Usage of Queueing Theory and Scheduling*
- *Different kinds of Information Retrieval systems.*

COURSE OUTCOMES-Upon completion of this course the students will be able to:

CO1: Explain the working of information retrieval system. **[Familiarity]**

CO2: Differentiate between static and dynamic inverted indices.**[Familiarity]**

CO3: Apply models like Bookstein's Two –Poisson, Approximating the Two-Poisson Model for Probabilistic Information Retrieval. **[Usage]**

CO4: Compare Traditional and nontraditional effectiveness measures for text retrieval. **[Familiarity]**

CO5: Develop parallel and XML information retrieval systems for efficient retrieval. **[Usage]**

UNIT I INTRODUCTION **L(9)**

Information Retrieval systems-Working with electronic text-Test Collections-Open source IR systems- Basic Techniques: Inverted indices, Retrieval and Ranking, Evaluation- Tokens and Terms.

UNIT II INDEXING **L(9)**

Static inverted indices-Query Processing-Index Compression- Dynamic inverted indices.

UNIT III RETRIEVAL AND RANKING **L(9)**

Probabilistic Retrieval-Language Modeling and Related Methods-Categorization and Filtering-Fusion and Meta learning.

UNIT IV EVALUATION **L(9)**

Measuring Effectiveness: Traditional Effectiveness Measures- The Text Retrieval Conference (TREC)- Using Statistics in Evaluation- Minimizing Adjudication Effort- Nontraditional Effectiveness Measures- Measuring Efficiency: Efficiency Criteria- Queueing Theory-Query Scheduling-Caching.

UNIT V APPLICATIONS **L(9)**

Parallel Information Retrieval: Parallel Query Processing, MAP Reduce - Web Search: Structure, Queries and Users, Ranking, Evaluation, Web Crawlers- XML Retrieval.

LECTURE: 45 TUTORIAL: 0 PRACTICAL : 0 TOTAL: 45

Reference Books	
1	Stefan Buttcher, Charles L. A. Clarke, V. Cormack**, "Information Retrieval Implementing and Evaluating Search Engines"**, MIT press, 2010.
2	Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze,**"Introduction to Information Retrieval"**, Cambridge University Press, 2008
3	Robert Korfhage , **"Information Storage & Retrieval"**, John Wiley & Sons,2006.
4	D. Grossman and O. Frieder, **"Information Retrieval: Algorithms and Heuristics"**, Second Edition, Springer Publishers, 2004.
5	Gerald Kowalski, **"Information Retrieval Architecture and Algorithms"**, Springer Science & Business Media, 2010.

16CSPE10 PARALLEL ALGORITHMS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES: Upon completion of this course the students will be familiar with:

- *Parallel Computing Architecture*
- *Fundamentals of parallel algorithms*
- *Analysis of Parallel algorithm*
- *Applications of parallel algorithms*
- *Parallelization of Fast Fourier transforms, linear equations and partial differential equations*

COURSE OUTCOMES-Upon completion of this course the students will be able to:

CO1: Explain the architecture of Parallel Computing Systems. **[Familiarity]**
CO2: Explain shared memory multiprocessors and Interconnection networks. **[Familiarity]**
CO3: Use adhoc techniques for parallel and non-serial parallel algorithms. **[Usage]**
CO4: Perform parallel algorithm analysis. **[Assessment]**
CO5: Write parallel algorithms for applications such as pattern matching, video compression etc. **[Usage]**
CO6: Solve Systems of Linear equations, FFT, partial differential equations using Parallelization.**[Usage]**

UNIT I PARALLEL COMPUTING ARCHITECTURE	**L(9)**
Introduction to parallel computers: Parallel Computing, Shared memory multiprocessors, Distributed Memory Multiprocessors, SIMD, Systolic processor, Cluster, Grid Computing, Multicore systems, SM, Communication between parallel processors – Shared memory multi processors: Cache coherence and Memory Consistency – Interconnection Networks: Classification and Interconnection.	

UNIT II FUNDAMENTALS OF PARALLEL ALGORITHMS	**L(9)**
Concurrency platforms: Cilk++, OpenMP, CUDA – Adhoc techniques for parallel algorithms: Independent loop scheduling, dependent loops, loop spreading, loop unrolling, problem partitioning, Divide and Conquer strategies, pipelining – Non serial Parallel algorithms.	

UNIT III ALGORITHM ANALYSIS	**L (9)**
Z-Transform analysis: Definition, DFA, Software and Hardware implementations of zTransform and various designs – Dependence Graph analysis: DFA, Deriving dependence graph of an algorithm, Scheduling function, Node projection operation, Nonlinear projection operation, Software and hardware implementations – Computational Geometry analysis.	

UNIT IV APPLICATIONS	**L(9)**
Pattern matching: Expressing the algorithm as RIA, Obtaining algorithm dependence graph, Data scheduling, DAG node projection – Motion estimation for video compression – Multiplication	

over GF (2m) – Polynomial division over GF(2).	
UNIT V CASE STUDY	**L(9)**
The Fast Fourier transforms: Decimation-in-time FFT, pipeline Radix 2Decimation-in-time FFTprocessor, Decimation-in-frequency FFT, pipeline Radix 2Decimation-in-frequency FFTprocessor– Solving systems of Linear equations – Solving partial differential equations.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL : 0 TOTAL: 45	
Reference Books	
1	Fayez Gebali, "**Algorithms and Parallel Computing**", Wiley publications, 2011.
2	A.Grama, A.Gupta, G.Karypis and V.Kumar, "**Introduction to Parallel Computing**", Second Edition, Addison-Wesley, 2003.
3	Barry Wilkinson and Michael Allen, "**Parallel programming: techniques and applications using networked workstations and parallel computers**", Pearson Education, 2003.
4	Joseph JaJa, "**An introduction to Parallel Algorithms**", Addison-wesley publications, 1992.
5	Selim G. Akl, "**Design and analysis of parallel algorithms**", Prentice Hall, 1989.

16CSPE11 SOCIAL NETWORKS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES-Upon completion of this course the students will be familiar with,

- Structure and properties of Social Networks
- Community discovery across Social Networks
- Privacy preserving mechanisms in Social Networks and predict the efficiency of links
- Building Social Network infrastructures
- Visualize Social Networks and explain applications of Social Networks

COURSE OUTCOMES: Upon completion of this course the students will be able to:

CO1: Compare static and Dynamic properties of Social Networks. ***[Usage]***

CO2: Explain random walks in graphs and algorithms to perform random walks. ***[Familiarity]***

CO3: Develop methods to discover communities in large scale online Social Networks. ***[Assessment]***

CO4: Use Similarity and influence maximization techniques to analyze online Social Networks. ***[Usage]***

CO5: Use k-anonymity, l-diversity and *t*-closeness techniques to detect privacy threats in Social Networks ***[Usage]***

CO6: Explain link selection and use Bayesian Probabilistic Models to estimate the efficiency of the links in graphs. ***[Familiarity]***

CO7: Explain decentralized large scale online Social Networks. ***[Familiarity]***

CO8: Use fuzzy sets to understand human behavior in Social Network communities ***[Assessment]***

CO9: Visualize Social Networks using social network analysis tools and study applications of Social Networks. ***[Assessment]***

UNIT I INTRODUCTION	**L(9)**

Properties of social networks – static and dynamic properties - Random walks on graphs – Algorithms for Hitting and Commute Times - Algorithms for Computing Personalized Pagerank and Simrank - Algorithms for Computing Harmonic Functions - Applications in computer vision, text analysis, combating webspam and collaborative filtering.

UNIT II DISCOVERING COMMUNITIES	**L(9)**

Communities in Context - Core methods – community discovery in dynamic, heterogeneous and directed networks- Classification of nodes - local classifiers – classifiers for large scale social networks. Social influence analysis – Similarity and influence maximization.

UNIT III PRIVACY AND LINK PREDICTION	**L(9)**

Privacy breaches in social networks - k-anonymity - l-diversity and *t*-closeness - Privacy preserving mechanisms social networks and affiliation networks. Link Prediction - Feature

Set Construction - Classification Models - Bayesian Probabilistic Models - Link Prediction by Local Probabilistic Models, Network Evolution based Probabilistic Model and Hierarchical Probabilistic Model - Probabilistic Relational Models - Relational Bayesian Network and Relational Markov Network.

UNIT IV SOCIAL NETWORK INFRASTRUCTURES	**L(9)**

Decentralized Online Social Networks - Multi-Relational Characterization of Dynamic Social Network Communities- Accessibility Testing of Social Websites - Understanding and Predicting Human Behavior for Social Communities - Associating Human-Centered Concepts with Social Networks Using Fuzzy Sets.

UNIT V VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS	**L(9)**

Visualization of Social Networks - Novel Visualizations and Interactions for Social Networks Exploration - Applications of Social Network Analysis - Online Advertising in Social Networks - Social Bookmarking on a Company's Intranet: A Study of Technology Adoption and Diffusion.

LECTURE: 45 TUTORIAL: 0 PRACTICAL : 0 TOTAL: 45

References

1	Charu C. Aggarwal, **"Social Network Data Analytics"**, Springer 2011.
2	Borko Furht, **"Handbook of Social Network Technologies and Applications"**, Springer 2010
3	Stanley Wasserman, Katherine Faust. "**Social network analysis: methods and applications"**, Cambridge University Press, 2007
4	David Easley and Jon Kleinberg. "**Networks, Crowds, and Markets: Reasoning About a Highly Connected World"**, Cambridge University Press, 2010

16CSPE12 CYBER FORENSICS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES-Upon completion of this course the students will be familiar with,

- Cyber forensics technology
- Cyber Crime Laws
- Basics of Digital forensics
- Basics of mobile phone forensics
- Methods of investigation using digital forensic techniques.

COURSE OUTCOMES: Upon completion of this course the students will be able to:

CO1: Describe the various Cyber forensics technologies. ***[Familiarity]***
CO2: Understand Cyber Laws. ***[Familiarity]***
CO3: Analyze the different Cyber Crime & Cyber Laws. ***[Assessment]***
CO4: Analyze the Digital Forensics Technology and Practices. ***[Assessment]***
CO5: Analyze the Mobile Forensics Technology and Practices. ***[Assessment]***
CO6: Investigate Cyber Crime. ***[Usage]***

UNIT I INTRODUCTION	**L(9)**

Introduction to Cyber forensics: Information Security Investigations, Corporate Cyber Forensics, Scientific method in forensic analysis, investigating large scale Data breach cases. Types of Computer Forensics Technology, Types of Military Computer Forensic Technology, Types of Law Enforcement: Computer Forensic Technology, Types of Business Computer Forensic Technology, Specialized Forensics Techniques.

UNIT II CYBER CRIME & CYBER LAWS	**L(9)**

Unauthorized Access to Computers, Computer Intrusions, White collar Crimes, Viruses and Malicious Code, Internet Hacking and Cracking, Virus Attacks, Pornography, Software Piracy, Intellectual Property, Mail Bombs, Exploitation, Stalking and Obscenity in Internet, Digital laws and legislation, Law Enforcement Roles and Responses.

UNIT III DIGITAL FORENSICS	**L(9)**

Introduction to Digital Forensics, Forensic Software and Hardware, Analysis and Advanced Tools, Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics.

UNIT IV MOBILE PHONE FORENSICS	**L(9)**

Crime and mobile phones, evidences, forensic procedures, files present in SIM card, device data, external memory dump, evidences in memory card, operators systems- Android forensics: Procedures for handling an android device, imaging android USB mass storage devices, logical and physical techniques.

UNIT V CYBER CRIME INVESTIGATION	L(9)
Introduction to Cyber Crime Investigation, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, Email Recovery, Hands on Case Studies: Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL : 0 TOTAL: 45	

References

1	John R. Vacca, Computer Forensics**: "Computer Crime Scene Investigation"**, 2nd Edition, Charles River Media, 2009.
2	Bernadette H Schell, Clemens Martin, **"Cybercrime"**, ABC – CLIO Inc, 2009.
3	Iosif I. Androulidakis, **"Mobile phone security and forensics: A practical approach"**, Springer publications, 2012.
4	Andrew Hoog, **"Android Forensics: Investigation, Analysis and Mobile Security for Google Android"**, Elsevier publications, 2011.
5	Angus M. Marshall, **" Digital forensics: Digital evidence in criminal investigation"**, John – Wiley and Sons, 2008.
6	Nelson Phillips and Enfinger Steuart, **"Computer Forensics and Investigations"**, Cengage Learning, 2009

16CSPE13 NETWORK OPTIMIZATION TECHNIQUES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES: Upon completion of this course the students will be familiar with:

- *Network Flow Algorithms*
- *Max-Flow and Min-Cost algorithms*
- *Simplex, dual ascent methods and auction algorithms*
- *Nonlinear network optimization*
- *Convex separable and Integer constraints network problems*

***COURSE OUTCOMES*-Upon completion of this course the students will be able to:**

CO1: Use the right network flow algorithm.**[Assessment]**
CO2: Assess the performance of label correcting and setting methods.**[Assessment]**
CO3: Optimize Max flow and min cost flow problems. **[Assessment]**
CO4: Use Simplex Methods, Dual Ascent and Auction Algorithms for Min-Cost flow problem. **[Usage]**
CO5: Perform Non-Linear Network Optimization. **[Usage]**
CO6: Solve Convex separable and Integer constraints network problems.**[Usage]**

UNIT I NETWORK FLOW MODELS **L(9)**

Introduction - Graphs and Flows - Network Flow Models - Network Flow Algorithms - Problem Formulation and Applications - Shortest Path Algorithm - Label Setting (Dijkstra) Methods - Label Correcting Methods - Comparison of Label Setting and Label Correcting - Single Origin/Single Destination Methods - Auction Algorithms - Multiple Origin/Multiple Destination Methods.

UNIT II MAX-FLOW AND MIN-COST FLOW PROBLEM **L(9)**

The Max -Flow and Min-Cut Problems - The Ford-Fulkerson Algorithm - Price-Based Augmenting Path Algorithms - Transformations and Equivalences - Duality.

UNIT III SIMPLEX, DUAL ASCENT METHODS AND AUCTION ALGORITHMS **L(9)**

Main Ideas in Simplex Methods - The Basic Simplex Algorithm - Extension to Problems with Upper and Lower Bounds - Dual Ascent - Primal-Dual Method - Relaxation Method - Implementation Issues -Auction Algorithm for the Assignment Problem - Extensions of the Auction Algorithm - Preflow-Push Algorithm for Max-Flow –ε-Relaxation Method - Auction/ Sequential Shortest Path Algorithm.

UNIT IV NONLINEAR NETWORK OPTIMIZATION **L(9)**

Convex and Separable Problems - Problems with Side Constraints - Multicommodity Flow Problems -Integer Constraints - Networks with Gains - Optimality Conditions - Duality- Algorithms and Approximations.

UNIT V CONVEX SEPARABLE AND INTEGER CONSTRAINTS NETWORK PROBLEMS	**L(9)**
Convex Functions of a Single Variable - Optimality Conditions - Dual Function Differentiability - Algorithms for Differentiable Dual Problems - Auction Algorithms - Monotropic Programming- Integer -Constrained Problems - Branch-and-Bound - Lagrangian Relaxation - Local Search Methods - Rollout Algorithms.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL : 0 TOTAL: 45	
Reference Books	
1	Dimitri P. Bertsekas "**Network optimization: Continuous & Discrete Models**", Athena Scientific, Belmont, Massachusetts, 1998.
2	Magnanti.T.L., Orlin.J.B., "**Network Flows: Theory, Algorithm and Applications**", Prentice Hall,1993
3	Cook.W.J., Cunningham.W.H., Pulleyblank.W.R., and Schrijver.A," **Combinatorial Optimization**", John Wiley&Sons,1998.
4	R. Tyrrell Rockafellar, "**Network Flows and Monotropic Optimization",** Wiley, 1984.

16CSPE14 VIRTUALIZATION TECHNIQUES

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES: Upon completion of this course the students will be familiar with:

- *The basics of virtualization*
- *Types of virtualization*
- *The concepts of virtualization and virtual machines*
- *The practical virtualization solutions and enterprise solutions*
- *The creation of virtual private network*

***COURSE OUTCOMES*-Upon completion of this course the students will be able to:**

CO1: Deploy legacy OSs on virtual machines.**[*Usage*]**
CO2: Explain the intricacies of server, storage, network, desktop and application virtualizations.**[*Familiarity]***
CO3: Design new models for virtualization. **[*Usage*]**
CO4: Design and develop cloud applications on virtual machine platforms.**[*Usage]***
CO5: Configuring server, Desktop and Network virtualization. **[*Assessment*]**
CO6: Deploy virtual private network in cloud environment. **[*Usage*]**

UNIT I OVERVIEW OF VIRTUALIZATION **L(9)**

Basics of Virtualization – Types of Virtualization Techniques – Merits and demerits of Virtualization – Full Vs. Para-virtualization – Virtual Machine Monitor/Hypervisor - Virtual Machine Basics – Taxonomy of Virtual machines – Process Vs System Virtual Machines – Emulation: Interpretation and Binary Translation - HLL Virtual Machines.

UNIT II SERVER AND NETWORK VIRTUALIZATION **L(9)**

Server Virtualization: Virtual Hardware Overview - Server Consolidation – Partitioning Techniques - Uses of Virtual server Consolidation – Server Virtualization Platforms, Network Virtualization: Design of Scalable Enterprise Networks – Layer2 Virtualization – VLAN - VFI - Layer 3 Virtualization – VRF - Virtual Firewall Contexts - Network Device Virtualization - Data- Path Virtualization - Routing Protocols.

UNIT III STORAGE AND APPLICATION VIRTUALIZATION **L(9)**

Hardware Devices – SAN backup and recovery techniques – RAID – Classical Storage Model – SNIA Shared Storage Model – Virtual Storage: File System Level and Block Level, Application Virtualization: Concepts - Application Management Issues - Redesign Application Management – Application Migration.

UNIT IV APPLYING VIRTUALIZATION **L(9)**

Practical Virtualization Solutions: Comparison of Virtualization Technologies: Guest OS/ Host OS – Hypervisor – Emulation – Kernel Level – Shared Kernel, Enterprise Solutions: VMWare Server – VMWare ESXi – Citrix Xen Server – Microsoft Virtual PC – Microsoft Hyper-V – Virtual Box

UNIT V APPLYING SERVER, DESKTOP AND NETWORK VIRTUALIZATION	**L(9)**
Configuring Servers with Virtualization – Adjusting and Tuning Virtual servers – VM Backup – VM Migration, Desktop Virtualization: Terminal services – Hosted Desktop – Web-based Solutions – Localized Virtual Desktops, Network and Storage Virtualization: Virtual Private Networks – Virtual LAN – SAN and VSAN – NAS.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL : 0 TOTAL: 45	

Reference Books

1	James E. Smith, Ravi Nair**, " Virtual Machines: Versatile Platforms for Systems and Processes"**, Elsevier/Morgan Kaufmann, 2005.
2	David Marshall, Wade A. Reynolds, **"Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center"**, Auerbach Publications, 2006.
3	Kumar Reddy, Victor Moreno, **"Network virtualization",** Cisco Press, July, 2006.
4	Danielle Ruest, Nelson Ruest, **"Virtualization: A Beginner's Guide",** TMH, 2009.
5	Kenneth Hess , Amy Newman: "**Practical Virtualization Solutions: Virtualization from the Trenches"** , Prentice Hall 2010.
6	Chris Wolf, Erick M. Halter, " **Virtualization: From the Desktop to the Enterprise**", A Press, 2005.

16CSPE15 DIGITAL IMAGE PROCESSING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES: Upon completion of this course the students will be familiar with:

- *Fundamentals of digital image processing and simple operations.*
- *Image transformation and image enhancement techniques.*
- *Different kinds of restoration and image compression techniques.*
- *Segmentation methods used in image processing, image understanding and recognition.*
- *Usage of image processing in real time applications.*

COURSE OUTCOMES-Upon completion of this course the students will be able to:

CO1: Process digital images using fundamental steps of image processing and simple arithmetic, logical and geometric operations. **[Usage]**

CO2: Analyze and apply image transforms like FFT, DCT, Hadamard,Haar,Slant, KL transforms for images. **[Usage]**

CO3: Enhance the quality of images using frequency and spatial domain techniques. **[Assessment]**

CO4: Identify the degradation modeling and restoring the image using different methods like algebraic approaches and projections**[Assessment]**

CO5: Apply Lossy and lossless image compression techniques for digital images **[Usage]**

CO6: Perform edge detection and segmentation. **[Assessment]**

CO7: Recognize image using matching by templates, statistical and neural network models. **[Usage]**

CO8: Apply suitable image processing techniques for various real time applications like medical and network security applications. **[Usage]**

UNIT I INTRODUCTION **L(9)**

Digital image processing systems-elements of visual perception-connectivity and relations between pixels - Arithmetic, logical, geometric operations.

UNIT II IMAGE TRANSFORMS AND ENHANCEMENT **L(9)**

Image Transforms: 2D orthogonal and unitary transforms-properties and examples. 2D DFT, FFT, DCT, Hadamard transform, Haar Transform, Slant transform, KL Transform- properties and examples. Image Enhancement: Point processing-filtering in spatial and frequency domain, Nonlinear filtering-Color image processing fundamentals.

UNIT III IMAGE RESTORATION AND COMPRESSION **L(9)**

Image Restoration: Image observation and degradation model-circulant and block circulant matrices and its application in degradation model-Algebraic approach to restoration-Inverse by Wiener filtering, Generalized inverse- SVD and iterative methods, blind deconvolution, image reconstruction from projections. Image compression: redundancy and compression models - Loss less compression: variable-length, Huffman, Arithmetic coding, bit-plane coding, Loss less predictive coding. Lossy compression: Transform based coding (DCT), JPEG standard, sub band

coding.	
UNIT IV IMAGE SEGMENTATION, UNDERSTANDING AND RECOGNITION	**L(9)**
Image segmentation: Edge detection, line detection, curve detection. Edge linking and boundary extraction-boundary representation-region representation and segmentation; morphology: dilation, erosion, opening and closing. Image understanding and recognition: Matching by templates, classifiers-statistical and neural network based model.	
UNIT V APPLICATIONS	**L(9)**
Applications: Automatic visual system in part inspection-forensic and security system- scientific and medical investigation- entertainment: multimedia.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL : 0 TOTAL: 45	
Reference Books	
1	Rafael C. Gonzalez and Richard E. Woods, "**Digital Image Processing**", Third Edition, Pearson Education, 2012.
2	Anil K. Jain, "**Fundamental of Digital Image Processing**", Prentice Hall , 2015.
3	B.Chanda, D.Dutta majumder, " **Digital Image Processing and Analysis**", Second Edition, PHI, 2011.
4	Annadurai S, Shanmugalakshmi R, "**Fundamentals of Digital Image Processing**", Pearson Education Pvt. Ltd., 2007.
5	Milan Sonka, Vaclav Hlavac and Roger Boyle, "**Image Processing, Analysis and Machine Vision**", Fourth Edition, Cengage Learning, 2015.
6	S. Sridhar, "**Digital Image Processing**", OXFORD University press, 2011.
7	S. Jayaraman, S.Esakkirajan, T.Veerakumar, "**Digital Image Processing**", Tata McGraw Hill Education Pvt. Ltd., 2011.

16CSPE16 EMBEDDED SYSTEMS				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

COURSE OBJECTIVES: Upon completion of this course the students will be familiar with:

- *Architecture and Instruction set of microcontrollers.*
- *Addressing modes and Interrupt mechanisms of microcontrollers*
- *Peripheral functions, Timers and data Convertors and their interfacing*
- *RTOS, Multiple process environment and develop applications*
- *Development Tools and Hardware Software Co-Design*

COURSE OUTCOMES-Upon completion of this course the students will be able to:

CO1: Describe architectural features of RENESAS RL78 microcontroller**.** ***[Familiarity]***

CO2: Design and implement software systems to provide an interface to RL 78 based hardware Systems. ***[Assessment]***

CO3: Describe the multiple process operating environment and system call interfaces to monitor and control processes. ***[Familiarity]***

CO4: Develop interface peripherals for serial communication, timer applications and Data convertors. ***[Usage]***

CO5: Describe architectural features of ARM Cortex M3 Microcontroller. ***[Familiarity]***

CO6: Design and implement software systems to provide an interface to ARM Cortex M3 based hardware systems. ***[Assessment]***

CO7: Explain the RTOS design issues and hardware software co-design methodologies. ***[Familiarity]***

UNIT I Microcontroller Architecture, clock and operating modes	**L(9)**

New generation embedded systems: low power operations, high performance, battery operated embedded systems; Introduction to RL78 microcontrollers; Architecture of RL78 microcontrollers, General purpose registers; Memory space; Flash mirror facility; Boot clusters; Special function registers; Pipeline execution. RL78 clock circuitry and operating modes; Operating modes; Reset management; Power-on-reset; Voltage detection circuit; Applying voltage detection circuits.

UNIT II Instruction set and Fail-safe features	**L(9)**

Instruction set; Addressing modes; Types of instructions; Types of interrupts; Interrupt sources and configurations, Interrupt priority; Interrupt servicing; Key interrupt functions; Introduction to fail- safe standard IEC60730; Usage of CRC in memory; Detection of abnormal CPU operations.

UNIT III Peripherals: I/O ports, communication functions, Timers, Data Converters	**L(9)**

RL78 peripheral functions; I/O Ports; Port architecture; Port operations; Port controlling registers; Serial ports of RL78, Functions of 3-wire serial I/O; Functions of UART channels; Functions of simplified IIC channels; Functions of LIN communications, Timer array units;

PWM output generation; One-shot pulse outputs; Multiple PWM outputs; Interval timers; Real time counters; Watchdog timers; Analog to digital converter overview; A/D conversion operations; A/D conversion modes; Flash memory configurations; Flash memory programming.	
UNIT IV Introduction to ARM Cortex M3 Microcontrollers	**L(9)**
Introduction to STM32F1xx family, Overview of Cortex-M3 architecture, Bus configurations and Memory structure, Reset and Clock circuitry, General purpose and alternate function I/Os, Interrupts and events, DMA controller, Data converters, Timers, Watchdog timers, Flexible static memory controller, SDIO, communication facilities like SPI, IIC, CAN, Ethernet, USB.	
UNIT V RTOS, Development Tools and Hardware Software Co-Design	**L(9)**
Understanding Code development environment for microcontrollers, Debugging tools, Embedded System Design Methodologies, RTOS, Hardware Software Codesign**.**	
LECTURE: 45 TUTORIAL: 0 PRACTICAL: 0TOTAL: 45	
Reference Books	
1	Alexander G. Dean and James M. conard, " **Creating Fast, Responsive and Energy-efficient Embedded Systems using the Renesas RL 78 Microcontroller"**, Micrium Press, 2011
2	Joseph Yiu, "**The Definitive Guide to the ARM Cortex-M3**", Elsevir Inc., Second Edition, 2010
3	Frank Vahid, Tony D. Givargis, "***Embedded system Design: A Unified Hardware/Software Introduction***", John Wily & Sons Inc.2002
4	Peter Marwedel, "***Embedded System Design***", Science Publishers, 2007.
5	Tammy Noergaard "**Embedded Systems Architecture:** ***A Comprehensive Guide for Engineers and Programmers***", Elsevier Pvt.Ltd.Publications, 2005

16CSPE17 COMPUTER NETWORK ENGINEERING AND MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES: Upon completion of this course the students will be familiar with:

- *The hardware and software architecture of Computer Networks*
- *The concepts of internetworking*
- *Issues in resource allocation*
- *End-to-end protocols and data transmission*
- *Network management models*

***COURSE OUTCOMES*-Upon completion of this course the students will be able to:**

CO1: *Explain the architecture and applications of Computer Networks.* ***[Familiarity]***
CO2: *Analyze the performance of MAC protocols.* ***[Assessment]***
CO3: *Configure switches and Routers.* ***[Assessment]***
CO4: *Design algorithms to ensure congestion control and QOS.* ***[Usage]***
CO5: *Appreciate the performance of End-to-End protocols and data transmission techniques.* ***[Assessment]***
CO6: *Use SNMP and RMON.* ***[Usage]***

UNIT I FOUNDATION **L(9)**

Applications – Requirements – Network Architecture – Implementing Network software – Performance – Perspectives on connecting – Encoding – Framing – Error detection – Reliable transmission – Ethernet and Multiple Access Networks – Wireless.

UNIT II INTERNETWORKING **L(9)**

Switching and bridging – IP – Routing – Implementation and Performance – Advanced Internetworking – The Global Internet – Multicast – Multiprotocol and Label Switching – Routing among Mobile devices.

UNIT III CONGESTION CONTROL AND RESOURCE ALLOCATION **L(9)**

Issues in Resource allocation – Queuing disciplines – Congestion Control – Congestion avoidance mechanism – Quality of Service.

UNIT IV END-TO-END PROTCOLS AND DATA **L(9)**

Simple Demultiplexer – Reliable Byte Stream –Remote Procedure Call – RTP – Presentation formatting - Multimedia data.

UNIT V NETWORK MANAGEMENT **L(9)**

SNMPv1 and v2 Organization and information model - Communication model – Functional model - SNMP proxy server- Remote monitoring- RMON1 and RMON2.

LECTURE: 45 TUTORIAL: 0 PRACTICAL : 0 TOTAL: 45

Reference Books	
1	Larry L. Peterson, Bruce S. Davie, **"Computer Networks a Systems approach"**, Fifth edition, Elsevier, 2011.
2	Priscilla Oppenheimer, **"Top-down Network Design: A Systems Analysis Approach to Enterprise Network Design"**, 3rd Edition, Cisco Press, 2010.
3	James D. McCabe, Morgan Kaufmann, **"Network Analysis, Architecture, and Design"**, Third Edition, Elsevier, 2007.
4	William Stalings, **"SNMP, SNMPv2, SNMPv3, and RMON 1 and 2,"** Third Edition, Pearson Education, 2012
5	Mani Subramanian, **"Network Management Principles and practice "**, Pearson Education, 2010.

16CSPE18 FUZZY LOGIC AND NEURAL NETWORKS

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES: Upon completion of this course the students will be familiar with:

- *Basics of fuzzy sets and fuzzy logic.*
- *Fuzzyfication and de-fuzzyfication methods.*
- *Neural network learning rules and training algorithms.*
- *Different neural network architectures and applications.*
- *Applications of neural networks and fuzzy logic.*

***COURSE OUTCOMES*-Upon completion of this course the students will be able to:**

CO1: Perform simple arithmetic, logical and geometric operations on classical and fuzzy sets. **[*Usage*]**

CO2: Use fuzzification and defuzzification methods. **[*Familiarity]***

CO3: Apply activation functions suitable for different neural networks and Solve linearly separable problems. **[*Usage]***

CO4: Apply training algorithm suitable for pattern classification, pattern association, pattern matching, image compression and storage and retrieval. **[*Usage]***

CO5: Discuss the features, operations and applications of Adaptive resonance neural networks, Boltzman Machine, Neocognitron and backpropagation networks.**[*Familiarity]***

CO6: Apply neural network and fuzzy logic techniques for real time applications. **[*Usage]***

UNIT I INTRODUCTION **L(9)**

Properties and operations on Classical and Fuzzy sets-Crisp and Fuzzy Relations-Cardinality, Properties and operations, Composition, Tolerance and Equivalence relations,-Simple Problems. Membership functions: Features of membership functions-Standard forms and Boundaries-Fuzzyfication, membership value assignments, Fuzzy to Crisp Conversions, Lambda Cuts for fuzzy sets and relations, Defuzzzyfication methods**.**

UNIT II ARCHITECTURE **L(9)**

Typical Architecture, Common Activation Functions, McCulloch-Pitts Neuron, Learning Rules, Simple Neural Nets For Pattern Classification: Architecture, Biases and Thresholds, Linear Separability, Hebb Net-Perceptron-Adaline.

UNIT III TRAINING ALGORITHM **L(9)**

Training Algorithm for Pattern Association-Hebb rule and Delta Rule, Heteroassociative, Auto associative and Iterative Auto Associative Net, Bidirectional Associative Memory- Storage and Retrieval Algorithms-Neural Network based on Competition: Fixed weight Competitive Nets-Kohonen Self-Organizing Maps-Linear vector Quantization.

UNIT IV ADAPTIVE RESONANCE NEURAL NETWORKS **L(9)**

Adaptive Resonance Neural networks: ART1 and ART2-Basic operation and Algorithm, BackPropagation Neural Net- Boltzman Machine Learning-Neocognitron-Architecture,

Algorithms.	
UNIT V ADAPTIVE RESONANCE NEURAL NETWORKS	**L(9)**
Adaptive Resonance Neural networks: Pattern Recognition-Image Compression-Communication-Control systems. Application of Fuzzy Logic: Fuzzy Clustering-Fuzzy pattern Recognition-Fuzzy Image Processing-Fuzzy Databases-Fuzzy Information retrieval.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL : 0 TOTAL: 45	
Reference Books	
1	Laurene Fausett, "**Fundamentals of Neural Networks",** Pearson Education India, 2008.
2	Timothy J.Ross, "**Fuzzy Logic with Engineering Applications**", John Wiley and sons Pvt.Ltd. 2010.
3	J. A. Freeman and B. M. Skapura, "**Neural Networks, Algorithms applications and Programming Techniques**", Pearson, 2002.
4	Klir G.J. and Folger.T, "**Fuzzy sets,Uncertainty and Information**", Prentice Hall, 1991.
5	Zimmermann.H. J, "**Fuzzy Set Theory and its Applications**", Fourth Edition, Kluwer Academic Publishers, Dordrecht, Germany, 2013.
6	Zurada J.M. "**Introduction to Artificial Neural Systems**", Jaico Publishing House, 1994.
7	James J. Buckley and Esfandiar Eslami, "**Advances in Soft Computing-An Introduction to Fuzzy Logic and Fuzzy Sets**", Springer International Edition, New Delhi,2011.

16CSPE19 DISTRIBUTED NETWORK ALGORITHMS

L	T	P	C
3	0	0	3

***COURSE OBJECTIVES*- Upon completion of this course the students will be familiar with:**

- *The principles and practice in the area of Distributed Systems.*
- *Vertex coloring, leader Election, Maximal independent set, dominating set, locality lower bounds distributed network algorithm.*
- *Distributed routing algorithms*
- *Distributed Fault-tolerance, consensus and Leader Election*
- *The various real-world distributed network algorithms applications.*

COURSE OUTCOMES-Upon Completion of the course the students will be able to

CO1: Explain the basic concepts, framework and model of Distributed Computing. ***[Familiarity]***.

CO2: Analyse the vertex coloring, leader Election , Maximal independent set , dominating set, locality lower bounds distributed network algorithm.***[Usage]***

CO3: Analyse the basic concepts of routing, routing strikes back, distributed approximation algorithms, Synchronization and Self-Stabilization. ***[Usage]***

CO4: Explain the Fault-tolerance, consensus and Leader Election. Multi-core computing – Byzantine Agreement distributed network algorithms***[Familiarity]***.

CO5: Explain the basic concepts, model and Algorithmic issues of real-world distributed networks. ***[Familiarity]***.

UNIT I INTRODUCTION **L(9)**

Distributed Computing – Framework -Fundamental issues in distributed computing: communication, limited knowledge, failures, timing, and synchrony ad algorithmic and programming difficulties. Distributed computing models: shared memory versus message passing, synchronous versus asynchronous, CONGEST versus LOCAL; Complexity measures - time and message complexity. Topology & routing - Basic algorithms: Broadcast, Convergecast, Upcast, Downcast. Tree Algorithms: Spanning Tree, Minimum Spanning Tree.Distributed Shortest Paths Algorithms : Bellman-Ford Algorithm

UNIT II DISTRIBUTED NETWORK ALGORITHMS -I **L(9)**

Symmetry breaking: Randomization -Vertex coloring – Leader Election – Distributed sorting – shared Memory –Shared Objects –Maximal Independent set – Dominating Set –Locality Lower bounds – Social Networks.

UNIT III DISTRIBUTED NETWORK ALGORITHMS -II **L(9)**

Routing: Array –mesh –Hot-potato Routing –Shortest path routing – compact routing –other routing schemes – Routing Strikes Back-Distributed approximation algorithms - Synchronization – Hard problems –stabilization: Self-Stabilization –Advanced stabilization– Labeling Schemes -All-to-all Communication.

UNIT IV DISTRIBUTED NETWORK ALGORITHMS -III	**L(9)**
Asynchronous systems : synchronizers –logical time –global snapshots – Fault-tolerance: Fundamental algorithms under failure and adversarial models – consensus and Leader Election. Multi-core computing -Byzantine Agreement -Authenticated Agreement - Distributed Storage.	
UNIT V REAL-WORLD DISTRIBUTED NETWORKS	**L(9)**
Peer-to-peer and dynamic networks : Models and Algorithmic issues– Wireless and Sensor networks: Models and Algorithmic issues – Distributed processing of Large –scale data: Models and Algorithmic issuesin systems such as MapReduce Algorithms and Pregel – Overlay Design- datacenter networks – Virtual networks – Software-defined networks.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL: 0 TOTAL: 45	
Reference Books	
1	David Peleg, "**Distributed Computing: A Locality Sensitive Approach**",SIAM, Philadelphia.,2000.
2	K. Erciyes , "**Distributed Graph Algorithms for Computer Networks**" Springer-Verlag London , 2013.
3	Stefan Schmid and parathasarathi mandal, " **Lecture notes for GIAN course on Distributed network Algorithms**",2016.*https://www.net.t-labs.tu-berlin.de/~stefan/NetAlg13.pd*
4	Roger Watten hofer ," **Distributed ComputingNotes**" http://www. dcg.ethz.ch/lectures/podc/
5	Nancy Lynch," **Distributed Algorithms**", Morgan Kaufmann Publishers Inc., San Francisco, CA, USA, 1996.
6	Gerard Tel," **Introduction to Distributed Algorithms**", second edition. Cambridge University Press, 2000.
7	Robert Sedgewick and Kevin Wayne,**"Algorithms",** fourth edition , Pearson Education ,2011.
8	T. H. Cormen, C. E. Leiserson, R. Rivest, and C. Stein. ***Introduction to Algorithms***. MIT Press, 2009
9	Research Papers published in IEEE, ACM, Elsevier publishers, etc.

16CSPE20 PERVASIVE COMPUTING

	L	T	P	C
	3	0	0	3

COURSE OBJECTIVES: Upon completion of this course the students will be familiar with:

- *Vision of Ubiquitous computing and smart devices.*
- *Human computer interaction.*
- *Intelligent systems and their interactions with artificial world.*
- *Managing communications among smart devices in the ubiquitous world.*
- *Cognitive networks and its future research.*

***COURSE OUTCOMES*-Upon completion of this course the students will be able to:**

CO1: Explain architectural design and service models for UbiCom Systems. **[Familiarity]**

CO2: Analyze interactions between UbiCom devices, devices and people (HCI), devices and the physical world. **[Assessment]**

CO3: Explain intelligent system architectures, autonomous intra systems and self aware systems. **[Familiarity]**

CO4: Use smart devices in virtual environment, establish communications and manage ubiquitous networks.**[Usage]**

CO5: Explain design issues and research challenges in cognitive networks. **[Familiarity]**

UNIT I SMART DEVICES AND SERVICES **L(9)**

Vision of ubiquitous computing, Modeling the Key Ubiquitous Computing Properties, Ubiquitous System Environment Interaction, Architectural Design for UbiCom Systems: Smart DEI Model, Smart Devices and Services, Service Architecture Models, Service Provision Life-Cycle, Virtual Machines and Operating Systems, Smart Mobiles, Cards and Device Networks, Smart Mobile Devices, Users, Resources and Code, Operating Systems for Mobile Computers and Communicator Devices, Smart Card Devices, Device Networks.

UNIT II HUMAN–COMPUTER INTERACTION **L(9)**

User Interfaces and Interaction for Four Widely Used Devices, Hidden UI Via Basic Smart Devices, Hidden UI Via Wearable and Implanted Devices, Human-Centered Design (HCD), User Models, Tagging, Sensing and Controlling - Sensors and Sensor Networks, Micro Actuation and Sensing: MEMS, Embedded Systems and Real-Time Systems, Control Systems (for Physical World Tasks), Robots, Context-Aware Systems – Mobility, Spatial and Temporal Awareness.

UNIT III INTELLIGENT SYSTEMS **L(9)**

Introduction, IS Architectures, Semantic KB IS, Soft Computing IS Models, IS System Operations, Intelligent System Interaction - Interaction Multiplicity, Interaction Design, Generic Intelligent Interaction Applications, Autonomous Systems - Basic Autonomous

Intra-Acting Systems, Reflective and Self-Aware Systems, Autonomic Computing, Complex Systems, Artificial Life.	
UNIT IV UBIQUITOUS COMMUNICATION	**L(9)**
Audio Networks, Data Networks, Wireless Data Networks, Universal and Transparent Audio, Video and Alphanumeric Data Network Access, Ubiquitous Networks, Management of Smart Devices, Managing Smart Devices in Virtual Environments, Managing Smart Devices in Human User-Centered Environments, Managing Smart Devices in Physical Environments, Ubiquitous System: Challenges and Outlook, Smart Physical Environment Device Interaction, Human Intelligence Versus Machine Intelligence	
UNIT V COGNITIVE NETWORKS	**L(9)**
Introduction to Biologically Inspired Networking, The road map to Cognitive networks, Vision of Cognitive networks, Cognitive network design, The Role of Autonomic Networking in Cognitive Networks – Future research in cognitive networks, Adaptive Networks and Self-Managing Networks –design issues and research challenges.	
LECTURE: 45 TUTORIAL: 0 PRACTICAL: 0 TOTAL: 45	
References	
1	Stefan Poslad, "**Ubiquitous Computing: Smart Devices, Environments and Interactions**", Wiley, 2009.
2	Qusay Mahmoud, **"Cognitive Networks: Towards Self-Aware Networks**", Wiley 2007.
3	Mohammad S .Obaidat et al, "**Pervasive Computing and Networking**",John Wiley, 2007.
4	Frank Adelstein Sandeep K. S. Gupta Golden G. Richard III Loren Schwiebert "**Fundamentals of Mobile and Pervasive Computing**, ", McGraw-Hill, 2005.

16CSOC1 PYTHON PROGRAMMING				
	L	**T**	**P**	**C**
	1	**0**	**0**	**1**

COURSE OBJECTIVES: Upon completion of this course the students will be familiar with:

- *Basics of python programming*
- *Fundamental programming concepts including data structures, networked application program interfaces, and databases, using the Python programming language.*
- *Scrape, parse, and read web data as well as access data using web APIs.*
- *Basic database design for storing data as part of a multi-step data gathering, analysis, and processing effort using SQLite3 as its database.*
- *Basic web site design using Django web framework*

***COURSE OUTCOMES*-Upon completion of this course the students will be able to:**

CO1: Explain the basic concepts of python programming **[Familiarity].**

CO2: Discuss the Fundamental programming concepts including data structures, networked application program interfaces, and databases, using the Python programming language **[Familiarity]**

CO3: Explain the step to access web data using python **[Familiarity]**

CO4: Apply the Network programming concepts using Python **[Usage]**

CO5: Implement, troubleshoot and debug SQLite3 database through hands on illustrations**[Usage].**

CO6: Create a dynamic website using django **[Usage]**

Lecture 1 – Downloading and installing Python, Basics of Python -Assignment statement, basic types – int ,foat ,bool

Lecture 2- Variables and Expressions

Lecture 3 – Strings, Lists -Manipulating List, User defined List, Sets

Lecture 4 – Control Flow

Lecture 5 – Functions, rage()

Lecture 6 – Function definitions - Global scope, nested functions

Lecture 7- Tuples and dictionaries

Lecture 8 – List Comprehension - Exception Handling

Lecture 9 – Standard input and Output , Formatting printed output, Handling files Lecture 10 – Abstract data types , Classes and objects in Python Lecture 11 – Regular Expressions Lecture 12 - Databases and Visualization Lecture 13 – Networks and sockets - Reading Web Data from Python Lecture 14 - Django : The web framework Lecture 15 - Create a Dynamic Website using Django
LECTURE: 15 TUTORIAL: 0 PRACTICAL: 0 TOTAL: 15

References

1	Richard L. Halterman, "**LEARNING TO PROGRAM WITH PYTHON**", Southern Adventist University 2011.
2	https://www.djangoproject.com/
3	https://pythonprogramming.net/django-web-development-with-python-intro/