



MANAV RACHNA UNIVERSITY

FACULTY OF ENGINEERING DEPARTMENT OF COMPUTER SCIENCE & TECHNOLOGY

PROGRAM STRUCTURE & DETAILED SYLLABUS

**M.Tech. Computer Engineering
BATCH: 2016-2018**



MANAV RACHNA UNIVERSITY
DEPARTMENT OF COMPUTER SCIENCE & TECHNOLOGY
M.TECH-CE (CSP01)

SEMESTER - 1										
SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
CSH501-T	ADVANCED ALGORITHMS	CS	HARD	CORE	3	0	0	0	3	3
CSH501-P	ADVANCED ALGORITHMS LAB	CS	HARD	CORE	0	0	2	1	2	2
CSH502-T	MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE	CS	HARD	CORE	3	0	0	0	3	3
CSH502-P	MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE LAB	CS	HARD	CORE	0	0	2	1	2	2
CSH503-T	SYSTEM ENGINEERING	CS	HARD	CORE	3	0	0	0	3	3
CSH-503-P	SYSTEM ENGINEERING LAB				0	0	2	1	2	2
CSH504-T	ARTIFICIAL INTELLIGENCE AND ARTIFICIAL NEURAL NETWORKS	CS	HARD	Elective	3	0	0	0	3	3
CSH505-T	ADVANCED COMPUTER NETWORKS									
CSH506-T	NO SQL DATABASE MODELS									
CSH505-P	ADVANCED COMPUTER NETWORKS LAB	CS	HARD	Elective	0	0	2	1	2	2
CSH504-P	ARTIFICIAL INTELLIGENCE AND ARTIFICIAL NEURAL NETWORKS LAB									
CSH506-P	NO SQL DATABASE MODELS LAB									
PH5501	RESEARCH METHODOLOGY	CS	SOFT	CORE	1	0	2	0	3	2
CSW507	AGILE TECHNOLOGIES	CS	WORKSHOP	CORE	0	0	3	0	3	2
CSW508	MATLab	CS	WORKSHOP	CORE	0	0	3	0	3	2
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					13	0	16	4	29	26

SEMESTER - 2										
SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
CSH509-T	INFORMATION SECURITY	CS	HARD	CORE	3	0	0	0	3	3
CSH509-P	INFORMATION SECURITY LAB	CS	HARD	CORE	0	0	2	1	2	2
CSH510-T	USER EXPERIENCE	CS	HARD	CORE	3	0	0	0	3	3
CSH510-P	USER EXPERIENCE LAB	CS	HARD	CORE	0	0	2	1	2	2
CSH511-T	MACHINE LEARNING	CS	HARD	ELECTIVE	3	0	0	0	3	3
ECH618-T	WIRELESS MOBILE COMMUNICATION	EC								
CSH512-T	OBJECT ORIENTED SOFTWARE ENGINEERING	CS								
CSH511-P	MACHINE LEARNING LAB	CS	HARD	ELECTIVE	0	0	2	1	2	2
ECH618-P	WIRELESS MOBILE COMMUNICATION LAB	EC								
CSH512-P	OBJECT ORIENTED SOFTWARE ENGINEERING LAB	CS								

CSH513-T	SOFT COMPUTING	CS	HARD	ELECTIVE	3	0	0	0	3	3
ECH441-T	WIRELESS SENSOR NETWORKS	EC								
CSH514-T	BUSINESS INTELLIGENCE	CS	HARD	ELECTIVE	0	0	2	1	2	2
CSH513-P	SOFT COMPUTING LAB	CS								
ECH441-P	WIRELESS SENSOR NETWORKS LAB	EC								
CSH514-P	BUSINESS INTELLIGENCE LAB	CS								
CSS515	WRITING RESEARCH PAPERS	CS	SOFT	CORE	1	0	2	0	3	2
CSW516	SOFTWARE PROJECT MANAGEMENT	CS	WORKSHOP	CORE	0	0	3	0	3	2
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					13	0	13	3	26	24

CSO517	SUMMER TRAINING POST 2nd SEMESTER									6
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SEMESTER - 3

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
CSH601-T	CLOUD COMPUTING	CS	HARD	CORE	3	0	0	0	3	3
CSH601-P	CLOUD COMPUTING LAB				0	0	2	1	2	2
CSH602-T	IMAGE PROCESSING AND PATTERN RECOGNITION	CS	HARD	ELECTIVE	3	0	0	0	3	3
CSH603-T	MOBILE SOFTWARE									
CSH604-T	DATA MINING	CS	HARD	ELECTIVE	0	0	2	1	2	2
CSH602-P	IMAGE PROCESSING AND PATTERN RECOGNITION LAB									
CSH603-P	MOBILE SOFTWARE LAB									
CSH604-P	DATA MINING LAB									
CSH605-T	EVOLUTIONARY COMPUTING	CS	HARD	ELECTIVE	3	0	0	0	3	3
CSH606-T	DISTRIBUTED AND MOBILE ARCHITECTURE									
CSH607-T	BUSINESS ANALYTICS WITH R									
CSH605-P	EVOLUTIONARY COMPUTING LAB	CS	HARD	ELECTIVE	0	0	2	1	2	2
CSH606-P	DISTRIBUTED AND MOBILE ARCHITECTURE LAB									
CSH607-P	BUSINESS ANALYTICS WITH R LAB									
PHS522	PEDAGOGICAL SKILLS	CS	SOFT	CORE	1	0	2	0	3	2
CSW608	SOFTWARE TESTING	CS	WORKSHOP	CORE	0	0	3	0	3	2
CSW609	NETWORK SIMULATOR 3	CS	WORKSHOP	ELECTIVE	0	0	3	0	3	2
CSN610	DISSERTATION PROJECT (STAGE I)	CS	NTCC	CORE	0	0	12	0	0	3
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					7	0	12	2	19	24

SEMESTER - 4

SUBJECT CODES	SUBJECT NAME	**OFFERING DEPARTMENT	*COURSE NATURE (Hard/Soft/ Workshop/ NTCC)	COURSE TYPE (Core/Elective / University Compulsory)	L	T	P	O	NO. OF CONTACT HOURS PER WEEK	NO. OF CREDITS
CSH611-T	BIG DATA	CS	HARD	CORE	3	1	0	1	3	3
CSH611-P	BIG DATA LAB	CS	HARD	CORE	0	0	2	0	2	2
CSS612	PROFESSIONAL AND ETHICAL ISSUES	CS	SOFT	CORE	1	0	2	0	3	2
CSN613	DISSERTATION	CS	NTCC	CORE	0	0	12	0	2	
TOTAL (L-T-P-O/CONTACT HOURS/CREDITS)					14	5	13	0	10	19

Total Credits for the Program	99
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*COURSE NATURE	Hard course (H): A course having L-T-P and/or O component ; L(Lecture), T(Tutorial), P(Practical)
	Soft Course (S): A course aimed at development of a person's emotional, social, ethical, professional
	Workshop course(W): A completely 'hands on' course conducted in laboratory, aimed at developing
	Non Teaching Credit Course(N): The course involves no teaching and has P and O component. Shall

**OFFERING DEPARTMENT NAMES				A course shall be assigned credits as
EC	DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING			
CS	DEPARTMENT OF COMPUTER SCIENCE & TECHNOLOGY			
*** Electives are subject to change according to expertise available/ required.				

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PROGRAMME BOOKLET

M.Tech. CE (CSP01)

(2016-2018)

Department of Computer Science and Technology

Manav Rachna University

MANAV RACHNA UNIVERSITY

Vision

To educate students in frontier areas of knowledge enabling them to take up challenges as ethical and responsible global citizens

Mission

- To impart outcome based holistic education
- To disseminate education in frontier areas
- To produce globally competitive, ethical and socially responsible human resources
- To produce human resources sensitive to issues of Environment and Sustainable Development
- To develop Environment and Sustainable development as a thrust area of research and development.

Quality Policy

To continuously learn from the best practices, study role models and develop transparent procedures for empowerment of stakeholders.

Strategic Objectives

- To facilitate, enhance & promote innovation in curriculum design and delivery and have Outcome-oriented Learning Culture.
- To promote Research Environment and Management Practices.
- To enhance the quality of the student learning experience.
- To provide Resources and Infrastructure for Academic Excellence.

DEPARTMENT OF COMPUTER SCIENCE & TECHNOLOGY

Vision

To be quality conscious, research-centric, and change-oriented technological leader in the relevant areas.

Department Mission

- To develop and impart knowledge and skills in the field of Computer Science and Engineering.
- To encourage and support the generation and implementation of innovative ideas.
- To focus on new techniques, tools, and technology, in an ethical and responsible manner.
- To carry out collaborative interdisciplinary Academic and Research activities with a focus on Sustainable Development.
- To create employment-ready human resources.

Program Educational Objectives

Core Competency: To inculcate analytical, design and implementation skills required to provide software solutions in industry.

Breadth: To groom graduates to innovate, design and develop products to provide sustainable solutions to contemporary societal and business problems.

Professionalism: To instill the ability to work in teams, communicate effectively and lead as ethically and socially responsible professionals and entrepreneurs.

Lifelong Learning: To foster the ability of lifelong learning to constantly adapt to emerging technologies, to pursue higher education and instill life skills for a successful career.

Program Outcomes (PO's)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSO's)

1. **PSO1:** Design and develop computer programs and possess acquaintance with emerging technologies and open-source platforms in the area of mobile app development, artificial intelligence, machine learning, web development, data analytics, cloud computing , networking , cyber security , gaming and animation to build effective computer-based systems.
2. **PSO2:** Acquire technical competency to deliver computer-based innovative and effective solutions to tackle business and societal challenges, for pursuing successful career, entrepreneurship, research and higher studies.

CSP01- Semester-I

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS				CREDITS
				L	T	P	O	
		Core(Departmental/Allied)/ Elective (Departmental/ Open) / University Compulsory	Hard/Soft/ Workshop/ NTCC					
CSH501-T & CSH501-P	Advanced Algorithms	Domain Core	Hard	3	0	2	1	5
CSH502-T & CSH502-P	Mathematical Foundation Of Computer Science	Domain Core	Hard	3	0	2	1	5
CSH503-T & CSH503-P	System Engineering	Domain Core	Hard	3	0	2	1	5
CSH504 -T & CSH504-P	Artificial Intelligence and Artificial Neural Networks	Domain Elective	Hard	3	0	2	1	5
CSH505-T & CSH505-P	Advanced Computer Networks	Domain Elective	Hard	3	0	2	1	
CSH506-T & CSH506-P	No SQL Database Models	Domain Elective	Hard	3	0	2	1	
CSW507-T & CSH507-P	Agile Technologies	Domain Core	Workshop	0	0	3	0	
CSW508	MATLAB	Domain Core	Workshop	0	0	3	0	2
PHS501	Research Methodology	Allied Core	Soft	1	0	2	0	2
		Total Credits		13	0	16	4	26

CSP01- Semester-II

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS				CREDITS
				L	T	P	O	
		Core(Departmental/Allied)/ Elective (Departmental/ Open) / University Compulsory	Hard/Soft/ Workshop/ NTCC					
CSH509-T & CSH509-P	Information Security	Domain Core	Hard	3	0	2	1	5
CSH510-T & CSH510-P	User Experience	Domain Core	Hard	3	0	2	1	5
CSH511-T & CSH511-T P	Machine Learning	Domain Elective	Hard	3	0	2	1	5
ECH617-T & ECH617-P	Wireless & Mobile Communication	Allied Elective	Hard	3	0	2	1	
CSH512-T & CSH512-P	Object Oriented	Domain Elective	Hard	3	0	2	1	

	Software Engineering							
CSH513-T & CSH513-P	Soft Computing	Domain Elective	Hard	3	0	2	1	5
ECH441-T & ECH441-P	Wireless Sensor Networks	Allied Elective	Hard	3	0	2	1	
CSH514-T & CSH514-P	Business Intelligence	Domain Elective	Hard	3	0	2	1	
CSW517	Software Project Management (group agile)	Domain Core	Workshop	0	0	3	0	2
CSS515	Writing Research Papers	Domain Core	Soft	1	0	2	0	2
		Total Credits		13	0	13	0	24
CSO517	SUMMER TRAINING POST 2nd SEMESTER							6

CSP01- Semester-III

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS				CREDITS
				L	T	P	O	
CSH618-T & CSH618-P	Cloud Computing	Domain Core	Hard	3	0	2	1	5
CSH619-T & CSH619-P	Image Processing and Pattern Recognition	Domain Elective	Hard	3	0	2	1	5
CSH620 -T & CSH620-P	Mobile Software	Domain Elective	Hard	3	0	2	1	
CSH621-T & CSH621-P	Data Mining	Domain Elective	Hard	3	0	2	1	
CSH622-T & CSH622-P	Evolutionary computing	Domain Elective	Hard	3	0	2	1	5
CSH623-T & CSH623-P	Distributed and Mobile Architecture	Domain Elective	Hard	3	0	2	1	
CSH624-T & CSH624-P	Business Analytics with R	Domain Elective	Hard	3	0	2	1	
CSW516	Network Simulator 3	Domain Core	Workshop	0	0	3	0	2
CSW625	Software Testing	Domain Core	Workshop	0	0	3	0	2
CSN626	Dissertation Project (Stage I)	Domain Core	NTCC	0	0	3	0	3
PHS522	Pedagogical Skills	Allied Core	Soft	1	0	2	0	2
		Total Credits		10	0	17	7	24

CSP01- Semester-IV

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS				CREDITS
				L	T	P	O	
		Core(Departmental/Allied)/ Elective (Departmental/ Open) / University Compulsory	Hard/Soft/ Workshop/ NTCC					
CSH627-T & CSH627-P	Big Data	Domain Core	Hard	3	0	2	1	5
CSN628	Dissertation (0-0-12)	Domain Core	NTCC	0	0	12	0	12
CSS629-T & CSS629-P	Professional and Ethical Issues	Allied Core	Soft	1	0	2	0	2
Total Credits				4	0	16	1	19

Total Credits Scheme

S. No.	Semester	Credits
1	I	26
2	II	24
3	SUMMER TRAINING (POST 2 nd SEMESTER)	6
4	III	24
6	IV	19
Total		99

DETAILED SYLLABUS

CSP01- Semester-I

Course Title/ Code	Advanced Algorithms(CSH501-T & CSH501-P)
Course Type	Core
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	Students will be able to understand the properties and efficiency of algorithms as a function of its input size in terms of both time and memory.

Section-A

Introductory Concepts: Introduction to Algorithms, Time and Space Complexity, Solving recurrence equations. Design Paradigms Overview: Overview of Iterative, Divide and Conquer, Greedy and Dynamic Programming strategies.

Section-B

String Matching and Radomized Algorithms: Introduction to string-matching problem, Naïve algorithm, Rabin Karp, Knuth Morris Pratt, Boyer-Moore algorithms and complexity analysis. Random numbers, randomized quick sort,randomly built binary search tree.

Graph Algorithms: Basic search and traversal techniques for graphs, Backtracking, Branch and Bound.

Section-C

Parallel and Max Flow Algorithms: Introduction to parallelism, PRAM models, speedup and efficiency, some PRAM algorithms and their parallel time and processors complexity, merging and sorting, handling writing conflicts, finding connected components, Min-Cut Max-Flow algorithms.

Section-D

Complexity Theory and Approximation Algorithms: P, NP and NP-Complete complexity classes; A few NP-Completeness proofs; Introduction to approximation, absolute approximation, e-approximation, Combinatorial Optimization, approximation factor, Polynomial time approximation schemes(PTAS), fully polynomial time approximation schemes (FPTAS), Approximation algorithms for vertex cover, set cover, TSP, knapsack, bin packing, subset-sum problem etc. Analysis of the expected time complexity of the algorithms.

List of Experiments

1. To implement divide and conquer technique on a suitable problem.
2. To implement knapsack problem using Greedy and dynamic approach.
3. To implement knapsack problem using branch and bound technique.
4. To implement Rabin Karp string matching algorithm.
5. To implement KMP string matching algorithm.
6. To implement randomized quick Sort algorithm.
7. To find connected components in a graph.
8. To implement Max Flow algorithm.
9. To implement Vertex Cover problem using approximation algorithm.
10. To implement TSP problem using approximation algorithm.

Text Books:

1. Introduction to Algorithms: T.H. Cormen, C.E. Leiserson and R.L. Rivest
2. Fundamentals of Algorithms: G. Brassard and P. Bratley

Reference Book:

1. Approximation Algorithms: Vijay V. Vazirani
2. Randomized Algorithms: R. Motwani and P. Raghavan
3. Reference book: Algorithms: The spirit of computing: D. Harel
4. Fundamental of Computer algorithms, Ellis Horowitz and Sartaj Sahni, 1978, Galgotia Publ.

Course Title/ Code	Mathematical Foundation in Computer Science (CSH502-T & CSH502-P)
Course Type	Core
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	The student will understand concepts in theoretical computer science and their interconnection.

Section-A

Mathematical notions and Terminology of sets,function, relation, logic.

Finite Automaton: - Finite State Systems, Representation of finite automaton, N DFA, DFA, Equivalence of DFA and N DFA. Removals of ϵ – moves from finite automata's, Minimization of finite Automata. Moore and mealy Machines, Properties and limitations of FSM,

Regular Expressions: - basic operation of regular expression, Equivalence of finite automata and Regular Expressions, Arden's Method. The Pumping Lemma for Regular Sets.

Section-B

Context free grammar: - Basic concept of CFG: tuples, production rules, derivation, parse tree, Ambiguity, left recursion, left factoring. Equivalence of CFL and CFG, Reduced forms, Removal of useless Symbols and unit production. Chomsky Normal Form (CNF), Griebach Normal Form (GNF). Pumping lemma for CFL.

Pushdown Automata: - stack, input tape, R/W head. NDPDA, DPDA, Representation of PDA, Equivalence of PDA and Context free Grammar, acceptability of string. Application of Pushdown Machines.

Section-C

Recursively Enumerable Grammar: - Basic concept of REG and REL, context sensitive grammar. Equivalence of REL and REG.

Turing Machines:- Basic concept of TM: tuples, transition function, Deterministic and Non-Deterministic Turing Machines, universal turing machine, Design of T.M. Halting problem of T.M., computing with turing machines. Chomsky hierarchy.

Section-D

Decidability:-Decidable problems concerning to CFL. The halting problems: Diagonalization method

Reducibility: -Undecidable problems from language theory. Post Correspondence Problem

Computability: - Primitive Recursive Functions.

List of Experiments

1. Regular expression
2. Finite Automaton
3. Identify and remove Left Recursion
4. Pushdown Automaton Lexical Analyzer
5. First and Follow

6. Turing machines
7. Decidability

Text Books:

1. The Theory of Computer Science (Automata, Language and Computation), K.L.P. Mishra, 2nd Edition, Prentice Hall Of India, 2001.
2. Introduction to Automata Theory, Languages and Computation, - J.E. Hopcroft, and J.D. Ullman, 2nd Edition, Pearson Education

Reference Books:

1. An Introduction to Formal Languages And Automata, - Peter Linz, Narosa Publishing House, 2007.
2. Introduction to Languages and the Theory of Computation, - John C. Martin, 3rd edition, McGraw-Hill Inc, New York, 2003.

Course Title/ Code	System Engineering (CSH503-T & CSH503-P)
Course Type	Core
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	The students will be able to study the concepts of system engineering and focus on system Modeling using SysML and UML Modeling languages.

Section-A

Introduction to Systems: System Definitions and elements, classification of systems, Technology and Technical Systems, Transition to system age, System Engineering, System Life-Cycle Engineering, System Engineering process, System Engineering Fields and Approaches, Systems Engineering Activities And Products, System design considerations, System Synthesis - Analysis and Evaluation, Implementing System Engineering.

Section-B

System Design process: Conceptual System Design (problem definition, need identification, Design and Feasibility Analysis, Operation Requirements, Maintenance, performance measures, Functional Analysis), Preliminary System Design (requirement-development-product-process and material specifications, Functional Analysis, Design criteria, design engineering activities, design review and evaluation), Detail design and development (requirements, evolution, integrating system elements & Activities, design tool, prototype development), System Test – Evaluation and Validation of design process.

Section-C

System Modeling: Model based system engineering, System function specifications, Unified Modeling Language (UML), UML 2, System modeling language (SysML) , SysML diagrams: Activity diagram, Use case diagram, Sequence diagram, Timing Diagram, State machine diagram, Block Definition diagram, Package diagram, Requirement diagram, Parametric diagram. UML2 vs. SysML.

Decision analysis and support – Decision making, modeling throughout system development, modeling for decisions, Trade-off analysis, and Evaluation methods.

Section-D

Software System Engineering: Nature of Software development, Software System Engineering Process, Software development life cycle models, Software analysis and design, software engineering development, Software integration and testing, Software engineering management.

List of Experiments

1. Introduction to Unified Modeling Language (UML) and UML 2 and Visual paradigm for UML Software as a CASE Tool.
2. Behavior diagrams in UML (Refer www.omg.sysml.org).

3. Modeling behavior with UML: Activity diagram, Use case Diagram, State chart modeling and Interaction Diagram.
4. Modeling Structure with UML: Class diagram, Object diagram, deployment diagram.
5. Package diagram in the UML 2 language.
6. System modeling language using Visual Paradigm tool- Introduction.
7. Modeling diagrams of SYSML. (www.omgsysml.org)
8. Modeling behavior with SysML: Activity diagram.
9. Modeling Structure with SysML: Block definition diagram, Internal block diagram.
10. Requirement diagram and Parametric diagram in SysML.

Text Books:

1. System Engineering & Analysis, Benjamin S. Blanchard and Wolter J. Fabrycky, Pearson.
2. Alexander Kossakoff, William N Sweet, Systems Engineering: Principles and Practice, Wiley India, 2010

Reference Books:

1. Dennis M Beude, The engineering Design of Systems: Models and Methods, Wiley India, 2006
2. SysML tool available at: www.omgsysml.org
3. UML vs SysML : www.visual-paradigm.com/features/uml-and-sysml-modeling

Course Title/ Code	Artificial Intelligence and Artificial Neural Networks(CSH504-T & CSH504-P)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	<ul style="list-style-type: none"> • Solve computationally complex problems using artificial intelligence techniques. • Implement Artificial Neural Networks for solving

Section-A

Basics of Artificial Intelligence: Introduction to AI, AI Techniques, AI Problems, Problem Spaces and Search, Blind Search, Heuristics Search Techniques,

Knowledge Representation: Issues, Approaches to Knowledge Representation: Logic, Weak Slot and filler structures(Semantic Nets, Partitioned Semantic Nets, Frames, Thematic Role Frames), Strong Slot and filler Structures(Conceptual Dependency, Scripts), Natural deduction and Resolution.

Reasoning: Reasoning under Uncertainty, Statistical Reasoning.

Application areas: Expert System, Application area of Expert System.

Section-B

Basics of Artificial Neural Networks, Synaptic Dynamics: Artificial Neural Networks (ANN), Biological inspiration, Basic terminology related to an Artificial Neuron: Dendrite, synapses and their weights, pre- and post-synaptic signals, activation potential, activation function and its types, Excitatory and inhibitory synapses, the biasing input. Mathematical Fundamentals of ANN: Encoding (training phase) and decoding (active phase).Taxonomy of neural networks: feed-forward, feedback and recurrent networks with supervised and unsupervised learning laws.

Perceptron: The Perceptron and its learning law, Classification of linearly separable patterns, Multi-category Single Layer Perceptron Networks, Limitations of Single Layer Perceptrons. Adaline and Madaline Networks.

Section-C

Multilayer Feedforward Networks: Linearly Non-separable Pattern Classification, Delta Rule and Generalized Delta Learning Rule, Feedforward recall and Error Backpropagation Training, Learning Factors, Applications of feedforward networks, Limitations of Backpropagation Learning, Supervised Learning as Optimization Problem.

Radial Basis Function Networks: Introduction, Cover's theorem on separability of patterns, Interpolation Problem, Regularization Theory and Regularization Networks, Generalized RBF, Approximation properties of RBF Networks, Comparison of RBF and Multilayer Perceptrons.

Section-D

Associative Memories: Basic Concepts, Linear Associative, Recurrent Auto associative Memory and its performance analysis, Bidirectional Associative Memory, Associative Memory of Spatio-temporal patterns.

Recurrent networks:Hopfield networks.

Matching and Self-Organising Networks:Hamming Net, MAXNET, Unsupervised learning of clusters, counterpropagation networks, feature mapping, Self-Organizing Feature Maps, Cluster Discovery Network (ART1).

List of Experiments

1. Study of PROLOG.
2. Implementation of facts and rules.
3. PROLOG code for solving an AI Problem.
4. PROLOG code for solving an AI Problem.
5. Write a program to implement an Expert System.
6. Basic programs to implement Neural Networks and generating activation functions used in neural networks.
7. Problems based on Perceptrons.
8. Problems based on Adaline Networks.
9. Problems based on Madaline Networks
10. Problems based on FeedForward networks.
11. Problems based on Back Propagation networks.
12. Problems based on RBF networks.
13. Problems based on Associative Memory.
14. Problems based on Hopfield Networks.
15. Problems based on SOFM.

Text Books:

1. Elaine Rich, Kevin Knight, Shivashankar B. Nair, Third Edition,Artificial Intelligence, TMH.
2. Jacek M. Zurada, "Introduction to Artificial Neural Systems", JaicoPublishing House.
3. Simon Haykin, "Neural Networks.... A comprehensive foundation", Prentice Hall International, 2nd Edition 1999, ISBN 0-13-273350-1.

Reference Books:

1. S. Russel, P. Norvig, Artificial Intelligence – A Modern Approach", Pearson Education.
2. Simon Haykin, "Neural Networks.... A comprehensive foundation", Prentice Hall International, 3rd Edition 2007, ISBN 0-13-147139-2.
3. B. Yegnanarayana, "Artificial Neural Network", Prentice-Hall of India.

Course Title/ Code	Advanced Computer Networks(CSH505-T & CSH505-P)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	Students shall be able to learn about advanced networking techniques to use in analysis, modeling, design and operation of modern computer networks efficiently.

Section-A

Network Concepts - Requirements , Network architecture , Networking principles, Network services and Layered architecture, Network services and Layered architecture ,OSI and TCP/IP network model, Flow, Error and Congestion Control, Multiplexing.

Local Area Network Technologies: Channel Access Schemes, Aloha, Slotted Aloha, CSMA/CD, Fast Ethernet, Gigabit Ethernet, IEEE 802.11 WLAN, and Bluetooth, Connecting LANs, and VLANS, Token Ring.

Section-B

Frame Relay: Circuit switched networks and Packet switched networks, Frame relay architecture, Layered structure of Frame relay, Frame relay over LAN, Congestion Control.

Cell Relay and ATM:ATM features, Protocol Architecture, Virtual Channel and Virtual Paths, ATM Cells – Structure at UNI and NNI, Generic Flow Control, Header Error Control, ATM Services – CBR,VBR,UBR,ABR. ATM Layers. ATM Traffic Control: Connection Admission Control (CAC), Usage Parameter Control (UPC)- Virtual Scheduling Algorithm, Continuous State Leaky Bucket Algorithm, Traffic Shaping, IP Over ATM.

Section-C

Advanced Routing-I:IP addressing, CIDR addressing, introduction to Intra-domain and inter-domain routings Unicast Routing Protocols, Multicast Routing Protocols, Routing Protocol Basics, Routing Information Protocol (RIP), OSPF, BGP, IP switching and NAT and Virtual Private Networks.

Advanced Routing-II: Multi-Protocol Label Switching (MPLS), MPLS Architecture and Security in MPLS, Traffic Engineering (TE) and TE with MPLS, Mobile IP- characteristics, Mobile IP operation and Security related issues. Mobility in networks, IPv6: Why IPv6, basic protocol, extensions and options, support for QoS, security, etc.

Section-D

Distributed Systems: Naming, DNS, DDNS, Paradigms for Communication in Internet, Caching, Issues of Scaling in Internet and Distributed Systems, Caching Techniques for Web, Content Delivery Networks, Overlay and P2P Networks, Storage Area Network, overlay Networks.

Multimedia Networking: Requirements on Internet, Streaming Audio and Video – Access through Web Server, Real-Time Streaming Protocol (RTSP).Voice over IP, RSVP, Internet Phone-Packet Loss, End-to-End Delay, Delay Jitter, Fixed and Adaptive Play-out, RTP, RTCP and SIP protocol

List of Experiments

1. Study and Working of Network Devices in Detail.
2. Study of basic network command and Network configuration commands i.e. attributes like ipconfig, ping, Tracert, Pathping, Netstat, Arp, Netstate.
3. Sharing of Drive or folder over the Network, Sharing of printer over the network.
4. Program to create a chat server using socket programming.
5. Configure a Network topology using cisco packet tracer software and simulation of basic network commands.
6. Create a Local Area Network using Hubs and end devices(computer,servers,laptops etc.)
7. Create a Local Area Network using switch and end devices(computer,servers,laptops etc.)
8. Create a Local Area Network using switches, end devices(computer,servers,laptops etc.)and perform inter switch communication over the same networks.
9. Create a Local Area Network using switches, end devices(computer,servers,laptops etc.) and perform inter switch communication over the different networks using router.
10. Simulation of RIP protocol using CPT and perform Debugging.
11. Simulation of OSPF protocol using CPT and perform Debugging.
12. Simulation of EIGRP protocol using CPT and perform Debugging.
13. Track the network using a network management and monitoring tool such as wireshark.
14. Introduction to NS2 and its installation in Linux or windows environment.
15. Simulation of wired network using NS2.

Text Books:

1. Data Communications and Networking by ForouzanBehrouz A, TMH Publications.
2. Computer Networks (3rd edition), Tanenbaum Andrew S., International edition, 1996.
3. TCP/IP Protocol Suite by ForouzanBehrouz A., TMH Publications.
4. Data and Computer Communications BY William Stallings.

Reference Books:

1. Data Communications, Computer Networks and Open Systems (4th edition), Halsall Fred, 2000, Addison Wesley, Low Price Edition.
2. Computer Networking – ED Tittel, 2002, T.M.H.
3. Douglas E. Comer, "Internetworking with TCP/IP Vol –I", 5th Edition Publisher:Prentice Hall, 5th edition.
4. Larry L. Peterson, Bruce S , "Computer Networks: A Systems Approach", 4th edition, Davie Publisher: Elsevier/Morgan Kaufmann,

Course Title/ Code	NoSQL Database Model(CSH506-T & CSH506-P)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	Students will be able to create, design & construct database using NoSQL Database (Graph database).

Section-A

Introduction: Defining NoSQL, What and Why NoSQL? Relational Database (persistent data, concurrency, integration), Application & Integration databases, cluster attack. NoSQL storage types. Aggregate Data Model: (example, consequences), key-value and document data model, and column-family model, Neo4j- key concepts and characteristics, Neo4j installation process.

Section-B

Data Models: Relationships, Graph & Schema-less Databases, Materialized Views, Modeling for Data Access.
Distribution Models: (Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication).

Consistency: Update, Read, Relaxing Consistency, CAP Theorem, Relaxing Durability, Quorums.

Version Stamps: Business and System Transactions, Version Stamps on Multiple Nodes, Modeling data for Neo4j, Designing Graph databases on Neo4j.

Section-C

Map-Reduce: Basic, Partitioning & Combining, Composing Map-Reduce Calculations (Two Stage & Incremental Map-Reduce). **Key-Value Databases:** features (consistency, transactions, query, structure of data, scaling), Use cases, issue with key-value stores. Importing data into Neo4j, importing small(ish) datasets using Neo4j-shell-tools.

Section-D

Document Databases: introduction, features, use cases (event logging, content management systems, blogging platforms, web analytics or real-time analytics, e-commerce), problem in document databases.

Column-Family Stores: basic, features, use cases (event logging, counters, blog, content management), issues in column family.

Graph Databases: basics, features, use cases (connected data, routing, dispatch & location based services, engines), problem with graph database. **Visualizations for Neo4j-** open source visualization libraries. Other tools related to Neo4j- data integration tools and business intelligence tools.

List of Experiments

1. Create nodes of graph.
2. Create relationships between nodes.
3. Update the nodes and relationships.

4. Queries to fetch the data from the graph created.
5. Queries using the general clause.
6. Queries using the reading clause.
7. Queries using the Writing clause.
8. Queries using the Functions.

Text Books:

1. Pramod J. Sadalage, Marting Fowler: NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence. Addison-Wesley 2012 ISBN: 0321826620 (PS).
2. GauravVaish: Getting Started with NoSQL. PACKT Publishing, ISBN 978-1-84969-4-988.
3. Eric Redmond; Jim R. Wilson. Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement. Pragmatic Bookshelf. 2012. ISBN: 1934356921 (ER).
4. Graph Databases by [Dr. Jim Webber](#).

Reference Books:

1. Practical Neo4j - by [Gregory Jordan](#)

Course Title/ Code	Agile Technologies (CSW507)
Course Type	Core
Course Nature	Workshop
L-T-P-O Structure	(0-0-3-0)
Objectives	To introduce the practical applications of agile software development tools.

Section-A

Agile Programming Tools: UNIX, Eclipse, Git, jUnit,
Processes: Stories, End-to-end Testing, Unit Testing, TDD, Refactoring
Reading: Scrum, Extreme Programming, Features Driven Development, Lean Software Development

Section-B

Agile Architecture/Design and Continuous Integration Tools: Jenkins, Maven, Cucumber
Processes: Scrum, Architecture, Iterative Refinement, Agile Design.

Section-C

Agile Design Tools: Use Cases, PowerPoint Design, Requirements/Story Extraction, Test Case Management
Processes: Use cases to Design, Design to Backlog, Backlog to Tasks, End to End Testing, Estimation

Section-D

Agile Process Management Tools: Agilefant
Processes: Agile Process Management, Estimation, Burn-down, Release Planning, Multi-team coordination, Distributed teams

List of Experiments

1. Test Driven Development on Eclipse using jUnit
2. Software Configuration Management using Git
3. Backlog development from use cases and user interface designs using Specification by Example
4. End-to-end/Acceptance tests using Cucumber
5. Continuous Integration using Jenkins
6. Agile Process Management using Agilefant.

Text Books:

1. Robert C. Martin, Clean Code: A Handbook of Agile Software Craftsmanship, available at <http://www.it-ebooks.info/book/1441/>.

Reference Links:

1. Agile software development, http://en.wikipedia.org/wiki/Agile_software_development
2. Scrum, http://en.wikipedia.org/wiki/Scrum_%28software_development%29
3. Extreme Programming, http://en.wikipedia.org/wiki/Extreme_programming
4. Feature-drive development, http://en.wikipedia.org/wiki/Feature-driven_development
5. Lean Software development, http://en.wikipedia.org/wiki/Lean_software_development
6. Test-driven development, http://en.wikipedia.org/wiki/Test-driven_development
7. Unit testing, http://en.wikipedia.org/wiki/Unit_testing
8. Specification by example, http://en.wikipedia.org/wiki/Specification_by_example
9. Behavior-driven development, http://en.wikipedia.org/wiki/Behavior-driven_development
10. Code refactoring, http://en.wikipedia.org/wiki/Code_refactoring
11. User Experience, http://en.wikipedia.org/wiki/User_experience

Tool Web Sites:

1. Ubuntu, <http://www.ubuntu.com/desktop>
2. Eclipse, <https://eclipse.org/users/>
3. jUnit, <http://junit.org/>
4. Git, <http://git-scm.com/>
5. Jenkins, <https://jenkins-ci.org/>
6. Ant, <http://ant.apache.org/>
7. Maven, <https://maven.apache.org/>
8. Cucumber, <https://cukes.info/>
9. Fitnesse, <http://www.fitnesse.org/>
10. Agilefant, <http://agilefant.com/>

Course Title/ Code	Introduction To MATLAB (CSW508)
Course Type	Hard
Course Nature	WORKSHOP
L-T-P-O Structure	(0-0-3-0)
Objectives	Practical applications of problem solving techniques in MATLABs and Hands on instruction in MATLAB for developing, debussing and Texting of MATLAB programming Project.

Section-A

Introduction to MATLAB Basics: Getting MATLAB to Run, Programming, The Command Prompt, Simple Expressions, Variables and Assignments, Referencing Matrix Elements, Useful Commands. Operation Mode and Operators: Interpreter(Command Promt), Compiler (Create .m file), Background Mode, Logical operators * Scalars: &&, ||, ~ * Element-wise: &, |, ~, xor() * Bit-wise: bitand(), bitor(), bitcmp(), bitxor(), Arithmetic operator, Assignment Operators, Input & Output Commands.

Section-B

Arrays and Vector(1D Array): Array, List and Structures and its use, Overview of Cell Structure, Array, Sorting and Searching a list, Vector(1D Array) multiplication, addition, subtraction, division, Vectors manipulations,. Matrices: Accessing Matrix Elements, Assigning into Submatrices, Multiplication of two matrix. Basic Tools:Matrix Concatenations, More Expressions, Logical Constructs, Formatting Text.

Section-C

Control Structures &Fuctions:"if" Statement, else-if statement, Switch statement, "for" Loops, "while" Statements, Do-while statements.Functions and Logic:Inline function, Variable Scope in functions, Multiple Input Functions, More on Logic, Programming in Matlab: Addition of two numbers, Swapping of numbers, Fibbonacciseriesetc.Matlab with Windows OS, .NET, Apache, PHP , Install .NET (with c#) , Compile CallMat.vb program.

Section-D

Debugging Tools &Visualization Tool: Graph Plots, Generating Web froms, Sound Reply, Load and save. Image processing toolkit (IPT), Simulink based on different DataSets, Text Manipulation tools, Fuzzy Inferences Systems, Simulink: MobileAdhoc Networks Simulation kit,MathematicalToolKit.

GUI Interface: attaching buttons to actions, getting input, and setting output.

TextBooks:

1. Matlab And Its Application R.K.Bansal,Pearson Publications.
2. MatLab Programming For Engineers,StephenChapmann,Thomson Press.
3. Practical Introduction to programming and problem solving, 3rd Edition, Attaway.

Reference Books:

1. Getting Started with MatLab by Rudrapratap,Oxford University Press.
2. Matlab Practical Introduction to Programming an Problem solving by Stormy attaway ,B.H.Publication.
3. MATLAB Programming by Richard Johnson
4. Essential MatLab for Scientist and Engineers by Grand D. Hahn, Arnold Publication.

DETAILED SYLLABUS**CSP01- Semester-II**

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS				CREDITS
		Core(Departmental/Allied)/ Elective (Departmental/ Open) / University Compulsory	Hard/Soft/ Workshop/ NTCC	L	T	P	O	
CSH509-T & CSH509-P	Information Security	Domain Core	Hard	3	0	2	1	5
CSH510-T & CSH510-P	User Experience	Domain Core	Hard	3	0	2	1	5
CSH511-T & CSH511-T P	Machine Learning	Domain Elective	Hard	3	0	2	1	5
ECH617-T & ECH617-P	Wireless & Mobile Communication	Allied Elective	Hard	3	0	2	1	
CSH512-T & CSH512-P	Object Oriented Software Engineering	Domain Elective	Hard	3	0	2	1	
CSH513-T & CSH513-P	Soft Computing	Domain Elective	Hard	3	0	2	1	5
ECH441-T & ECH441-P	Wireless Sensor Networks	Allied Elective	Hard	3	0	2	1	
CSH514-T & & CSH514-P	Business Intelligence	Domain Elective	Hard	3	0	2	1	
CSW517	Software Project Management (group agile)	Domain Core	Workshop	0	0	3	0	2
CSS515	Writing Research Papers	Domain Core	Soft	1	0	2	0	2

Course Title/ Code	Information Security(CSH509-T & CSH509-P)
Course Type	Core
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	The main goal of this course is to provide student a background, foundation, and insight into the many dimensions of information security and awareness of essential concepts and methods for evaluating security in information processing systems.

Section -A

Mathematics of Cryptography Groups, Rings, and Fields, Integer Arithmetic, Modular Arithmetic, The Euclidean Algorithm, Finite Fields of The Form $GF(p)$, Polynomial Arithmetic, Finite Fields Of the Form $GF(2^n)$, Linear Congruence, The Chinese Remainder Theorem, Discrete Logarithms.

Section-B

Conventional Encryption: Attacks on Encryption Schemes, Perfect Security, Cipher Machines, Modes of Operation (ECB, CBC, CFB, OFB) , Multiple Encryption , DES, Triple-DES, AES,RC4 Stream Cipher , Attacks on DES.

Pseudo-random Number Generators (PRNGs): Random and Pseudorandom Numbers, Next-bit Test, Removing Biases, ANSI X9.17 Generator Blum-Blum-Shub Generator, Statistical Tests.

Section-C

Hash Functions and MAC: Standard hashes (MD5, SHA-1, SHA-256/384/512, and RIPEMD-160), Birthday Attack,Collision freeness and recent attacks, Message Authentication Code (MAC) Algorithms, Authenticated Encryption

Key Establishment and Public-key Cryptography Key Management, Diffie-Hellman Key Exchange, Attacks on Diffie Hellman, RSA, Attacks on RSA , ElGamal , Attacks on ElGamal , Semantic Security and Chosen-ciphertext Security ,Provably Secure Schemes.

Section-D

Integrity and Digital Signature: Message Integrity, Digital Signature, Authentication Protocol, Digital Signature Standards, Attacks on Digital Signature, Variation and Applications.

Other Data Hiding Techniques: Steganography, Types of steganography, Carriers in steganography, Difference between steganography and cryptography. Watermarking technique, Basic Definitions of Cloud Computing, Deployment of Cloud Computing, Security issues in Cloud Computing.

List of Experiments

1. Programs on different encryption algorithms.

Text Books:

1. William Stallings, "Cryptography and Network Security, Principles and Practice", Prentice Hall India.
2. Behrouz A Forouzan, "Cryptography & Network Security", Tata McGraw-Hill Publications

Course Title/ Code	User Experience(CSH510-T & CSH510-P)
Course Type	Core
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	Students will be able to learn the ability to design good interface. To make clear distinction between good design and better design.

Section – A

Overview of HCI, Theories and Principles

HCI: Introduction to HCI, Goals of System Engineering, Goals of User-Interface Design, Usability of Interactive Systems Motivations for Human Factors in Design, Guidelines, Principles and Theories, Conceptual, Semantic, Syntactic and Lexical Model, GOMS (Goals, Operators, Methods, and Selection) and Keyboard-level model, HCI, Object-Action Interface Model.

Interaction Styles: Introduction to interaction Devices, Keyboards and Function Keys, Pointing Devices, Speech and Auditory Interfaces, Speech Recognition, Image and Video Displays, Printers, Response Time and Display Rate with Respect to Display, Goals of Collaboration, Asynchronous and Synchronous Interfaces, Face-to-Face Interfaces.

Section –B

Managing Design Processes and Tools and Testing

Design Processes: Three Pillars of Design, Development Methodologies, Ethnographic Observation, Participatory Design, Scenario Development, Expert Reviews.

Tools and Testing: Usability Testing and Laboratories, Acceptance Testing, Evaluation during Active Use, Specification Methods, Interface Building Tools, Evaluation Tools.

Section-C

Design Principles for Designing GUI Objects: Direct Manipulation (examples, explanations), Visual Thinking and Icons, 3D Interfaces, Virtual Reality, Introduction to Menu Selection, Form Fill-in and Dialog Boxes, Task Related Organizations, Fast Movement through Menus, Item Presentation Sequences, Response Time and Display Rate, Data Entry with Menus Menu Layout, Command-Organizational Strategies, Naming and Abbreviations, Command Menus, Natural language in Computing.

Section – D

Presentation Design Issues and Information Search & Visualization

Presentation Design Issues: Error Messages, Display Design, Individual-Window Design, Multiple Window Design and Coordination by Tightly-coupled Windows, Color.

Information Search & Visualization: Introduction, Search in Textual Documents and Database Querying, Multimedia Document Searches, Advanced Filtering and Search Interfaces, Information Visualization, OAI Model for Website Design.

List of Experiments

1. Introduction to PENCIL Tools and its Controls.
2. To study the process of creating an animation with 2D objects, motion and sound.
3. To draw the Path and resizable shapes.
4. To draw the images and special constraints for Dimension and Handle.
5. Using external SVG.
6. Drawing sketchy lines.
7. Use of External JavaScript.
8. Designing a User Interface.
9. Creating a PENCIL based Presentation with UI Controls.
10. Project based on PENCIL.

Text Books:

1. Schneiderman, Ben and Catherine Plaisant, Designing the User Interface (DTUI), Fifth edition, (Addison-Wesley, 2010)
2. Dix, Alan, Janet Finlay, Gregory D Abowd, Russell Beale, Human-Computer Interaction (HCI), Third edition (Pearson, 2004)

Reference Books:

1. Bill Buxton, Sketching User Experiences: Getting the Design Right and the Right Design (Interactive Technologies), Elsevier, 2007.
2. Bill Moggridge, Designing Interactions, MIT Press, 2008.

Course Title/ Code	Machine Learning(CSH511-T & CSH511-P)
Course Type	Hard
Course Nature	Elective
L-T-P-O Structure	(3-0-2-1)
Objectives	Students will be able to learn instance based learning algorithms , Analyze probabilistic methods for learning and Build optimal classifiers using genetic algorithms

Section-A

Introduction – Well defined learning problems, Designing a Learning System, Issues in Machine Learning.

The Concept Learning Task - General-to-specific ordering of hypotheses, Find-S, List then eliminate algorithm, Candidate elimination algorithm, Inductive bias.

Decision Tree Learning - Decision tree learning algorithm-Inductive bias- Issues in Decision tree learning.

Section-B

Artificial Neural Networks – Perceptrons, Gradient descent and the Delta rule, Adaline, Multilayer networks, Derivation of back propagation rule-Back propagation Algorithm- Convergence, Generalization

Evaluating Hypotheses – Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms.

Bayesian Learning – Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm.

Section-C

Computational Learning Theory– Sample Complexity for Finite Hypothesis Spaces, Sample Complexity for Infinite Hypothesis Spaces, the Mistake Bound Model of Learning; -

Instance-Based Learning –K-Means, K-Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Function Networks, Case-Based Learning.

Section-D

Genetic Algorithms – an illustrative example, Hypothesis space search, Genetic Programming, Models of Evolution and Learning; Learning first order rules-sequential covering algorithms-General to specific beam search-FOIL

Reinforcement Learning - The Learning Task, Q Learning.

List of Experiments

1. Introduction to Matlab: Arithmetic,Logical,Bitwiseetc operations.
2. Vectors and Matrix Algebra and its Operations.
3. Logistic Regression
4. K-Means Clustering

5. k-Nearest Neighbor Classification Method
6. Naive Bayes Classifier
7. Decision Trees (CART)
8. AdaBoost
9. Support Vector Machines (SVM)
10. Apriori Algorithm

Text Books:

1. Tom.M.Mitchell, Machine Learning, McGraw Hill International Edition
2. EthemAlpaydin, Introduction to Machine Learning. Eastern Economy Edition, Prentice Hall of India, 2005.

Reference Books:

1. Jaime Guillermo Carbonell and Tom Michael Mitchell, "Machine Learning", MorganKaufmann, 1994.

Course Title/ Code	WIRELESS SENSOR NETWORK (ECH441-T & ECH441-P)
Course Type:	Elective (Departmental)
Course Nature:	Hard
L-T-P-O Structure	(3-1-2-0)
Objectives	Students will be able to implement communication network using wireless sensors.

Section A

Introduction and Overview of WSN: Introduction, Brief historical survey of sensor networks, Challenges for wireless sensor networks, Enabling technologies for wireless sensor networks, Ad-Hoc networks, Applications of wireless sensor networks: Sensor and robots, Reconfigurable sensor networks, Highway monitoring, Military applications, Civil and environmental engineering applications, Wildfire instrumentation, Habitat monitoring, Nanoscopic sensor applications, Wireless Network Standards: IEEE 802.15.4.

Section B

Architecture: Basic sensor network architectural elements, Single node architecture, Hardware components, Energy consumption of sensor nodes, Operating systems and execution environments, Network architecture, Sensor network scenarios, Optimization goals and figures of merit, Gateway concepts.

Section C

Medium Access Control for WSN: Physical layer and transceiver design Considerations, MAC protocols for wireless sensor, Networks, Low duty cycle protocols and wakeup concepts -Box-MAC, Bit-MAC, H-MAC, I-MAC, O-MAC, S-MAC , The mediation device protocol, Wakeup radio concepts, Address and name management, Assignment of MAC addresses, Routing protocols- Energy efficient routing, Geographic routing, Flooding and its variants.

Section D

Infrastructure Establishment: Topology control, Clustering, Time synchronization, Localization and positioning, Sensor tasking and control, Examples of operating systems: Tiny OS, Mate, Magnet OS.

List of Experiments:

1. Optimum Placements of sensors in wireless sensor network.
2. Sensor placement for effective diagnosis of multiple faults.
3. To generate a random matrix.
4. Generate a data matrix of the designated pattern vectors

5. Find the Fisher Information matrix associated to this matrix
6. Calculate the determinant for the Gram matrix for each sensor. This is done by deleting the rows and columns of matrix corresponding to the sensor reading with lowest interference, thus providing effective independence for the chosen sensor location
7. Remove the sensor which has least determinant from the data matrix by obtaining the matrix,
8. Add the next column from the matrix of data in order to update the Gram matrix with a new sensor. This procedure is repeated until an optimum matrix is obtained with all optimum sensor location sets.

Text Books:

1. Holger Karl & Andreas Willig, Protocols And Architectures for Wireless Sensor Networks, John Wiley.
2. Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks- An Information Processing Approach, Elsevier

Reference Books:

1. Kazem Sohraby, Daniel Minoli, Taieb Znati, Wireless Sensor Network, John Wiley.
2. Ananthram Swami, Qing Zhao, Yao-Win Hong, Lang Tong, Wireless Sensor Networks Signal Processing and Communications, John Wiley.
3. Murthy, Adhoc Wireless Networks: Architectures And Protocols, Pearson Education .
4. C. S. Raghavendra, Wireless sensor networks, Springer.

Course Title/ Code	Object Oriented Software Engineering (CSH512-T & CSH512-P)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	To model and design an object oriented system.

Section- A

Object Oriented Concepts and Modeling : Introduction to rational Unified Process, What is Object Orientation? (Introduction to class, Object, inheritance, polymorphism), Model, Importance of Modeling, Object Oriented Modeling, Object oriented system development, Function/data methods, Object oriented analysis, Object oriented construction, Object oriented testing, Identifying the elements of an object model, Identifying classes and objects, Specifying the attributes, Defining operations, Finalizing the object definition

Introduction to UML : Overview of UML, Conceptual Model of UML, Architecture, Use cases, Use Case Diagram

Section-B

Basic and Advanced Structural Modeling : Classes Relationship, Common mechanism, Diagrams, Class diagram, Advanced classes, Advanced Relationship, Interface, Types and Roles, Packages, Object Diagram

Basic Behavioral Modeling : Interactions, Interaction Diagram, Activity Diagram, State chart Diagram

Section-C

Architectural Modeling : Component , Components Diagram, Deployment Diagram

Object Oriented Design : Generic components of OO Design model, System Design process, Partitioning the analysis model, design patterns, principles of design patterns, Concurrency and subsystem allocation, Task Mgmt component, Data Mgmt component, Resource Mgmt component, Inter sub-system communication

Section-D

Object Design process : Object Oriented Analysis, Iterative Development, Unified process & UP Phases : Inception, Elaboration, Construction, Transition, Understanding requirements, UP Disciplines, Agile UP

Object Oriented Testing : Overview of Testing and object oriented Testing, Types of Testing, Object oriented Testing strategies, Test case design for OO software, Inter class test case design

List of Experiments (Rational Rose)

1. Use case diagram
2. Activity diagram

3. State chart diagram
4. Sequence diagram
5. Collaboration diagram
6. Class diagram
7. Interaction diagram
8. Implementation diagram

Text Books:

1. Ivar Jacobson, "Object Oriented Software Engineering", Pearson, 2004.
2. Grady Booch, James Runbaugh, Ivar Jacobson, "The UML User Guide", Pearson, 2004.
3. Wendy Boggs, Michael Boggs "Mastering UML with Rational Rose", BPB Publication, 2003.

Reference Book:

1. Stephen R. Scach, "Classical & Object Oriented Software Engineering with UML and Java: McGraw Hill, 1999.
2. Richard C. Lee, William M. Tepfenhard, "UML and C++, A Practical guide to object-oriented Development", Pearson Education, 2002.
3. Craig Larman, "Applying UML and Patterns"

Course Title/Code	SOFT COMPUTING(CSH513-T & CSH513-P)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	The student will understand and apply the concepts of fuzzy theory and neuro-fuzzy computing.

Section-A

Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing, Basics of Fuzzy Logic Theory, Crisp and Fuzzy Sets, Basic Set Operations, Fuzzy Relations, properties of membership functions, types of membership functions: triangular, trapezoidal, Gaussian, Composition of Fuzzy Relations, Mathematical Similarities between Neural Networks and Fuzzy Logic Models, Extension Principle, Membership Function Formulation and Parameterization, Fuzzy Reasoning.

Section-B

Fuzzy Inference Systems: Zadeh's Compositional Rule of Inference, linguistic values, linguistic variables, fuzzy rules, fuzzy inference, fuzzy inference systems, fuzzification, defuzzification, Mamdani, Sugeno, Tsukamoto Fuzzy Models.

Section-C

Neuro Fuzzy Modeling: Neuro-Fuzzy Computing, Neuro-Fuzzy Inference Systems, Adaptive Neuro-Fuzzy Inference Systems: Architecture, Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN, Coactive Neuro-Fuzzy Inference Systems (CANFIS).

Section-D

Applications of Soft Computing: Printed Character Recognition, Color Recipe Prediction, Applications in Bioinformatics, Neuro-Fuzzy Control, Speech Recognition.

List of Experiments

1. Given the following fuzzy set:

$$A = 0.5/3 + 0.3/6 + 0.1/8 + 1/10$$

Find A complement.

2. Given the following fuzzy sets:

$$A = 0.5/3 + 0.3/6 + 0.1/8 + 1/10$$

$$B = 0.7/2 + 0.4/6 + 0.8/10$$

Find A intersection B.

3. Given the following fuzzy sets:

$$A = 0.2/3 + 0.4/7 + 0.8/21 + 1/27$$

$$B = 0.4/7 + 0.5/34 + 0.9/27$$

$$C = 0.3/3 + 0.5/7 + 1/38$$

Find

- a) $A \cup B \cap C$
- b) $A \cap B \cap C$

4. Write programs in MATLAB for implementing the following:

- a. A complement
- b. B complement
- c. C complement
- d. A intersection B
- e. A intersection C
- f. B intersection C
- g. A intersection B intersection C
- h. A union B
- i. A union C
- j. B union C
- k. A union B union C

5. Verify the following for the union operation:

- a. Commutative Law for the sets A and B
- b. Associative Law for the sets A, B and C

6. Consider the following fuzzy sets:

$$A = 1/2 + 0.4/3 + 0.6/4 + 0.3/5$$

$$B = 0.3/2 + 0.2/3 + 0.6/4 + 0.5/5$$

$$C = 0.5/2 + 0.25/3 + 0.9/4 + 1/5$$

Calculate the following by writing a MATLAB program.

- a. $A \cup B$,
- b. $A \cap B$,
- c. $A \cap (B \cup C)$,
- d. $A \cup (B \cap C)$,

7. Write MATLAB programs to verify the following fuzzy set properties:

- a. Distributive Law
- b. Idempotency Law
- c. Identity Law
- d. DeMorgan's Law
- e. Involution Law

8. Assume the following universes: $X = \{x1, x2\}$, $Y = \{y1, y2\}$, and $Z = \{z1, z2, z3\}$, with the following fuzzy relations:

	Y1	Y2
X1	0.7	0.5
X2	0.8	0.4

	Z1	Z2	Z3
Y1	0.9	0.6	0.2
Y2	0.1	0.7	0.5

Find the fuzzy relation between X and Y, and Y and Z, using the max-min and max-product composition.

9. Use the built-in GUI tool for a Fuzzy Inference System to check whether the day is sunny, partially sunny, partially cloudy, or cloudy.
10. Use the built-in GUI tool for an ANFIS to check whether a given object is a triangle or a square or a rectangle.

Text Books:

1. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education
2. Fakhreddine O. Karray, Clarence De Silva, "Soft Computing and Intelligent Systems: Theory, Tools and Applications," Pearson Education, 2009

Reference Books:

1. "Fuzzy Sets and Fuzzy Logic: Theory and Applications", by George J. Klir and Bo Yuan, 1995, Prentice Hall

Course Title/ Code	WIRELESS MOBILE COMMUNICATION (ECH618-T & ECH618-P)
Course Type:	Domain Elective
Course Nature:	Hard
L-P-O Structure	(3-2-1)
Objectives	Students (A)will be able to comprehend (B) latest 4G technologies and standards (D) by reviewing various research journals and papers

SECTION A

Introduction to wireless radio systems: Cellular concept, frequency reuse, channel assignment strategies, Interference and system capacity, trunking and grade of service, HO strategies, OFDM.

Mobile radio propagation: mechanism, free space path loss, log-distance path loss models, Okumara model, Hata model, PCS model, Wideband PCS microcell model, indoor propagation models, Jake's channel model, Multi path characteristics of radio waves, signal fading, Time dispersion, Doppler spread, coherence time LCR, fading statistics, diversity techniques.

SECTION B

Introduction to Cognitive Radio: Marking radio self-aware, cognitive techniques – position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

Cognitive Radio Architecture: Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture.

SECTION C

MIMO: Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems, Spectral efficiency and capacity, Transmitting independent streams in parallel, The generic MIMO problem, Singular Value Decomposition, Predistortion in MIMO systems, Disadvantages of predistortion in MIMO systems, Precoding and combining in MIMO systems, Advantages of precoding and combining, Disadvantages of precoding and combining, Beamforming Analog and Digital Networks.

SECTION D

LTE vs WiMAX: 3GPP evolution towards LTE/LTE-Advanced standardization, LTE/LTE-Advanced Radio Resource Management, Radio network deployment and frequency planning, Spectrum management, Satellite wireless mobile Communication, 4G Mobile WiMAX (IEEE 802.16m-2011), Femto cells in advanced WiMAX systems, WiMAX Interworking with LTE/LTE-Advanced networks , Mobile IP, IEEE 802.21 for seamless, Mobility , 4G regulation: Mobile WiMAX and LTE/LTE-Advanced.

LIST OF EXPERIMENTS

EXPT 1.To write a program to calculate the link budget for satellite communication.

EXPT 2.To write a program to calculate the carrier to noise ratio for ratio for uplink and downlink and overall carrier to noise ratio.

EXPT 3. To determine the free space loss and the power received using MATLAB.

EXPT 4. To write a program to calculate the median path loss for okumura model for outdoor propagation.

EXPT 5. To write a program to calculate the median path loss for Hata model for outdoor propagation

EXPT 6. To write a program to encode and transmit using CDMA.

EXPT 7. To write a program to receive and decode using CDMA.

EXPT 8. Implementation of research paper.

EXPT 9. Implementation of research Paper.

EXPT 10. Implementation of research paper.

TEXT BOOKS/ Journals/ Papers:

1. Rappaport, “Wireless Communication”.
2. Joseph Mitola III, “Cognitive Radio Architecture: The Engineering Foundation of Radio XML”, Wiley-Interscience. 2006
3. Bruce A. Fette, “Cognitive Radio Technology”, Elsevier, 2009
4. Gilsic, S.G., “Advanced Wireless Networks: 4G Technology”, John Wiley & Sons. 2006

REFERNCE BOOKS/ Journals/ Papers:

1. Joseph MitolaIII, “Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering”, John Wiley & Sons Ltd. 2000.
2. Simon Haykin, “Cognitive Radio: Brain –Empowered Wireless Communications”, IEEE Journal on selected areas in communications, Feb 2005.
3. HasariCelebi, HuseyinArslan, “Enabling Location and Environment Awareness in Cognitive Radios”, Elsevier Computer Communications, Jan 2008
4. HuseyinArslan, “Cognitive Radio, SDR and Adaptive System”, Springer, 2007.

Course Title/ Code	Business Intelligence (CSH514-T & CSH514-P)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	To develop knowledge and expertise on how to select and/or develop, and deploy successful business intelligence systems to assist managers in decision making.

Section- A

Introduction to data warehouse : DW definition, 3 – Tier data warehouse architecture, OLAP server – ROLAP, MOLAP, HOLAP; OLTP vs OLAP, Metadata, role of metadata repository in data warehouse, data mart, distributed and virtual data warehouses, quality issues in data warehouse.

Introduction to Business Intelligence: BI Definitions & Concepts, Business Applications of BI, BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities.

Section-B

Basics of Data Integration and ETL : Concepts of data integration, need and advantages of using data integration, introduction to common data integration approaches, Data preprocessing, ETL Process, extract transform Load, ETL Tools & ETL concepts: Source system, Mapping, Metadata Data, Staging Area, Cleansing, Transformation Introduction to ETL using SSIS, Introduction to data quality, data profiling concepts and applications.

Section-C

Introduction to Multi-Dimensional Data Modeling: Introduction to data and dimension modeling, multi dimensional data model, ER Modeling vs. multi dimensional modeling, concepts of dimensions, facts, cubes, attribute, measures, introduction to business metrics and Key Performance Indicator ,hierarchies, Stars, snowflakes and fact constellations and defining schemas, OLAP operations , creating cubes using SSAS.

Section-D

Basics of Enterprise Reporting

Introduction to enterprise reporting, concepts of dashboards, balanced scorecards, introduction to SSRS Architecture, enterprise reporting using SSRS

List of Experiments

Using SQL Server along with Business Intelligence Development Studio (BIDS):

1. SSIS SQL Server Integration Services
2. SSAS SQL Server Analysis Services
3. SSRS SQL Server Reporting Services

There will be 2 projects

- a) Project 1: Data in disparate data sources such as Excel, text file, databases etc. will be provided to the students. They will be expected to extract, cleanse, integrate and load it into the data-warehouse.
- b) Project 2: Design reports according to given business scenarios. The data for the reports is to be pulled from the data-warehouse built in the earlier project.

Text Books:

1. R N Prasad, Seema Acharya, "Fundamentals of Business Analytics", Wiley

Reference Book:

1. David Loshin, "Business Intelligence", Elsevier
2. Mike Biere, "Business intelligence for the enterprise", IBM Press
3. Larissa Terpeluk Moss, ShakuAtre, "Business intelligence roadmap", Addison-Wesley Professional
4. Cindi Howson, "Successful Business Intelligence: Secrets to making Killer BI Applications", McGraw Hill
5. Brain, Larson, "Delivering business intelligence with Microsoft SQL server 2008", McGraw Hill
6. Lynn Langit, "Foundations of SQL Server 2005 Business Intelligence", Apress
7. Stephen Few, "Information dashboard design", OReilly

Course Title/ Code	Software Project Management(CSW516)
Course Type	Core
Course Nature	Workshop
L-T-P-O Structure	(0-0-3-0)
Objectives	To introduce the practical applications of agile software development tools.

Section-A

Project Design/Two Sprints: Overall goals are set. Two sprints.

Section-B

Three Sprints: The team completes three sprints and reviews the backlog, perhaps adjusting the effort estimates

Section-C

Three Sprints: The team completes three sprints and reviews the backlog, perhaps adjusting the effort estimates

Section-D

Three Sprints/Project Presentations: The team ends the project and presents what they have to the class.

List of Experiments

1. Project Proposal
2. Use Case Development
3. User interface Design
4. Creation of User Stories
5. Sprint Planning Meetings
6. Sprint Demo
7. Sprint Retrospective
8. Unit testing using junit and Eclipse
9. Calculation of burn-down chart
10. Effort Estimation using Planning Poker (Wide-band Delphi)
11. End-to-end/Acceptance tests using Cucumber
12. Continuous Integration using Jenkins
13. Agile Process Management using Agilefant.

Text Books:

12. Robert C. Martin, Clean Code: A Handbook of Agile Software Craftsmanship, available at <http://www.it-ebooks.info/book/1441/>.

Wikipedia Pages:

1. Agile software development, http://en.wikipedia.org/wiki/Agile_software_development
2. Scrum, http://en.wikipedia.org/wiki/Scrum_%28software_development%29
3. Extreme Programming, http://en.wikipedia.org/wiki/Extreme_programming
4. Feature-drive development, http://en.wikipedia.org/wiki/Feature-driven_development
5. Lean Software development, http://en.wikipedia.org/wiki/Lean_software_development
6. Test-driven development, http://en.wikipedia.org/wiki/Test-driven_development
7. Unit testing, http://en.wikipedia.org/wiki/Unit_testing
8. Specification by example, http://en.wikipedia.org/wiki/Specification_by_example
9. Behavior-driven development, http://en.wikipedia.org/wiki/Behavior-driven_development
10. Code refactoring, http://en.wikipedia.org/wiki/Code_refactoring
11. User Experience, http://en.wikipedia.org/wiki/User_experience

Tool Web Sites:

11. Ubuntu, <http://www.ubuntu.com/desktop>
12. Eclipse, <https://eclipse.org/users/>
13. junit, <http://junit.org/>
14. Git, <http://git-scm.com/>
15. Jenkins, <https://jenkins-ci.org/>
16. Ant, <http://ant.apache.org/>
17. Maven, <https://maven.apache.org/>
18. Cucumber, <https://cukes.info/>
19. Fitnesse, <http://www.fitnesse.org/>
20. Agilefant, <http://agilefant.com/>

Course Title/ Code	RESEARCH PAPER WRITING / SEMINAR (RPW / S)
Course Code	MES 515
Course Type	DOMAIN CORE
Course Nature	SOFT COURSE
L-T-P-O Structure	1-0-2-0
Objectives	To acquaint the researcher with the tools of research by exposing them to the mechanics of writing a research report/ research paper/ thesis/ dissertation.
Learning Outcomes	<p>Upon completion of this course, the students should be able to:</p> <ul style="list-style-type: none"> • Know what formats, designs, structure and styles to use to best get their ideas, concepts and messages across in a way that is clear and unambiguous. • Be capable of recognising and correcting many common errors that currently occur within written communication in the technical field. • Produce different types of Technical Reports for various purposes • Use clear and powerful language to target and persuade readers for positive results • Produce documents of a high professional standard.

SECTION A

Research Paper:- Definition, Quality of a good Research Paper, Report Paper and Thesis Paper; Details of a Research Paper – Steps and Schedule.

Choosing a Topic:- Brainstorming, Consulting Experts, Considering Parameters, Narrowing the Research Topic.

Thesis:- Definition and function, Outline, Thesis Statement

SECTION B

Doing Research:- Finding Information, Sources of Information; Online Resources, Search Engines, Databases, Newsgroups, Internet Sites; Library – Books, Research Papers, Periodicals, Magazines and Journals,, Interviews, Surveys, Government Documents, Pamphlets, Special Collections; Evaluating Sources

Taking Notes:- Reading, Notes Taking Methods, Guidelines and Summarizing

SECTION C

Rough Draft :- Transforming Notes into Rough Draft Creating Outlines, Types of Outlines; Basics of Research Paper Style ; Words, Sentences, Punctuation ; Writing Introduction; Using Notes, Quotations, Graphics etc.

Revising Rough Drafts:- Principles, Revising Opening Paragraph, Sentences, Words and Rules for Writers, Plagiarism and how to avoid it, Plagiarism Detection Programs.

SECTION D

Documentation :- MLA System of Documentation ; Parenthetical Documentation, Format for Work Cited, Using Footnotes and Endnotes to Document Sources and add Observations and Comments – Guidelines and Format ; APA System of Documentation, Traditional System of Documentation (CMS).

Presentation of Research Paper:- Title Page, Table of Contents, Forward and Preface, Abstract, Presentation Footnote. Finished Form of Paper – Revising, Editing, Proofreading, Peer Review Checklist, Submitting Electronically. Model Research Papers.

Reference Books:

- 1) Gibaldi, Joseph. *MLA Handbook for Writers of Research Papers*. 7th ed. New Delhi: East-West Press, 2009
- 2) Kothari, C.R. *Research Methodology: Methods and Techniques*. New Delhi: New Age International Ltd, 1985.
- 3) Rahim, F. Abdul. *Thesis Writing: A Manual for Researchers*. New Delhi: New Age International Pvt Ltd, 1996.
- 4) Laurie Rozakis, *Schaum's Quick Guide to Writing Great Research Papers*, M/cGraw- Hill 2007.
- 5) Anthony C. Winkler / Jo Ray McCuen –Metherel, *Writing the Research Paper*. Wadsworth Cengage Learning. 2008

LABORATORY

Report writing consisting of about 1,000 words, on any subject of the student's choice, in the field of research in Mechanical Engineering.

Prepare atleast two Research Papers in IEEE & Science Direct Format. Your **research paper** must be 3 pages **minimum** plus reference page, typed (approx. 250 words per page) on a technical topic of the student's choice dealing the field of research in Mechanical.

Seminar presentation, on Report Writing and Research Papers.

DETAILED SYLLABUS

CSU01- Semester-III

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS				CREDITS
		Core(Departmental/Allied)/ Elective (Departmental/ Open) / University Compulsory	Hard/Soft/ Workshop/ NTCC	L	T	P	O	
CSH618-T & CSH618-P	Cloud Computing	Domain Core	Hard	3	0	2	1	5
CSH619-T & CSH619-P	Image Processing and Pattern Recognition	Domain Elective	Hard	3	0	2	1	5
CSH620 -T & CSH620-P	Mobile Software	Domain Elective	Hard	3	0	2	1	
CSH621-T & CSH621-P	Data Mining	Domain Elective	Hard	3	0	2	1	
CSH622-T & CSH622-P	Evolutionary computing	Domain Elective	Hard	3	0	2	1	5
CSH623-T & CSH623-P	Distributed and Mobile Architecture	Domain Elective	Hard	3	0	2	1	
CSH624-T & CSH624-P	Business Analytics with R	Domain Elective	Hard	3	0	2	1	
CSW516	Network Simulator 3	Domain Core	Workshop	0	0	3	0	2
CSW625	Software Testing	Domain Core	Workshop	0	0	3	0	2
CSN626	Dissertation Project (Stage I)	Domain Core	NTCC	0	0	3	0	3
PHS522	Pedagogical Skills	Allied Core	Soft	1	0	2	0	2

Course Title/ Code	Cloud Computing(CSH618-P & CSH618-P)
Course Type	Core
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	Students will be able to learn the concepts, techniques and implementation of clouds.

Section-A

Overview of Cloud Computing: Brief history and evolution - History of Cloud Computing, Evolution of Cloud Computing, Traditional vs. Cloud Computing. Why Cloud Computing, Cloud service models (IaaS, PaaS&SaaS). Cloud deployment models (Public, Private, Hybrid and Community Cloud, Benefits and Challenges of Cloud Computing.

Working with Private Cloud: Basics of virtualization, Virtualization technologies, Server virtualization, VM migration techniques, Role of virtualization in Cloud Computing. Business cases for the need of Cloud computing environment, Private Cloud Definition, Characteristics of Private Cloud, Private Cloud deployment models, Private Cloud Vendors, Private Cloud Building blocks namely Physical Layer, Virtualization Layer, Cloud Management Layer, Challenges to private Cloud, Virtual Private Cloud. Implementing private cloud (one out of CloudStack, OpenStack, Eucalyptus, IBM or Microsoft)

Section-B

Working with Public Clouds: What is Public Cloud, Why Public Cloud, When to opt for Public Cloud, Public Cloud Service Models, and Public Cloud Players. Infrastructure as a Service Offerings, IaaSVendors, PaaS offerings, PaaS vendors, Software as a Service. Implementing public cloud (one out of AWS, Windows Azure, IBM or Rackspace).

Application Development: Service creation environments to develop cloud based applications. Development environments for service development; Amazon, Azure, Google App.

Section-C

Overview of Cloud Security: Explain the security concerns in Traditional IT, Introduce challenges in Cloud Computing in terms of Application Security, Server Security, and Network Security. Security reference model, Abuse and Nefarious Use of Cloud Computing, Insecure Interfaces and APIs, Malicious Insiders, Shared

Technology Issues, Data Loss or Leakage, Account or Service Hijacking, Unknown Risk Profile, Introduce the different vendors offering Cloud Security for public and private clouds.

Overview of Multi-Cloud Management Systems: Explain concept of multi-cloud management, Challenges in managing heterogeneous clouds, benefits and advantages of multi-cloud management systems. Implementing Multi-Cloud Management System (e.g. RightScale Cloud Management System)

Future directions in Cloud Computing: Future technology trends in Cloud Computing with a focus on Cloud service models, deployment models, cloud applications, and cloud security. Migration paths for cloud, Selection criteria for cloud deployment. Current issues in cloud computing leading to future research directions.

Section-D

Business Clouds: Cloud Computing in Business, Various Biz Clouds focused on industry domains (Retail, Banking and Financial sector, Life Sciences, Social networking, Telecom, Education). Cloud Enablers (Business Intelligence on cloud, Big Data Analytics on Cloud).

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

List of Experiments

1. Creation of EC2 Instance on Amazon.
2. Implementation of Load Balancing.
3. Deployment of various services on Amazon.
4. Design, development and implementation of a given business application.
5. Management of one application using multi-cloud management.
6. Case Study of Computing PI with Clouds.
7. Case Study of Association of clouds with mining.

Text Books:

1. A Practical Approach Cloud Computing: By Anthony T Velte, Toby J Velte, Robert C Elsenpeter.
2. Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, *Kai Hwang, Jack Dongarra and Geoffrey Fox*, Morgan Kaufmann, 2011

Reference Book:

1. Cloud computing: Implementation, management and security By Rittinghouse, John, and W.
2. Cloud Computing Bible, By Barrie Sosinsky, Wiley, 2011.
3. Cloud Computing Architected: Solution Design Handbook by Rhoton, John.
4. Cloud Security, A comprehensive Guide to Secure Cloud Computing by Krutz, Ronald L.; Vines, Russell Dean.
5. Cloud Computing: Principles and paradigms By Raj Kumar Buyya, James Broberg, Andrezei M. Goscinski, 2011

Course Title/Code	Image Processing And Pattern Recognition (CSH619-T & CSH619-P)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	The student will understand and apply the concepts of image processing and pattern recognition.

Section-A

Basic Concepts: Pixels, Image as a signal, light, brightness, contrast, colour, neighbours of a pixel, adjacency, connectivity, regions & boundaries, image noise, distortion.

Fundamental Steps involved in Digital Image Processing: image sensing & acquisition, preprocessing, segmentation, feature selection, image representation, image interpretation.

Elements of visual perception systems: hue, brightness, contrast, image negatives, image subtraction, edge enhancement, gamma correction, mach band effect.

Colour image fundamentals-RGB, HSI models, Sampling, Quantization, Dithering, Two dimensional mathematical preliminaries, 2D transforms-DFT, DCT, KLT, SVD.

Image formation: Monocular imaging system, orthographic & perspective projection, camera model and camera calibration.

Section-B

Image Enhancement and Restoration

Concepts: Noise distribution, spatial averaging, directional smoothing, frequency domain, spatial domain, filtering.

Spatial Domain Filtering: Intensity transformation-piece-wise linear transformations, bit plane slicing, histogram equalization, histogram processing, image subtraction, image averaging, smoothing filtering masks, lowpass filtering, highpass filtering.

Frequency Domain Filtering: Image Sampling, 2-D discrete Fourier transformations, lowpass filtering-ideal and Gaussian, high pass filtering-ideal, Gaussian, Laplacian, noise models, mean, median and min-max filters, minimum mean square error filter.

Section-C

Image segmentation: Line detection, edge detection, Edge linking and boundary detection, region based segmentation. Representation and Description: Representation, Boundary and Regional Descriptors, Relational Descriptors.

Image Compression: Fundamentals – coding redundancy, interpixel redundancy, fidelity criteria. Image Compression Models – The Source Encoder and Decoder, The Channel Encoder and Decoder. Elements of Information Theory – Measuring Information, The Information Channel, Fundamental Coding Theorems, Using

Information Theory, Error-Free Compression – Variable-Length Coding, Bit-Plane Coding, Lossless Predictive Coding, Lossy Compression – Lossy Predictive Coding, Transform Coding.

Section-D

Applications of Image Processing: Classification, feature extraction, projection, multi-scale signal analysis.

Pattern Recognition: Basic concepts of pattern recognition, fundamental problems in pattern recognition system, design concepts and methodologies, example of automatic pattern recognition system, simple automatic pattern recognition model, Pattern Recognition Techniques: Neural Networks.

List of Experiments

Note: Use MATLAB to implement the following programs:

1. Write a program to read and display a digital image.
2. To write and execute programs for image arithmetic operations:
 - a. Addition of two images,
 - b. Subtract one image from other image,
 - c. Calculate mean value of image,
 - d. Changing the brightness of an image.
3. To write and execute programs for image logical operations:
 - a. AND operation between two images
 - b. OR operation between two images
 - c. Calculate intersection of two images,
 - d. Water Marking using EX-OR operation,
 - e. NOT operation (Negative image).
4. To write a program for histogram calculation and equalization using standard MATLAB functions.
5. To write and execute programs for geometric transformation of image:
 - a. Translation,
 - b. Scaling,
 - c. Rotation,
 - d. Shrinking,
 - e. Zooming.
6. To understand various image noise models and to write programs for image restoration:
 - a. Minimize Gaussian noise,
 - b. Median filter,
 - c. Weiner filter
7. Write and execute programs to remove noise using spatial filters
 - a. Understand 1-D and 2-D convolution process,
 - b. Use 3x3 Mask for low pass filter and high pass filter.
8. Write and execute programs for image frequency domain filtering:
 - a. Apply FFT on given image,
 - b. Perform low pass and high pass filtering in frequency domain,
 - c. Apply IFFT to reconstruct image
9. Perform pattern recognition on a set of digits 0, 1, ..., 9 using a neural network.
10. Perform pattern recognition on a set of alphabets A, B, ..., Z using a neural network.

Text Books:

1. R.C. Gonzalez, R.E. Woods, "Digital Image Processing", Pearson Education, 2nd Edition, 1999.
2. R.C.Gonzalez, Richard E.Woods, Steven L. Eddins, "Digital Image Processing using MATLAB", Pearson Education.

Reference Books:

1. John J. Proakis, D.G. Manolakis, Introduction to Digital Signal Processing, MacMillan Publishing
2. R.O.Duda, P.E. Hart, D.G. Stork, Pattern Classification, Wiley & Sons, 2nd Edition.

Course Title/ Code	Mobile Software(CSH620-T & CSH620-P)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	Students would be able To develop Application using android operating system,IOSApplication,Xamarin.

Section-A

Android Concepts and Its Working:Exception Handling, Threads, Broadcast Receivers.Working with Menu: Option menu, Context menu, Sub menu, and menu from xml, menu via code, Custom v/s System Menus, Create and Use handset Menu Buttons. Dialog: Creating and Altering Dialogs. List &Adapters:-Array Adapter, Base Adapters. List View and List Activity, Custom List View, Grid View using adapters. Styles and Themes: Applying styles and themes attributes in Layout.

Section-B

Introducing SQLite: Managing Database of Android using SQLite, and Sharing Data between Applications with Content Providers. Working with cursors: Inserts, Update and delete.Multimedia –Audio, video formats creation and association in any application.

Mobile Application Development:Introduction to Mobile Computing,Factors in Developing Mobile Applications:Mobile Software Engineering,Frameworks and Tools, Mobile Devices, Mobile Application Issues, Mobile Application vs web Application, Characteristics of Mobile Applications, Synchronization and Replication of Mobile Data,J2ME Overview,J2ME Architecture ,Commands

Section-C

Introduction to iOS Application Environment:The four pillars of iOS app development, C basics, C structure, Creating primitive variables, Using pointers, Messages and methods, Object creation, Object creation, Automatic Reference Counting (ARC), Using existing classes, Creating custom classes, Adding properties,Using the Model-View-Controller (MVC) pattern in iOS, Creating basic interaction, Dismissing the keyboard, Dismissing the keyboard with delegation, Understanding delegation, Alerting the user, The iOS application life cycle, Exploring the iOS project templates, Using the multitasking events, Creating iOS UI, Designing responsive interfaces with Auto Layout, Adding and troubleshooting Auto Layout constraints, Using a date picker control, Loading data into controls, Responding to selection, Exploring the object library, Using Apple's Human Interface Guidelines, Introduction to table views, Creating a basic table view and data source, Loading a property list into a table view, Reusing table view cells, Customizing table views, Customizing table view cells,Introduction to multiple-view applications, Deconstructing a utility app, Using navigation controllers, Deconstructing a master-detail app, Creating a tab-bar-driven app

Section-D

Cross-platform development tools: Types of mobile software available, Introduction to Xamarin, PhoneGap, appcelerator, iFactr, kony, SAP, alpha software, 5APP, FeedHenry, Sencha, types of mobile apps that can be created with Xamarin Studio vs. Visual Studio on both Windows and OS X, Requirements for creating a Xamarin.iOS application

List of Experiments

1. Installation and setup of java development kit(JDK),setup android SDK,setup eclipse IDE,setup android development tools (ADT) plugins,create android virtual device.
2. Create sample application with login module (Check username and password). On successful login, ChangeTextView “Login Successful”. And on failing login, alert user using Toast “Login fail.
3. Create an application that will pass two numbers using TextView to the next screen, and on the next screen display the sum of that number
4. Using Xcode and the iOS Simulator
5. Learning Objective-C basics and structure
6. Creating objects, variables, properties, and custom classes
7. Connecting UI elements to code
8. Using delegation
9. Using the Xcode debugger
10. Creating and customizing table views
11. Exploring storyboards
12. Introducing blocks
13. Saving and loading data
14. Understanding the differences in iPad development
15. Creating iPad apps with popovers and split views
16. Adding application icons and launch images
17. Installation of xamarin
18. Create sample application with login module.(Check username and password). On successful login, ChangeTextView “Login Successful”. And on failing login, alert user using Toast “Login fail using Xamarin

Text Books:

1. Professional Cross-Platform Mobile Development in C# By Scott Olson, John Hunter, Ben Horgen, Kenny Goers, Wiley
2. Android App for absolute beginners by Wallace Jackson, Apress

Reference Book:

1. Sams Teach Yourself iOS App Development by John Ray

Course Title/ Code	DATA MINING(CSH621-T & CSH621-P)
Course Type:	Elective
Course Nature:	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	Student will be able to understand and apply principles and techniques of Data mining

Section-A

Data Mining: Data mining definition & task, KDD versus data mining, Data Mining Applications , Data preprocessing, Classification of data mining systems, Data mining task primitives, data mining techniques, Data mining query languages . Data mining techniques: Market Basket Analysis, Frequent Itemsets, Closed Itemsets, and Association Rules(Apriori Algorithm), Mining Multilevel Association Rules, Mining Multidimensional Association Rules, Correlation Analysis.

Section-B

Classification & Prediction: Decision tree knowledge discovery, Bayesian Classification, Neural Networks (MLP) & Support Vector Machines (SVM). Instance based learning, Fuzzy techniques, set theory, Genetic Algorithm, Rough set theory, Classification Accuracy and error measures, evaluating the accuracy of Classifier, Introduction to ensemble methods.

Section-C

Clustering Analysis: What Is Cluster Analysis? Types Of Data In Cluster Analysis – A Categorization Of Major Clustering Methods – Hierarchical Methods , Partitioning methods, Density based method, Grid based method, Model based method , outlier analysis. Mining complex data object: (Spatial databases, Multimedia databases, Time series and Sequence data mining Text Databases and mining World Wide Web).

Section-D

Data Mining Applications (Case studies: Banking system, Telecommunication system, Biological data Analysis etc). Advance Topics : Introduction to ensemble methods. Graph Mining, Social network Analysis, Biological data Analysis, Big data Analysis Introduction to Business Intelligence.

LIST OF EXPERIMENTS:

1. Introduction to Data mining Tool
2. To study various preprocessing techniques.
3. To study attribute selection measures.
4. To implement Classification algorithms.
5. To Implement Association rule.
6. To implement Clustering.
7. To implement various ensemble methods.

8. To study PDI(Pentaho Data Integration) IDE.
9. To Create new repository in PDI and performing various tasks.

Text Books:

1. Data Warehousing In the Real World; Sam Anahory & Dennis Murray; 1997, Pearson
2. Data Mining- Concepts & Techniques; Jiawei Han & Micheline Kamber- 2001, Morgan Kaufmann.
3. Data Mining Techniques; Arun Pujari; 2001, University Press; Hyderabad.

Reference Book:

1. Paul Raj Poonia, "Fundamentals of Data Warehousing", John Wiley & Sons, 2003.
2. Sam Anahony, "Data Warehousing in the real world: A practical guide for building decision support systems", John Wiley, 2004.
3. W. H. Inmon, "Building the operational data store", 2nd Ed., John Wiley, 1999.
4. Mattison R., Web Warehousing and Knowledge Management, Tat McGraw-Hill.
5. Ponniah P., Data Warehousing, Wiley.

Course Title/ Code	Evolutionary computing (CSH622-T & CSH622-P)
Course Type	Elective
Course Nature:	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	Students will be able to apply techniques in evolutionary computation to problems such as optimization, automatic programming, control, and biological modeling.

Section-A

Introduction: Biological and artificial evolution - Evolutionary computation and AI – Different historical branches of EC-GAs- EP-ES- GP - A simple evolutionary algorithm, , EV on simple & complex fitness landscape, History of EV, Canonical Evolutionary Algorithm: Introduction, programming & strategies.

Section-B

Unified View: Simple EAs- common framework, Reproductive Mechanisms (mutation, recombination, Issues, mechanism). Search & selection operator: Recombination/Crossover for strings- one-point- multi-point-uniform crossover operators - Mutation for strings- bit-flipping - Recombination/Crossover and mutation rates - Recombination for real-valued representations- Fitness proportional selection and fitness scaling – Ranking methods – Tournament selection.

Section-C

Evolutionary Combinatorial Optimization: Case study on GA applications (Traveling salesman problem, Time tabling problem, Job scheduling problem) Hybrid evolutionary and local search algorithm. Convergence of EAs - Computational time complexity of EAs - No free lunch theorem.

Constraint Handling: Common techniques- penalty methods- repair methods - Analysis –Some examples. Pareto optimality – Multi-objective evolutionary algorithms.

Section-D

Genetic Programming: Trees as individuals - Major steps of genetic programming-, functional and terminal sets- initialization- crossover-mutation- fitness evaluation – Search operators on trees – Examples. Introduction to parallel genetic programming, Distributed genetic programming. Case study on GP applications (symbolic regression, multiplexer, artificial ant)

List of Experiments

1. Study of Matlab.
2. Implementation of Heuristic Search techniques.
3. Implementation of Simulated Annealing.
4. Implementation of Ant Colony methods.

5. Implementation of Particle swarm optimization.
6. Implementation of Genetic algorithm and genetic programming.
7. Implementation of Evolutionary techniques.
8. Implementation of Tabu Search.
9. Implementation of Constraint Handling.

Text Books:

1. Introduction to Evolutionary Computing by A.E. Eiben (Author), James E. Smith (Author).

Reference Books:

1. Goldberg and David E, "Genetic Algorithms in Search. Optimization and Machine Learning", Pearson Education, New Delhi, 1989.
2. Kalyamoy Deb, "Multiobjective Optimization using Evolutionary Algorithms", John Wiley & Sons, USA, 2003.
3. Koza, John, Wolfgang Banzhaf, Kumar Chellapilla, Kalyanmoy Deb, Marco Dorigo, David Fogel, Max Garzon, David Goldberg, Hitoshi Iba, and Rick Riolo(Eds.), "Genetic Programming", Academic Press. Morgan Kaufmann, USA, 1998.
4. John R.Koza, Forrest H Bennett III , David Andre and Martin A Keane, "Genetic Programming III: Darwinian Invention and Problem Solving" Morgan Kaufmann, USA, 1999.

Course Title/ Code	Distributed and Mobile Architecture (CSH623-T & CSH623-P)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	The students will be able to understand the specifications and functionalities of various protocols/standards of distributed and mobile networks.

Section-A

Introduction to Mobile Protocols: Introduction to WML, Features of WML, Global system for Mobile Communication (GSM) system overview: GSM Architecture, Mobility Management, Network signaling, General Packet Radio Services (GPRS): GPRS architecture, GPRS Network nodes, Mobile Data Communication: WLANs (Wireless LANs) IEEE 802.11 standard, Mobile IP, Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, Wireless Markup Languages (WML).

Section-B

Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G, Wireless local Loop (WLL): Introduction to WLL architecture, WLL technologies, Bluetooth technology and Wi-Max, Introduction to 4G mobile services, Case studies of IRIDIUM and GLOBALSTAR systems.

Section-C

Introduction to Distributed concepts: Architectural models for distributed and mobile computing systems. Basic concepts in distributed computing such as clocks, message ordering, consistent global states, and consensus, Introduction to Personal Communication Services (PCS): PCS architecture, Mobility management, Networks signaling, Distributed Systems Models: Architectural models – Client-Server model, Thin Client, Mobile Devices. Software agents, Fundamental models – Interaction, Failure and Security models.

Section-D

Distributed concepts: Hardware Architecture - Symmetric Multiprocessing , Distributed Shared Memory, Multicomputer, Software Architecture - Client server architecture , 3-tier architecture , N-tier architecture, Peer-to-peer, Cluster computing, Grid computing, Virtualization and Cloud Computing Recent trends in processor technologies - Superscalar processors, Multi-core processors, Embedded processors, Distributed Objects and Remote Invocation: Communication between distributed objects. Remote Procedure Call. Remote Object Invocation. Events and notification. Message and Stream-oriented communication. Case study: CORBA and DCOM.

List of Experiments

1. Study of WML and J2ME simulators.
2. Design of simple Calculator having +,-,* and / using WML/J2ME.
3. Design of Calendar for any given month and year using WML/J2ME.
4. Design a Timer to System Time using WML/J2ME.
5. Design of simple game using WML/J2ME.
6. Animate an image using WML/J2ME.
7. Design a personal phone book containing the name, phone no., address, e-mail etc.
8. Simulation of Authentication and encryption technique used in GSM.
9. Browsing the Internet using Mobile phone simulator.
10. Study of GlomoSim Simulator.

Text Books:

1. Yi –Bing Lin, ImrichChlamatac ,”Wireless and mobile Networks Architecture”, John Wiley & Sons
2. Tannenbaum, A, Van Steen. Distributed Systems, Principles and Paradigm, Prentice Hall India

Reference Books:

1. Raj Pandya , Mobile & Personnel communication Systems and Services”, Prentice Hall India.
2. Hensmann, Merk, &Stober , Principles of Mobile Computing”, Springer International Edition
3. Attiya, Welch, “Distributed Computing”, Wiley India.

Course Title/ Code	Business Analytics with R programming(CSH624-T & CSH624-P)
Course Type	Elective
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	Students will be able to perform business analytics with R programming

Section-A

Introduction: Introduction to Business Analytics, Understand the use of 'R' in the industry, Compare R with other software in analytics, Install R and the packages useful for Business Analytics, Using the R console, Getting help, Learning about the environment, Saving your work. Data Structures, Variables: Variables and Assignment, Data types, Indexing, subsetting, Viewing data and summaries, Functions, Naming conventions, Objects, Models, Graphics Control Flow: Branching, Looping, Vectorized calculations

Section-B

Data Import : The various steps involved in Data Cleaning, Functions used in Data Inspection, Tackling the problems faced during Data Cleaning, Uses of the functions like grepl(), grep(), sub(), Coerce the data, Uses of the apply() functions. Import data from spreadsheets and text files into R, Import data from other statistical formats like sas7bdat and spss, Packages installation used for database import, Connect to RDBMS from R using ODBC and basic SQL queries in R.

Section-C

Data Visualization & Data Mining in R: Understanding Data Visualization, Graphical functions present in R, Plot various graphs like tableplot, Scatter Plot, histogram, box plot, Customizing Graphical Parameters to improve the plots, Understanding GUIs like Deducer and R Commander, Introduction to Spatial Analysis. Introduction to data mining, K-means Clustering, Apriori for association rule mining, Linear Regression (Simple & Multiple), Logistic Regression.

Section-D

Predictive Analysis and Decision tree : Decision Trees, Algorithm for creating Decision Trees, Greedy Approach: Entropy and Information Gain, Classification Rules for Decision Trees, Concepts of Random Forest, Working of Random Forest, Features of Random Forest. Dimensionality reduction of Data: PCA, SVD, Analysis of Variance (Anova) Technique, Predictive Analysis. Time series Decomposition, Time series clustering and classification. Graphics in R: Lattice, GGplot2, Interactive graphics, Animated GIF, rGGobi.

Case Study: Analyze Census Data to predict insights on the income of the people, based on the factors like: Age, education, work-class, occupation, etc.

List of Experiments

1. Installation of Revolutionary R studio.

2. Vectors (logical, character) and their operation, Array indexing, Outer product of two array
3. Matrix operations
 - i. How to name rows and columns of matrix.
 - ii. Program to transpose matrix
 - iii. Singular value decomposition, Cbind and rbind.
4. List creations, Concatenations of two lists, Attach () and detach() functions
 - i. Data Cleaning using apply () and grep()
 - ii. Data import
5. Load and save data from csv and text file using save and load functions
6. Load data from R packages
7. Load data from database using RODB package
8. Visualize the data set using scatter plot, box plot and graph, heatmap, level plot and contour
9. Draw generalized linear model using glm() function and predict function
10. Decision tree of dataset using ctree() in party package
11. Decision tree of dataset using cforest() in party package
12. Implement k-means clustering, pamk() and Pam() function
13. Generate association rules using apriori on titanic dataset
14. Visualize the association rules using arulesViz
15. Time series decomposition of AirPassengers dataset
16. Time series Forecasting of AirPassengers dataset using Arima()
 - i. How to name rows and columns of matrix.
 - ii. Program to transpose matrix.
 - iii. Singular value decomposition, Cbind and rbind.

Text Book:

1. “Data mining and Business analytics with R” by Johannes Ladolter Willey Publications

Reference Books:

1. “R for Business Analytics” by Ajay Ohri Springer Publications
2. “Customer and Business Analytics Applied Data Mining for Business Decision Making using R” by Daniel S. Putler & Robert E. Krider CRC publications

Course Title/ Code	Software Testing(CSW625)
Course Type	Core
Course Nature	Workshop
L-T-P-O Structure	(0-0-3-0)
Objectives	Student will be able to implement software testing skills to test any given software based on the requirements specification.

Section-A

Introduction: Software Testing Techniques, software testing fundamentals: objectives, principles, testability; Test case design, V Model.

Code Tuning Techniques: Use of Correct Data Type, Ordering statements in switch, Stop testing in a loop when result is known, Minimizing array references, Jamming and Un-switching of Loops, Minimizing Computations in loop.

Functional Testing Techniques-Black Box Testing: Exploratory Testing, Logic Coverage: Interface Testing, Boundary Value Analysis, Robustness Testing, Worst Case Testing, Equivalence Class Testing.

Section-B

Functional/Structural Testing Techniques: Decision Table based Testing, Cause Effect Graphing Technique, and White box testing, Basis Path Testing, DD Paths and Cyclomatic Complexity.

Structural Testing Techniques-White Box Testing: Graph Matrices, Data Flow Testing, Mutation Testing, Unit Testing, Integration Testing.

Reducing the Number of Test Cases: Regression Testing, Regression Test Process, Selection of Regression Tests, Prioritization Guidelines, Slice based testing.

Functional Testing Techniques-Black Box Testing: Equivalence Class Testing, Strong Normal Equivalence Class Testing, Strong Robust Equivalence Class Testing, Weak Normal Equivalence Class Testing, Weak Robust Equivalence Class Testing.

Object Oriented Testing: Issues in OO Testing, Class Testing: Random Testing, Class Testing: Partition based Testing, Object Oriented Integration and System Testing, System Testing.

Debugging and Defect Tracking Report: Debugging Techniques, Debugging through Code Inspection, Debugging using Logs, Debugging using IDE, Creating Defect Tracking Reports.

Test Management: Test Planning, Test Management, Test Automation, Testing Tools, Static vs. Dynamic Testing Tools.

Section-C

Introduction of Test Automation Using Selenium: Why Selenium? , Selenium Vs other tools (HP etc), Selenium Components, Selenium RC vs Web driver, Selenium Core, Selenium IDE, Remote Control (Selenium1), Web driver (Selenium2), Grid, Locators & types, Test Automation, Getting started with Selenium IDE, Useful Tools for Writing Test Cases Firefox Add-ons, Basic Html Theory.

Test Automation Using Selenium-Recording Tests: Selenium Commands – SELENESE, Pattern Matching, Element Locators, Selenium RC Overview.

Section-D

Test Automation Using Selenium-Recording Tests: Install and Run Selenium RC, Recording and Playing Back Test Cases, Test Case Verification, Working with Test Suites, Test Case HTML Reports.

Test Automation Using Selenium-Recording Tests: The Eclipse IDE, Running a Test Using the JUnit Export from Selenium-IDE, Running a Test Using the TestNG Export from Selenium-IDE, Data Driven Testing using TestNG.

Test Automation Using Selenium: Selenium Grid: Introduction of Selenium Grid, Usage of Selenium Grid, executing same test on different browsers.

Text Books:

1. William Perry, "Effective Methods for Software Testing", John Wiley & Sons, New York, 1995.
2. Louise Tamres, "Software Testing", Pearson Education Asia, 2002.
3. CemKaner, Jack Falk, Nguyen Quoc, "Testing Computer Software", Second Edition, Van Nostrand Reinhold, New York, 1993.
4. David Burns, "SELENIUM 2 TESTING TOOLS: BEGINNER'S GUIDE", Packt Publishing.

Reference Books:

1. K.K. Aggarwal&Yogesh Singh, "Software Engineering", 2nd Ed., New Age International Publishers, New Delhi, 2005.
2. Boris Beizer, "Software Testing Techniques", Second Volume, Second Edition, Van Nostrand Reinhold, New York, 1990.
3. AdityaGarg, "A Practitioner's Guide To Test Automation Using Selenium", 1st Edition, McGraw Hill Education (India) Private Limited.

Course Title/ Code	Network Simulator(v2 &v3)(CSW626)
Course Type	Core
Course Nature	Workshop
L-T-P-O Structure	(0-0-3-0)
Objectives	Students shall be able to learn the NSv2 and NSv3 to Simulate and develop different Networks as per as the network requirements.

Section-A

Introduction to Network Simulator-2: History of NS2-Application-Basic architecture- NS2 goals- NS2 functionalities- Languages used- Installation of NS2 in Linux and Windows Environment.

Tcl/Otcl Programming: Variables-List- Procedure-Array-Conditional statements- Looping-Structures- Classes and objects-Expressions- File handling- Input/output Console.

Section-B

Simulation of Wired Networks Protocols: Simulator Class-Scheduler Class-Trace the events- Node creation- Link between nodes- Communication Agent(UDP,TCP ,TCPAgent)- Traffic agent(CBR,FTP)- Network Simulation, Nam tool, Xgraphtool, LossMonitor.

Simulation of Local Area Network Protocols: Channel Access Schemes(Aloha, Slotted Aloha, CSMA/CD), MAC Protocols, Ethernet Simulation.

Section-C

Simulation of Wireless Networks Protocols: Node Configuration-Routing protocols- Energy model- Topology generation- Graphical events on node- Neighbor Discovery- Route Discovery- Event Scheduling- Network Simulation.

Simulation of Wired-cum-Wireless Network: Simple wired-cum-wireless scenario- Running Mobile-IP in wired-cum-wireless topology.

Section-D

Introduction to Ns-3 and Simulation of Wired Network Protocols: Introduction, Installation in linux and Windows Environment, Programming in Ns-3, Python Scriptings and Bindings, Wired Network and local Area Network.

Applications of Network Simulator: Wireless Sensor network-mannasim, Green Cloud Simulator, Vehicular networks, Mobile Adhoc Network.

Text Books:

1. Teerawat Issariyakul, Ekram Hossain, "Introduction to Network Simulator NS2", Springer Publication 2012.

Reference Books:

1. NS-2 Documentation (Online www.isi.edu)
2. NS-3 Documentation (Online www.nsnam.org)

DETAILED SYLLABUS

CSU01- Semester-IV

COURSE CODE	COURSE NAME	Course Type	Course Nature	PERIODS				CREDITS
		Core(Departmental/Allied)/ Elective (Departmental/ Open) / University Compulsory	Hard/Soft/ Workshop/ NTCC	L	T	P	O	
CSH627-T & CSH627-P	Big Data	Domain Core	Hard	3	0	2	1	5
CSN628	Dissertation (0-0-12)	Domain Core	NTCC	0	0	12	0	12
CSS629-T & CSS629-P	Professional and Ethical Issues	Allied Core	Soft	1	0	2	0	2

Course Title/ Code	Big Data(CSH627-T & CSH627-P)
Course Type	Core
Course Nature	Hard
L-T-P-O Structure	(3-0-2-1)
Objectives	Student will be able to do Big Data Programming and Analytics using Hadoop.

Section-A

Introductory Concepts (Digital Data and Big Data):Digital Data Basics,Types of Digital Data (Structured, Semi-Structured, Unstructured),Introduction to Big Data Platform, Dimensions of Big Data, Challenges with Big Data,

Big Data Architecture, Big Data Algorithm, Big Data visualization, Big Data Stack,ScalingProblems.Big data processing tools(AWS).

Hadoop overview: Brief history of Hadoop, Hadoop 1.0 vs. Hadoop 2.0, Hadoop Components, High level architecture of Hadoop,HadoopStreaming,Hadoop Compression.

Section-B

Big Data Analytics : Analytics 1.0, Analytics 2.0, Analytics 3.0,Traditional BI vs. Big Data Environment ,Big Data technology Landscape,NoSQLDatabases,NoSQL Vs. RDBMS, New SQL .

Frameworks: Fundamentals of PIG, HIVE, HBASE, ZOOKEEPER, SGOOP.

Section-C

Big data programming using Hadoop: Hadoop Distributed File System: Architecture, Daemons related to HDFS, working with HDFS command,Special features of Hadoop, Introduction to functional programming, How Map Reduce Works, Mapreduce on YARN, Map Reduce Joins, Map Reduce Work Flows. HDFS and Hadoop Ecosystem.

Section-D

Interacting with Hadoop Ecosystem, APACHE HIVE: History of HIVE,HIVE architecture, Hive Primitive Data Types and Collection Types, Hive File Formats ,Hive Query Language – Statements, DDL DML ,:History and anatomy of PIG,PIG on Hadoop, PIGfeatures, PIGPhilosophy, Fundamentals of APACHE PIG& HBASE ,Business Intelligence on Hadoop. Case Study: Hadoop and Hive at facebook

List of Experiments

1. To Install and set up of Hadoop along with Start up and shut down process.
2. Introduction to (Hadoop Distributed File System) labs
 - Loading data
 - Viewing the cluster contents
 - Getting data out of the cluster
3. To write basic map reduce program
 - Driver code
 - 3Mapper
 - Reducer
4. To Creating Input and Output formats in Map Reduce Jobs
 - Text Input format
 - Key value input format
 - Sequence file input format
5. To implementing Latin commands on pig/ How to use basic pig commands
6. Introduction to processing data with Hive
 - Creating tables with Hive
 - Managing hive table data location and lifetime
 - Loading data into hive tables
 - Partitioning the data
 - Querying tables with Hive QL
7. Project

Text Books:

1. Tom White “Hadoop: The Definitive Guide” Third Edition, O’reilly Media, 2012.
2. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007.
3. Michael Minelli (Author), Michele Chambers (Author), AmbigaDhiraj (Author) , Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley Publications, 2013.

Reference Books:

1. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGraw Hill Publishing, 2012.
2. AnandRajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
3. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons, 2012.
4. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons, 2007.
5. Pete Warden, “Big Data Glossary”, O’Reilly, 2011.
6. Paul Zikopoulos ,Dirk deRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corrigan , Harness the Power of Big Data The IBM Big Data Platform, Tata McGraw Hill Publications, 201