

University of Mumbai
B. Tech Computer Engineering
(Semester VII and VIII)
From
Academic Year 2017-18
(KJSCE 2014)

**K. J. Somaiya College of Engineering, Vidyavihar,
Mumbai -77**

(Autonomous College Affiliated to University of Mumbai)

Vision and Mission of Computer Engineering Department

Vision

To become a center of excellence in discipline of Computer Engineering for developing technically adept professionals with ethical and leadership qualities in service of society.

Mission

- Provide sound technical foundation in Computer Engineering through comprehensive curriculum and application oriented learning.
- Provide ambience for professional growth and lifelong learning for adapting to challenges in rapidly changing technology.
- Inculcate social and ethical values and leadership qualities.

Program Educational Objectives (PEOs)

A graduate of Computer Engineering will

PEO 1: Solve problems in diverse fields using knowledge of Computer Engineering.

PEO 2: Excel in professional career, exhibit leadership qualities with ethics & soft skills.

PEO 3: Pursue higher education, research or entrepreneurship, engage in professional development, adapt to emerging technologies.

Program Outcomes (POs)

After successful completion of the program a Computer Engineering Graduate will be able to:

PO1- Apply knowledge of mathematics, science and computer engineering fundamentals to the problems in computer systems.

PO2- Formulate and analyze computer engineering problems.

PO3-Design component(s) and module(s) (hardware/software) to develop solutions for computer engineering problems based on specifications and constraints.

PO4- Design and conduct experiments as well as to analyze and interpret the data.

PO5- Identify and apply modern tools to solve computer engineering problems.

PO6- Know the responsibility towards societal, health, safety, legal and cultural problems.

PO7- Understand the impact of computer engineering solutions on society and environment for sustainable development.

PO8- Apply knowledge of computer engineering in profession with ethical responsibility.

PO9- Function effectively as a leader or a member in diverse teams.

PO10- Communicate effectively in professional community and society at large.

PO11- Apply principles of engineering and management in projects as a member or leader of a team.

PO12- Pursue lifelong learning as a means of enhancing the knowledge in the context of technological change

Program Specific Outcomes (PSO)

After successful completion of the program a Computer Engineering Graduate will be able to:

- Apply acquired skills of Information Systems, Networking, and Image processing in solving problems of varying complexities.
- Pursue higher studies in the field of Computer Science & Engineering and be employable in industries.

Semester VII (Computer Engineering) Credit Scheme

Sub Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Pract	Tutorial	Theory	TW/	Tutorial	Total
						Practical		
UCEC701	Cryptography & System Security	3	-		3	-		3
UCEC702	Data warehousing & Mining	3	-	-	3	-	-	3
UCEC703	Software Project Management	3	-	-	3	-	-	3
UCEC704	Human Machine Interaction	3	-	-	3	-	-	3
UCEE70 X	Elective - II	3	-	-	3	-	-	3
UCEP701	Project-I		4			4		4
UCEL701	Cryptography & System Security Laboratory	-	2	-	-	1	-	1
UCEL702	Data warehousing & Mining Laboratory	-	2	-	-	1	-	1
UCEL703	Software Project Management Laboratory	-	2	-	-	1	-	1
UCEL704	Human Machine Interaction Laboratory	-	2	-	-	1	-	1
UCEL70 X	Elective – II Laboratory	-	2	-	-	1	-	1
Total		15	14	0	15	9	0	24

Elective II	
UCEE701	Advanced Compiler Design
UCEE702	Soft Computing
UCEE703	Internet of Things
UCEE704	Computer Simulation and Modelling
UCEE705	Image Analysis
UCEE706	Social, Mobile, Analytics and Cloud

Semester VII (Computer Engineering) Examination Scheme

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Pract.	Oral	Total
		Test 1	Test 2	IA	ESE				
UCEC701	Cryptography & System Security	15	15	10	60	-	-	-	100
UCEC702	Data Warehousing & Mining	15	15	10	60	-	-	-	100
UCEC703	Software Project Management	15	15	10	60	-	-	-	100
UCEC704	Human Machine Interaction	15	15	10	60	-	-	-	100
UCEE705	Elective - II	15	15	10	60	-	-	-	100
UCEL701	Cryptography & System Security Laboratory	-	-	-	-	25	-	25	50
UCEL702	Data Warehousing & Mining Laboratory	-	-	-	-	25	-	25	50
UCEL703	Software Project Management Laboratory	-	-	-	-	25	-	25	50
UCEL704	Human Machine Interaction Laboratory	-	-	-	-	25	-	25	50
UCEL70X	Elective – II Laboratory	-	-	-	-	25	-	25	50
UCEP701	Project - I					25		25	50
Total		75	75	50	300	150	0	150	800

Semester VIII (Computer Engineering) Credit Scheme

Subject Code	Subject Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Pract	Tutorial	Theory	TW/	Tutorial	Total
						Practical		
UCEC801	Distributed & Cloud Computing	3	-	-	3	-	-	3
UCEC802	Software Testing & Quality Assurance	3	-	-	3	-	-	3
UCEC803	Advance Internet Technology	3	-	-	3	-	-	3
UCEE80X	Elective -III	3	-	-	3	-	-	3
UCEP801	Project -II	-	8	-	-	8	-	8
UCEL801	Distributed & Cloud Computing Laboratory	-	2	-	-	1	-	1
UCEL802	Software Testing & Quality Assurance Laboratory	-	2	-	-	1	-	1
UCEL803	Advance Internet Technology Laboratory	-	2	-	-	1	-	1
UCEL80X	Elective –III Laboratory	-	2	-	-	1	-	1
Total		12	16	0	12	12	-	24

Elective III	
UCEE801	Machine Learning
UCEE802	Big Data Analytics
UCEE803	Software Architecture
UCEE804	Parallel Computing
UCEE805	Cyber Security Technology and Crime

Semester VIII (Computer Engineering) Examination Scheme

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Pract.	Oral	Total
		Test 1	Test 2	IA	ESE				
UCEC801	Distributed & Cloud Computing	15	15	10	60	-	-	-	100
UCEC802	Software Testing & Quality Assurance	15	15	10	60	-	-	-	100
UCEC803	Advanced Internet Technologies	15	15	10	60	-	-	-	100
UCEE80 X	Elective -III	15	15	10	60	-	-	-	100
UCEP801	Project -II	-	-	-	-	50	-	50	100
UCEL801	Distributed & Cloud Computing Laboratory	-	-	-	-	25	-	25	50
UCEL802	Software Testing & Quality Assurance Laboratory	-	-	-	-	25	-	25	50
UCEL803	Advanced Internet Technologies Laboratory	-	-	-	-	25	-	25	50
UCEL80 X	Elective –III Laboratory	-	-	-	-	25	-	25	50
Total		60	60	40	240	150	0	150	700

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEC701	Cryptography & System Security	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEC701	Cryptography & System Security	15	15	10	60	--	--		100

Course Outcome	After successful completion of the course students should be able to
CO1	Explain various security goals, threats, vulnerabilities and controls
CO2	Identify the principles of cryptographic techniques and Apply various cryptographic algorithms for securing systems
CO3	Apply Cryptographic Hash functions system security
CO4	Implement various Authentication mechanisms for Applications
CO5	Illustrate Secure software design principles and apply them for secure software development

Module No.	Unit No.	Details of Topic	Hrs.
Cryptography & System Security			
1		Introduction	4
	1.1	Security Attacks, Security Goals, Computer criminals, Methods of defense, Security Services, Security Mechanisms	
2		Basics of Cryptography and Modern Ciphers	11
	2.1	Traditional Symmetric Key cipher- Introduction, Substitution cipher, transposition ciphers, Stream and block ciphers, Other Cipher Properties- Confusion, Diffusion	
	2.2	Modern Block Ciphers, Modern Stream ciphers	
	2.3	Data Encryption Standard(DES), Strength of DES, Block Cipher Design Principles and Modes of Operations, Triple DES, Advance Encryption Standard- Transformations. Key expansion, AES cipher , Analysis of AES	
3		Public Key Cryptography	11
	3.1	Introduction, RSA cryptosystem, Rabin cryptosystem, Diffie Hellman	
	3.2	Message Integrity and Message Authentication Message integrity, Message authentication Cryptographic Hash Function –SHA-512,Tiger Hash Digital signatures – Comparison, Process, Services, attacks on Digital signature, Digital Signature Schemes, variations and Application, Entity Authentication - Passwords, Challenge Response System, Zero Knowledge, Biometrics	
	3.3	Key Management - Symmetric Key Distribution, Kerberos, Symmetric Key Agreement, Public Key Distribution, public Key infrastructure, X.509 certificates, hijacking	
	3.4	Security at Application Layer - PGP,S/MIME	
4		Program Security	7
	4.1	Description of a system, Users Trust and Trusted System, Buffer overflow, Format String Attacks and malicious Software, Malicious Programs, worms, Viruses, Phishing , Intrusion Detection System, Firewall: definitions, Construction and Working Principles	
5		Network Security	6
	5.1	Security at Transport Layer- SSL architecture, Four Protocols,	

		SSL Message formats, Transport Layer Security Security at Network Layer- Two modes, Two Security protocols, Security Association, Security Policy, Internet Key Exchange, ISAKMP Web Security and OWASP	
	5.2	DoS, DDoS, Session Hijacking and Spoofing	
		Total	39

Recommended Books:

1. Behrouz A Fourouzan, Debdeep Mukhopadhyay, "Cryptography and Network", 2nd edition, TMH.
2. Bernard Menezes, "Network Security and Cryptography", 2nd edition, Cengage Learning..
3. William Stallings, "Cryptography and Network Security: Principles and Practice" 5th edition, , Pearson
4. Charles P. Pfleeger, "Security in Computing", Pearson Education
5. Matt Bishop, "Computer Security Art and Science", Addison-Wesley
6. V K Pachghare: Cryptography and Information Security, PHE ,2013.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEC702	Data Warehousing and mining	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEC702	Data Warehousing and mining	15	15	10	60	--	--		100

Course Outcome	After successful completion of the course students should be able to
CO1	Design a data warehouse for any organization
CO2	Apply Online Analytical Processing to extract knowledge from a data warehouse
CO3	Learn data mining techniques in integrating and interpreting data set.
CO4	Compare and contract different data mining algorithms

Module No.	Unit No.	Details of Topic	Hrs.
Data Warehouse and Mining			
1		DATA WAREHOUSING	8
		Data warehousing Components –Building a Data warehouse – Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata.	
2		BUSINESS ANALYSIS	6
		Reporting and Query tools and Applications – Tool Categories – The Need for Applications – Cognos Impromptu – Online Analytical Processing (OLAP) – Need –Multidimensional Data Model – OLAP Guidelines – Multidimensional versus Multi relational OLAP – Categories of Tools – OLAP Tools and the Internet.	
3		Introduction to DATA MINING concepts	8
		What is Data Mining; Knowledge Discovery in Database (KDD), What can be Data to be Mined, Related Concept to Data Mining, Data Mining Technique, Application and Issues in Data Mining Data Exploration:Types of Attributes; Statistical Description of Data; Data Visualization; Measuring similarity and dissimilarity. Data Preprocessing:Why Preprocessing? Data Cleaning; Data Integration; Data Reduction: Attribute subset selection, Histograms, Clustering and Sampling; Data Transformation & Data Discretization: Normalization, Binning, Histogram Analysis and Concept hierarchy generation.	
4		ASSOCIATION RULE MINING AND CLASSIFICATION	9
		Association Rule Mining: Market Basket Analysis, Frequent Itemsets, Closed Itemsets, and Association Rules; Frequent Pattern Mining, Efficient and Scalable Frequent Itemset Mining Methods, The Apriori Algorithm for finding Frequent Itemsets Using Candidate Generation, Generating Association Rules from Frequent Itemsets, Improving the Efficiency of Apriori, A pattern	

		<p>growth approach for mining Frequent Itemsets; Mining Frequent itemsets using vertical data formats; Mining closed and maximal patterns; Introduction to Mining Multilevel Association Rules and Multidimensional Association Rules; From Association Mining to Correlation Analysis, Pattern Evaluation Measures; Introduction to Constraint-Based Association Mining.</p> <p>Classification Basic Concepts; Classification methods:</p> <ol style="list-style-type: none"> 1. Decision Tree Induction: Attribute Selection Measures, Tree pruning. 2. Bayesian Classification: Naïve Bayes' Classifier. <p>Prediction: Structure of regression models; Simple linear regression, Multiple linear regression.</p> <p>Model Evaluation & Selection: Accuracy and Error measures, Holdout, Random Sampling, Cross Validation, Bootstrap; Comparing Classifier performance using ROC Curves.</p> <p>Combining Classifiers: Bagging, Boosting, Random Forests.</p>	
5		CLUSTERING AND APPLICATIONS AND TRENDS IN DATA MINING	8
		<p>What is clustering? Types of data, Partitioning Methods (K-Means, KMedoids) Hierarchical Methods(Agglomerative , Divisive, BIRCH), Density-Based Methods (DBSCAN, OPTICS)</p> <p>Applications and trends in Data Mining</p>	
		Total	39

Recommended Books:

1. Alex Berson and Stephen J. Smith, “ Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Tenth Reprint 2007.
2. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Second Edition, Elsevier, 2007.
3. Paulraj Ponniah, “Data Warehousing: Fundamentals for IT Professionals”, Wiley India
4. Reema Theraja “Data warehousing”, Oxford University Press.
5. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, “ Introduction To Data Mining”, Person Education, 2007.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEC703	Software Project Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEC703	Software Project Management	15	15	10	60	--	--		100

Course Outcome	After successful completion of the course students should be able to
CO1	Provide an overview of software project management and the project planning.
CO2	Evaluate and assess the projects and to estimate the project cost using cost benefit evaluation techniques.
CO3	Plan various project activities based on efforts and duration estimations by analyzing risks involved in it.
CO4	Monitor the progress of projects and to assess the risk of slippage so that project's requirements can be controlled.
CO5	Understand the selection of the most appropriate people for the project and the role of continuing training and learning, to improve group working and to select appropriate leadership styles.

Module No.	Unit No.	Details of Topic	Hrs.
Software Project Management			
1		Software Project Management	4
	1.1	Introduction, Categorization of Software Projects, Importance of Software Project Management,	
	1.2	Contract management and Technical Project management	
	1.3	Activities of Software Project Management	
	1.4	Management control, problems with Software projects	
2		Project Evaluation and Project planning	8
	2.1	Strategic Programme management	
	2.2	Evaluation of Individual Project	
	2.3	Cost benefit analysis, Cash Flow Forecasting, Early start & late start, Crash cost.	
	2.4	Cost-benefit evaluation Techniques, Risk evaluation	
	2.5	Introduction to step-wise Project Planning	
3		Activity Planning and Risk Management	9
	3.1	Objectives of Activity Planning, Project schedules, projects and activities	
	3.2	Sequencing and Scheduling Activities, Network Planning Models Forward Pass, Backward Pass, Identifying the critical path, AoA & AoN diagrams.	
	3.3	Activity Float ,Shortening Project Duration, Activity on Arrow Networks	
	3.4	Categories of Risks, Nature Of Risk, Types of Risk, Risk Identification, Risk Assessment, Risk planning and control, Risk management, Evaluating risk to schedule, PERT technique.	
4		Project Monitoring and control	9
	4.1	Introduction, Creating Framework ,Collecting The Data	
	4.2	Visualizing Progress, Cost Monitoring, Earned Value	
	4.3	Prioritizing Monitoring ,Getting Project Back To Target, Change	

		Control	
	4.4	Introduction , Types Of Contract, stages in contract placement, typical terms in contract.	
	4.5	Managing Contracts and acceptance.	
5		Team Organization and People Management	9
	5.1	Introduction, Understanding Behavior, Organizational Behavior	
	5.2	Selecting The Right Person for The Job, Instruction In The Best Methods, Motivation.	
	5.3	The Oldham-Hackman job Characteristics Model, Working in Groups, Becoming A Team	
	5.4	Decision Making, Leadership	
	5.5	Organizational Structures	
	5.6	Stress, Health and Safety	
Total			39

Recommended Books:

1. Bob Hughes, Mike cotterell, Rajib Mall “Software Project Management”, fifth Edition, Tata McGraw Hill, Special Indian Edition
2. Ramesh, Gopalaswamy, "Managing Global Projects", Tata McGraw Hill, 2001.
3. Royce, “Software Project Management”, Pearson Education, 1999.
4. Project Management Institute: “A Guide to the Project Management Body of Knowledge (PMBOK Guide)” 5th Edition Project Management Institute.
5. John Nicholas, Herman Steyn, “Project Management for Business Engineering and Technology” 4th Edition.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEC704	Human Machine Interaction	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEC704	Human Machine Interaction	15	15	10	60	--	--		100

Course Outcome	After successful completion of the course students should be able to
CO1	Design user centric interfaces
CO2	Design innovative and user friendly interfaces
CO3	Apply HMI in their day-to-day activities
CO4	Perform critical analysis of existing interface designs, and improve them.
CO5	Design application for social and technical task

Module No.	Unit No.	Details of Topic	Hrs.
Human Machine Interaction			
1		Introduction:	6
	1.1	Introduction to Human Machine Interface, Hardware, software and operating environment to use HMI in various fields.	
	1.2	The psychopathology of everyday things – complexity of modern devices; human-centered design; fundamental principles of interaction; Psychology of everyday actions- how people do things;	
	1.3	The seven stages of action and three levels of processing; human error	
2		Understanding Designs – Goal Directed & Guidelines	12
	2.1	Goal directed design; Implementation models and mental models; Beginners, experts and intermediates – designing for different experience levels;	
	2.2	Understanding users; Modeling users – personas and goals.	
	2.3	Perception, Getsalt principles, visual structure, reading is unnatural, color, vision, memory, six behavioral patterns, recognition and recall, learning, factors affecting learning, time.	
3		GUI:	4
	3.1	benefits of a good UI; popularity of graphics; concept of direct manipulation; advantages and disadvantages	
	3.2	characteristics of GUI; characteristics of Web UI; General design principles	
4		Interaction Styles and Communication	14
	4.1	Menus, Windows	
	4.2	Device based controls, Screen based controls	
	4.3	Text messages, feedback and guidance	
	4.4	Graphics, icons and images	
	4.5	Colors	
5		Past and future of HMI	3
	5.1	Perceptual interfaces, context-awareness and perception	
		Total	39

Recommended Books:

1. *Wilbert O. Galitz, "The Essential Guide to User Interface Design", Wiley publication.*
2. *Alan Cooper, Robert Reimann, David Cronin, "About Face3: Essentials of Interaction design", Wiley publication.*
3. *Donald A. Normann, "Design of everyday things", Basic Books; Reprint edition 2002*
4. *Rogers Sharp Preece, "Interaction Design: Beyond Human Computer Interaction", Wiley*

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEE701	Advanced Compiler Design	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEE701	Advanced Compiler Design	15	15	10	60	--	--	--	100

Course Outcome	After successful completion of the course students should be able to
CO1	Study phases of compiler and illustrate different parsing techniques
CO2	Illustrate different intermediate code generation techniques
CO3	Apply optimization techniques
CO4	Explain issues in Code Generation

Module No.	Unit No.	Details of Topic	Hrs.
Advanced Compiler Design			
1.0		Source Program Analysis	08
		Analysis of source program, Phases of compiler, Grouping of Phases, Compiler construction Tools, Lexical Analysis, Language for Lexical Analyzer, Role of parser, Context free Grammars, Writing a grammars, Predictive Parser LR Parser	
2.0		Intermediate Code Generation	07
		Intermediate Language, Declarations, Assignment statements, Boolean Expressions, Case Statements, Back Patching, Procedure calls	
3.0		Basic Optimization	08
		Constant Expression Evaluation, Scalar Replacement of Aggregates, Algebraic simplifications and Re association, Value Number, Copy Propagation, Common Sub expression Elimination, Loop invariant Code motion, Partial Redundancy Elimination, Redundancy Elimination and Re association, Code Hoisting, Induction Variable optimization, Unnecessary Bounds Checking Elimination	
4.0		Procedure Optimization and Register Allocation	08
		Tail call optimization and Tail Recursion Elimination, Procedure Integration, Inline Expansion, Leaf Routine optimization and shrink wrapping, Register allocation and assignment, Graph coloring, Unreachable Code Elimination, Straightening If simplifications, Loop Simplifications, Loop inversion, Un switching, Branch optimizations, Tail merging or cross jumping, Conditional moves, Dead code Elimination, Branch Prediction, Machine Idioms and Instruction combining	
5.0		Code Generation	08
		Issues in the Design of code generator, The Target Machine, Runtime Storage management , Next use information, A simple code generator, DAG Representation of Basic Blocks, Peephole Optimization, Generating code from DAG's	
		Total	39

Recommended Books:

1. *"Compilers Principles, Techniques and Tools"* Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Pearson Education.
2. *"Advanced Compiler Design Implimentation"*, Steven S. Muchnick, Academic Press.
3. *"Engineering a Compiler"*, Cooper & Torczon, Elsevier.
4. *"Compiler Construction: Principles and Practice"*, K C. Loudon, Cengage.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEE702	Soft Computing	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEE702	Soft Computing	15	15	10	60	--	--		100

Course Outcome	After successful completion of the course students should be able to
CO1	Explain the learning and adaptation capability of neural and fuzzy systems.
CO2	Design, analyze and solve problems using various Supervised & Unsupervised Neural Learning Algorithms.
CO3	Conceptualize fuzzy logic and apply the rules of fuzzy logic for fuzzy control.
CO4	Model hybrid systems using Neuro Fuzzy modeling & deep learning.

Module No.	Unit No.	Details of Topic	Hrs.
Soft Computing			
1		Supervised learning Neural Networks:	10
	1.1	Introduction to soft computing, overview of techniques in soft computing, applications.	
	1.2	Fundamental Concepts and Models of Artificial Neural Systems, Neural Network Learning Rules and Comparison. Linearly and Non-Linearly Separable Pattern Classification.	
	1.3	Multilayer Feedforward Network: Delta Learning Rule for Multiperceptron Layer, Adaline networks.	
	1.4	Error Back-propagation Training algorithm.	
2		Unsupervised learning Neural Networks:	10
	2.1	Associative Memory: Hopfield Network, Bidirectional Associative Memory, Radial basis function networks.	
	2.2	Introduction, competitive learning, Kohonen self-organizing feature maps.	
	2.3	Learning vector quantization, SPD, Basic ART network.	
3		Fuzzy Set Theory:	08
	3.1	Fuzzy Logic: Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets	
	3.2	Operations on Fuzzy & Classical Sets: Compliment, Intersections, Unions, Combinations of Operations, properties.	
	3.3	Classical relation & fuzzy relation: Cardinality operations, property and composition. Fuzzy arithmetic and extension principle.	
4		Fuzzy systems:	06
	4.1	Fuzzification: Definition, development of membership function.	
	4.2	De – Fuzzification: Introduction, Lambda Cut, defuzzification methods and fuzzy rule based systems (Mamdani & Sugeno model).	
5		Hybrid systems & introduction to deep learning:	05
	5.1	Fuzzy-Neural Systems, Neuro-Genetic Systems, Fuzzy-Genetic Systems,	
	5.2	Deep Learning : Definition & background, historical Context of deep learning, Three classes of deep learning network.	
Total			39

Recommended Books:

- 1) *S. N. Sivanandam and S. N. Deepa, "Principles of Soft Computing," 2nd ed. Wiley India*
- 2) *J.S.R.Jang "Neuro-Fuzzy and Soft Computing" PHI 2003.*
- 3) *Jacek M. Zurada, "Introduction to Artificial Neural Systems," Jaico Publishing House.*
- 4) *Timothy J. Ross, "Fuzzy Logic with Engineering Applications," 3rd ed. Wiley India.*
- 5) *Haykin, Simon. Neural Networks and Learning Machines, Pearson Higher Education.*
- 6) *Adaptive Business Intelligence by Zbigniew Michalewicz, Martin Schmidt, Matthew Michalewicz, Constantin Chiriac "Adaptive Business Intelligence" by Springer Publication.*

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEE703	Internet of Things	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEE703	Internet of Things	15	15	10	60	--	--		100

Course Outcome	After successful completion of the course students should be able to
CO1	Interpret the Internet of Things concepts and challenges
CO2	Evaluate the software for IoT Technologies.
CO3	Study Hardware Platforms used in IoT
CO4	Design small IoT applications

Module No.	Unit No.	Details of Topic	Hrs.
Internet of Things			
1		Introduction to Internet of Things	04
	1.1 1.2 1.3.	Physical Design Logical Design IoT Enabling Technologies	
2		Domain Specific IoTs	08
	2.1 2.2 2.3 2.4	Home Automation. Environment, Energy Retail & Logistics Health & Life Style	
3		IoT & M2M	06
	3.1 3.2	Difference Between IoT & M2M SDN & NFV for IoT	
4		IoT Physical Devices	10
	4.1 4.2 4.3 4.4 4.5	Basic Arduino Programming Extended Arduino Libraries, Arduino – Based Internet Communication, Raspberry PI Sensors and Interfacing.	
5		IoT design Methodology	07
	5.1 5.2	Generic Design Methodology Application Development Steps	
6		Case Study	04
		Agriculture Industrial Application Cities	
Total			39

Recommended Books:

1. *Arshdeep Bahga, Vijay Madisetti, "Internet of Things, A Hands-on Approach", University Press*
2. *Samuel Greengard., "The Internet of Things", MIT Press*
3. *Marco Schwartz, "Arduino Home Automation Projects" Packt Publishing Limited*
4. *Adrian Mcewen, Hakin Cassimally, "Designing The Internet of Things", Wiley*

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEE704	Computer Simulation & Modeling	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEE704	Computer Simulation & Modeling	15	15	10	60	--	--	--	100

Course Outcome	After successful completion of the course students should be able to
CO1	Understand basic concepts of simulation and modeling.
CO2	Use various statistical methods and queuing in simulation and modeling.
CO3	Generate random numbers, random variates and apply various random number testing techniques.
CO4	Analyze the systems for input modeling, output analysis and validation.

Module No.	Unit No.	Details of Topic	Hrs
1		Introduction to Simulation, Simulation Examples & general principles	10
	1.1	Introduction to Simulation: advantages, disadvantages, types of models & steps in simulation study.	
	1.2	Simulation Examples: Manual Simulation: Queuing and Inventory problems	
	1.3	General Principles: Event Scheduling Algorithm/Time advance algorithm, Simulation using time advance algorithm.	
2		Statistical & Queuing Models	10
	2.1	Statistical Models in simulation: Discrete and Continuous Distributions.	
	2.2	Queuing Models: M/G/1, M/M/1	
3		Random Number Generation	10
	3.1	Random Number Generation Techniques	
	3.2	Testing random numbers: Chi square, K-S, Runs up and Down test.	
	3.3	Random Variate Generation: Inverse transform technique, Convolution Method & Acceptance-Rejection Technique	
4		Analysis of simulation data	06
	4.1	Input Modeling, Verification, Calibration and Validation of Simulation. Models.	
	4.2	Estimation of absolute performance, Output Analysis Concepts	
5		Applications of Simulation, Case Study of Simulated systems	03
Total			39

Recommended Books:

1. *Jerry Banks, John Carson, Barry Nelson, and David M. Nicol, “Discrete Event System Simulation”; Third Edition, Prentice-Hall.*
2. *Averill M Law, “System Modeling & Analysis”; 4th Edition TMH.*
3. *Banks C M , Sokolowski J A, “Principles of Modeling and Simulation”, Wiley*
4. *Geoffrey Gordon, “ System Simulation”, EEE*
5. *Narsing Deo, “System Simulation with Digital Computer”, PHI*

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEE705	Image Analysis	03	-	--	03	-	-	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Assignment/Quiz/Presentation					
UCEE705	Image Analysis	15	15	10	60	-	-	-	100

Course Outcome	After successful completion of the course students should be able to
CO1	Explain Image processing system
CO2	Illustrate the importance of Image Analysis .
CO3	Analyze different methods of Feature generation, Representation Description
CO4	Use the methods of image analysis for various Image Processing Applications

Module No.	Unit No.	Details of Topic	Hrs.
1		Introduction to Image Processing System	10
	1.1	Introduction, Elements of Image Processing System Image Modelling – Sampling, Quantization and Representing Digital Images.	
	1.2	Image Preprocessing – Enhancement : Power Law Transformation, Contrast Stretching and Histogram Equalization,	
	1.3	Smoothing, Sharpening., Spatial domain Filters	
	1.4	Morphological Image Processing: Dilation and Erosion, Opening and Closing, The Hit-or-Miss Transformation	
2		Feature Generation & Image Analysis	9
	2.1	Edge Detection operators :Sobel,prewitt and other edge detection operators.	
	2.2	Image Segmentation: Thresholding, Edge based and Region Based Segmentation.	
	2.3	Boundary Extraction, Feature Extraction, Spatial Feature Extraction and Transform Feature Extraction.	
3		Image Representation and Description	9
	3.1	Boundary Representation : Chain codes ,Fourier descriptors Region Representation :Run length codes	
	3.2	Structure Representation : Morphological Processing and transforms Moments Representation :Moment matching	
	3.3	Shape Representation :geometry features, moment based features Texture Representation: statistical, structure approach	
4		Statistical decision making and Vector Quantization	7
	4.1	Statistical decision making: Bayesian theorem	

	4.2	Multiple features Vector Quantization	
5		Case study : Medical image processing, fingerprint	4
		Total	39

Recommended Books

1. *Fundamentals of Digital Image Processing* Anil K. Jain, PHI
2. *Digital Image Processing An Algorithm Approach*, Madhuri A. Joshi, PHI
3. *Digital Image Processing ,Second Edition*, Rafael C. Gonzalez and Richard E.Woods, Pearson Prentice Hall,
4. *Pattern recognition and Image analysis* by Earl Gose, Richard Johnsonbaugh, Steve Jost, PHI publication

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEE706	Social, Mobile, Analytics and Cloud	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEE706	Social, Mobile, Analytics and Cloud	15	15	10	60	--	--		100

Course Outcome	After successful completion of the course students should be able to
CO1	Explain fundamentals of SMAC and pillars of SMAC
CO2	Describe benefits, challenges and key enterprise trends in mobile arena.
CO3	Explain the purpose of analytics and big data
CO4	Explain regarding cloud computing structure, cloud service types, security in cloud and clouds benefits to market.
CO5	Describe in detail SMAC implementation with flexible integration model

Module No.	Unit No.	Details of Topic	Hrs.
Social Media Analytics and Cloud			
1		Introduction to SMAC and Social:	6
	1.1	What is SMAC convergence; SMAC stack and market impact SMAC impact on digital channel, Pillars of SMAC	
	1.2	Social media and its impact	
	1.3	Social media in regions	
	1.4	Reasons of social media use	
	1.5	Social media benefits for business	
	1.6	Enterprise social media application market	
	1.7	social media strategy framework	
	1.8	Social Media intelligence	
	1.9	Social CRM	
2		Mobile:	8
	2.1	Mobile devices and its limitations	
	2.2	Mobile subscriber and data traffic	
	2.3	Mobile penetration	
	2.4	Enterprise mobile market	
	2.5	Benefits of enterprise mobility	
	2.6	Key enterprise trends in mobile arena	
	2.7	Key industry challenges imposed by mobile trends	
	2.8	Mobile maturity	
	2.9	Mobile within the SMAC stack	
3		Analytics and Big Data:	10
	3.1	Introduction to Big Data Platform	
	3.2	Challenges of Conventional Systems	
	3.3	Intelligent data analysis	
	3.4	Nature of Data	
	3.5	Analytic Processes and Tools	
	3.6	Analysis v/s Reporting	
	3.7	Modern Data Analytic Tools	
	3.8	Big data market	
	3.9	Big data framework and ecosystem data sources	
	3.10	Big data implication to business	

	3.11	Implementation model	
	3.12	Big data purpose	
	3.13	Analytics in e-commerce	
	3.14	SoLoMo analytics	
	3.15	Business analytics expectations	
	3.16	Social Media Analytics	
	3.17	Google Analytics	
	3.18	SEO	
4		Cloud	7
	4.1	Cloud computing structure	
	4.2	Deployment model	
	4.3	Cloud computing service types	
	4.4	Data Governance	
	4.5	Data Security	
	4.6	Application Security	
	4.7	cloud service benefits	
	4.8	cloud computing market	
	4.9	Types of cloud service	
	4.10	Growth drivers	
5		SMAC implementation roadmap	8
	5.1	Develop an open IT structure and multichannel platform	
		Open architecture	
		Multichannel platform	
	5.2	Cloud should be on the core	
	5.3	Allow open mobile access	
		Mobile application development and connectivity	
		Mobile analytics	
	5.4	Encourage social interaction	
	5.5	Use analytics for insight and business decision	
		Cloud-based deployment	
	5.6	Ensure devOps culture for faster innovation	
		DevOps architecture	
		DevOps tool chain	
		Monitor and optimize	
	5.7	Implement flexible integration model	

	5.8	SMAC success case studies	
			Total 39

Recommended Books:

1. *Dan Zarrella: The Social Media Marketing Book: 2010 edition, O'Reilly Media.*
2. *Ganis/Kohirkar, Social Media Analytics, First Edition, 2016, Pearson Education India*
3. *Rajkamal: Mobile computing, Oxford University Press, 2007 edition.*
4. *John W. Rittinghouse, James F. Ransome: Cloud Computing: Implementation, Management, and Security, CRC Press Taylor & Francis Group, 2010*
5. *Michael Minelli (Author), Michele Chambers (Author), Ambiga Dhiraj (Author), Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Wiley Publications, 2013*

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEL701	Cryptography & System Security Laboratory		02			01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEL701	Cryptography & System Security Laboratory					25		25	50

Term Work:

Term work should consist of practical experiments and assignments based on the syllabus of the course **UCEC701 Cryptography & System Security**

Term work assessment will be based on the overall performance of the student during practical with every experiment graded from time to time. The grades converted into marks as per Grade Table will be added and averaged as final TW marks.

The Oral examination will be based on UCEC701 Cryptography & System Security and UCEL701 Cryptography & System Security Laboratory.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEL702	Data Warehousing and Data mining Laboratory		02			01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEL702	Data Warehousing and mining Laboratory					25	25	--	50

Term Work:

Term work should consist of practical experiments and assignments based on the syllabus of the course **UCEC702 Data Warehousing and mining**.

Term work assessment will be based on the overall performance of the student during practical with every experiment graded from time to time. The grades converted into marks as per Grade Table will be added and averaged as final TW marks.

The oral examination will be based on UCEC702 Data Warehousing and mining and UCEL702 Data Warehousing and mining Laboratory.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEL703	Software Project Management Laboratory	--	02	--	--	01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEL703	Software Project Management Laboratory	--	--	--	--	25	--	25	50

Term Work:

Term work should consist of practical experiments and assignments based on the syllabus of the course **UCEC703 Software Project Management**.

Term work assessment will be based on the overall performance of the student during practical with every experiment graded from time to time. The grades converted into marks as per Grade Table will be added and averaged as final TW marks.

The oral examination will be based on UCEC703 Software Project Management and UCCEL703 Software Project Management Laboratory.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEL704	Human Machine Interaction Laboratory		02			01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEL704	Human Machine Interaction Laboratory					25	--	25	50

Term Work:

Term work should consist of practical experiments and assignments based on the syllabus of the course **UCEC704 Human Machine Interaction**.

Term work assessment will be based on the overall performance of the student during practical with every experiment graded from time to time. The grades converted into marks as per Grade Table will be added and averaged as final TW marks.

The oral examination will be based on UCEC704 Human Machine Interaction and UCEL704 Human Machine Interaction Laboratory.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEL70X	Elective –II Laboratory		02			01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEL70X	Elective –II Laboratory					25		25	50

Term Work:

Term work should consist of practical experiments based on the syllabus of the **concerned Elective Course**.

Term work assessment will be based on the overall performance of the student during practical with every experiment graded from time to time. The grades converted into marks as per Grade Table will be added and averaged as final TW marks.

The Oral examination will be based on Laboratory and Theory course of respective Elective

Elective II	
UC EE701	Advanced Compiler Design
UC EE702	Soft Computing
UC EE703	Internet of Things
UC EE704	Computer Simulation and Modelling
UC EE705	Image Analysis
UC EE706	Social, Mobile, Analytics and Cloud

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEC801	Distributed & Cloud Computing	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEC801	Distributed & Cloud Computing	15	15	10	60	--	--		100

Course Outcome	After successful completion of the course students should be able to
CO1	Identify the principles and concepts in parallel and distributed computing systems
CO2	Describe Scalable Parallel Computing architectures
CO3	Classify virtualization in to its various forms
CO4	Demonstrate use of various Cloud Platform Architectures
CO5	Explore different types of architectures for Distributed computing

Module No.	Unit No.	Details of Topic	Hrs.
Distributed & Cloud Computing			
1		Distributed System Models and Enabling Technologies	07
	1.1	Scalable Computing Over the Internet, Technologies for Network-Based Systems, System Models for Distributed and Cloud Computing, Software Environments for Distributed Systems and Clouds, Performance, Security, and Energy Efficiency	
2		Computer Clusters for Scalable Parallel Computing	07
	2.1	Clustering for Massive Parallelism, Computer Clusters and MPP Architectures, Design Principles of Computer Clusters, Cluster Job and Resource Management	
3		Virtual Machines and Virtualization of Clusters and Data Centers	08
	3.1	Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation	
4		Cloud Platform Architecture over Virtualized Data Centers	08
	4.1	Cloud Computing and Service Models, Data-Center Design and Interconnection Networks, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms: GAE, AWS, and Azure, Inter-cloud Resource Management, Cloud Security and Trust Management	
5		Service-Oriented Architectures for Distributed Computing	09
	5.1	Services and Service-Oriented Architecture, Message-Oriented Middleware, Portals and Science Gateways, Discovery, Registries, Metadata, and Databases, Workflow in Service-Oriented Architectures	
		Total	39

Recommended Books:

1. Kai Hwang, Jack Dongarra, Geoffrey C. Fox , *Distributed and Cloud Computing: From Parallel Processing to the Internet of Things*, 1st Edition, Morgan Kaufmann Publishers Inc.
2. Rajkumar Buyya , James Broberg, Andrzej Goscinski: *Cloud Computing Principles and Paradigms*, Willey 2014.
3. John W Rittinghouse, James F Ransome: *Cloud Computing Implementation, Management and Security*, CRC Press 2013
4. Dan C Marinescu: *Cloud Computing Theory and Practice*. Elsevier (MK) 2013

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEC802	Software Testing & Quality Assurance	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEC802	Software Testing & Quality Assurance	15	15	10	60	--	--		100

Course Outcome	After successful completion of the course students should be able to
CO1	Explore the fundamentals of testing.
CO2	Describe the various levels of testing and their use in designing of various test cases.
CO3	Model various test cases for real life applications.
CO4	Outline software quality concepts.
CO5	Identify software quality assurance goals and standards.

Module No.	Unit No.	Details of Topic	Hrs.
1		Fundamentals of Testing:	5
		Human and errors, Testing and Debugging, Software Quality, Requirement Behavior and Correctness, Fundamentals of Test Process, Psychology of Testing, General Principles of Testing, The Tester's Role in a Software Development Organization, Origins of Defects, Defect Classes, The Defect Repository and Test Design, Defect Examples	
2		Levels of Testing:	8
		The Need for Levels of Testing, Unit Test, Unit Test Planning, Designing the Unit Tests. The Class as a Testable Unit, The Test Harness, Running the Unit tests and Recording results, Integration tests, Designing Integration Tests, Integration Test Planning, System Test – The Different Types, Regression Testing, Alpha, Beta and Acceptance Tests	
3		Test Case Design and Implementation:	10
		Introduction to Testing Design Strategies, Test Case Design Strategies, Using Black Box Approach to Test Case Design, Random Testing, Equivalence Class Partitioning, Boundary Value Analysis, Other Black box Test Design Approaches, Using White-Box Approach to Test design, Coverage and Control Flow Graphs, Covering Code Logic, Additional White Box Test Design.	
4		Quality Concepts	8
		Introduction to software quality, definition of software quality, quality dimensions and factors, cost, risks, security. Achieving software quality: Software Engineering Methods, Project Management Techniques , Quality Control , Quality Assurance	
5		Software Quality Assurance	8
		Elements of software quality assurance, SQA tasks , goals and metrics, formal approaches to SQA, statistical software quality assurance: ISO ,CMMI and PCMMI, Six Sigma, software reliability , SQA plan.	
		Total	39

Recommended Books:

1. Bernd Bruegge, *“Object oriented software engineering”*, Second Edition, Pearson Education.
2. Stephan R. Schach, *“Object oriented software engineering”*, Tata McGraw Hill.
3. Roger Pressman, *“Software Engineering”*, sixth edition, Tata McGraw Hill.
4. Timothy C. Lethbridge, Robert Laganier *“ Object-Oriented Software Engineering -A practical software development using UML and Java”*, Tata McGraw-Hill, New Delhi
5. Ian Sommerville, *“Software Engineering”* 6th Edition, Pearson Education

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEC803	Advanced Internet Technology	03	02	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEC803	Advanced Internet Technology	15	15	10	60	--	--		100

Course Outcomes:

Course Outcome	After successful completion of the course students should be able to
CO1	Use different tools and techniques for responsive web design.
CO2	Identify the use of mashup in rich internet applications.
CO3	Describe the role of web services in web application development.
CO4	Describe the different techniques for search engine optimization.

Module No.	Unit No.	Details of Topic	Hrs.
Advanced Internet Technology			
1		Responsive web with HTML 5 and CSS3	10
	1.1	Getting Started with HTML 5, CSS3 for Responsive Web Design.	
	1.2	Media Queries: Supporting Differing Viewports, Embracing Fluid Layout HTML 5 for Responsive Design.	
	1.3	CSS3: Selectors, Typography and color Modes Stunning Aesthetics with CSS3, CSS3 Transitions, Transformations and Animations, Conquer Forms HTML5 and CSS3.	
2		RIA and Mashup	10
	2.1	Characteristic of RIA – Web Mashup Mashup Techniques : 1) Mashing on the Web Server, Rich User Interface using Ajax, Mashing with JSON 2) RIA: Ajax vs Traditional Approach JavaScript and AJAX, Angular JS.	
	2.2	JSON Alternative to XML	
	2.3	Syndication	
3		REST and WS * Web Services	07
	3.1	Understanding Web Services technology, REST based web services (Resource Oriented Architecture) and Service oriented Architecture.	
	3.2	REST design principles, create, read, update, and delete (CRUD) operations and HTTP methods. use of POST. GET. PUT. DELETE.	
4		Search Engine Optimization	06
	4.1	Developing SEO plans Prior to Site Development - SEO for Raw traffic; E-commerce Sales; Mindsahre/Branding; Direct Marketing; Reputation Management; Ideological Influence Getting started	

		SEO: Defining Your Site's Information Architecture, Auditing an Existing Site to identify SEO Problems, Identifying Current Server Statistic Software and Gaining Access	
	4.2	Search Engine Basics Algorithm based Ranking Systems – Determining Searcher Intent and Delivering Relevant, Fresh Content, Analyzing Ranking Factors, Using Advanced Search Techniques, Vertical Search Techniques, Country Specific Search Engines Determining SEO Objective and Finding Your Site's Audience – Setting SEO Goals and Objective	
5		Website SWOT analysis	06
	5.1	Determining Top competitors, Benchmarking Current Indexing Status, Current Rankings, Benchmarking Current Traffic Source and Volumes, Conduct SEO/Website SWOT analysis. Keyword Generation Creating Pages	
	5.2	Website Structure- Creating Content-Creating Communities building Links-Using Google Analytics-Social Media Optimization-Creating Pay-per-click Campaigns Optimizing PPC Campaigns through Quality Score optimization - Tracking Results and Measuring Success.	
		Total	39

Recommended Books:

1. *Rich Internet Application AJAX and Beyond* WROX press 2.
2. *Web Technology*, Srinivasan, Pearson
3. *Professional Web 2.0 Programming* WROX press 2.
4. *Responsive Web Design with HTML5 and CSS3* PACKT 3.
5. *The Art of SEO* O'Reilly Publication
6. *Using Google App Engine*: By Charles : O'reilly Press
7. *Web Services Essentials*:By Ethan: O'Reilly
8. *RESTful web services*: By Leonard: O'Reilly Press
9. *Angular JS* : Brad Green : O'Reilly Press

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEE801	Machine Learning	03	-	--	03	-	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEE801	Machine Learning	15	15	10	60	--	--		100

Course Outcome	After successful completion of the course students should be able to
CO1	Describe and apply supervised learning methods
CO2	Appreciate Dimensionality reduction techniques
CO3	Analyze unsupervised learning methods
CO4	Understand the working of Reinforcement learning.

Module No.	Unit No.	Details of Topic	Hrs.
Machine Learning			
1		Machine Learning Basics :	4
	1.1	What is Machine Learning?, Key Terminology, Types, Applications of Machine Learning, How to choose the right algorithm, Steps in developing a Machine Learning Application.	
2		Supervised Learning :	9
	2.1	Linear Regression, Logistic Regression.	
	2.2	Decision Trees, Constructing Decision Trees, Classification and Regression Trees (CART)	
3		Learning with Classification :	8
	3.1	Support Vector Machines: Maximum Margin Linear Separators, Quadratic Programming solution, Kernels for learning non-linear functions.	
	3.2	Bayesian Belief networks, Hidden Markov Models.	
4		Dimensionality Reduction :	6
	4.1	Dimensionality Reduction Techniques: Principal Component Analysis, Independent Component Analysis.	
5		Unsupervised Learning :	6
	5.1	K-means clustering, Hierarchical clustering, Expectation Maximization Algorithm, Supervised learning after clustering, Radial Basis functions	
6		Reinforcement Learning :	6
	6.1	Introduction, Elements of Reinforcement Learning, Model based learning, Temporal Difference Learning, Generalization, Partially Observable States.	
		Total	39

Recommended Books:

1. *Peter Harrington “Machine Learning In Action”, DreamTech Press*
2. *Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press*
3. *Tom M. Mitchell “Machine Learning” McGraw Hill*
4. *Stephen Marsland, “Machine Learning An Algorithmic Perspective” CRC Press*

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEE802	Big Data Analytics	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEE802	Big Data Analytics	15	15	10	60	--	--		100

Course Outcome	After successful completion of the course students should be able to
CO1	Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.
CO2	Understand the fundamental enabling techniques like Hadoop, MapReduce and NO SQL in achieving Big data analytics
CO3	Demonstrate the statistical analysis techniques used in decision making.
CO4	Interpret business models and scientific computing paradigm for solving real world problems.

Module No.	Unit No.	Details of Topic	Hrs.
Big Data Analytics			
1		Introduction to Big Data and mining large scale system	8
	1.1	Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Case Study of Big Data Solutions.	
	1.2	Introduction to Hadoop and its components, NOSQL	
	1.3	Distributed File Systems : Physical Organization of Compute Nodes, Large-Scale File-System Organization MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures.	
	1.4	Algorithms Using MapReduce: Matrix-Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce, Grouping and Aggregation by MapReduce, Matrix Multiplication, Matrix Multiplication with One MapReduce Step.	
2		Finding Similar Items	3
	2.1	Applications of Near-Neighbor Search, Jaccard Similarity of Sets, Similarity of Documents, Collaborative Filtering as a Similar-Sets Problem.	
	2.2	Distance Measures: Definition of a Distance Measure, Euclidean Distances, Jaccard Distance, Cosine Distance, Edit Distance, Hamming Distance.	
3		Mining Data Streams	6
	3.1	The Stream Data Model: A Data-Stream-Management System, Examples of Stream Sources, Stream Query, Issues in Stream Processing.	

	3.2	Sampling Data in a Stream: Obtaining a Representative Sample, The General Sampling Problem, Varying the Sample Size.	
	3.3	Filtering Streams: The Bloom Filter, Analysis.	
	3.4	Counting Distinct Elements in a Stream The Count-Distinct Problem, The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements. Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-Indyk-Motwani Algorithm, Query Answering in the DGIM Algorithm, Decaying Windows.	
4		Link Analysis And Frequent Itemsets	10
	4.1	PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: PageRank Iteration Using MapReduce, Use of Combiners to Consolidate the Result Vector. Topic sensitive Page Rank, link Spam, Hubs and Authorities	
	4.2	Handling Larger Datasets in Main Memory Algorithm of Park, Chen, and Yu, The Multistage Algorithm, The Multihash Algorithm.	
	4.3	The SON Algorithm and MapReduce	
	4.4	Counting Frequent Items in a Stream Sampling Methods for Streams, Frequent Item sets in Decaying Windows	
5		Clustering	12
	5.1	CURE Algorithm, Stream-Computing , A Stream-Clustering Algorithm, Initializing & Merging Buckets, Answering Queries	

	5.2	Case Studies: Recommendation Systems, Mining Social-Network Graphs	
		Total	39

Recommended Books:

1. Anand Rajaraman and Jeff Ullman *“Mining of Massive Datasets”*, Cambridge University Press,
2. Alex Holmes *“Hadoop in Practice”*, Manning Press, Dreamtech Press.
3. Dan McCreary and Ann Kelly *“Making Sense of NoSQL” – A guide for managers and the rest of us*, Manning Press.
- :
4. Bill Franks , *“Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics”*, Wiley
5. Chuck Lam, *“Hadoop in Action”*, Dreamtech Press

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEE803	Software Architecture	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEE803	Software Architecture	15	15	10	60	--	--		100

Course Outcome	After successful completion of the course students should be able to
CO1	Design the architecture of software systems in various architectural styles
CO2	Analyze software architecture using analysis techniques
CO3	Analyze non-functional properties in the architectural design
CO4	Design domain models for domain specific software engineering and architecture

Module No.	Unit No.	Details of Topic	Hrs.
Software Architecture			
1		Basic Concepts, Designing Architectures, Conventional Architectural styles :	10
	1.1	Concepts of Software Architecture, Models, Processes, Stakeholders	
	1.2	The Design Process, Architectural Conception,	
	1.3	Styles and Architectural Patterns, Pipes and Filters, Event- based, Implicit Invocation, Layered systems, Repositories, Interpreters,	
2		Connectors :	6
	2.1	Connector Foundations, Connector Roles	
	2.2	Connector Types and Their Variation Dimensions, Example	
3		Modeling , Analysis :	10
	3.1	Modeling Concepts, Ambiguity, Accuracy, and Precision, Complex Modeling: Mixed Content and Multiple Views, Evaluating Modeling Techniques, Specific Modeling Techniques	
	3.2	Analysis Goals, Scope of Analysis, Architectural Concern being Analyzed, Level of Formality of Architectural Models, Type of Analysis, Analysis Techniques	
4		Designing for Non-Functional Properties and implementation	6
	4.1	Efficiency, Complexity, Scalability and Heterogeneity, Adaptability, Dependability Concepts, Existing Frameworks	
5		Applied Architectures and Domain-Specific Software Engineering	7
	5.1	Distributed and Networked Architectures, Architectures for Network-Based Applications, Decentralized Architectures, Service-Oriented Architectures and Web Services	

	5.2	Domain-Specific Software Engineering in a Nutshell, Domain-Specific Software Architecture, DSSAs, Product Lines, and Architectural Styles	
		Total	39

Recommended Books:

- 1) *Richard N. Taylor, Nenad Medvidovic, Eric Dashofy, "Software Architecture: Foundations, Theory, and Practice" ISBN: 978-0-470-16774-8*
- 2) *M. Shaw: "Software Architecture Perspectives on an Emerging Discipline", Prentice-Hall.*
- 3) *Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Pearson.*

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEE804	Parallel Computing	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEE804	Parallel Computing	15	15	10	60	--	--		100

Course Outcome	After successful completion of the course students should be able to
CO1	Understand different parallel processing approaches and issues involved in it to achieve high computing performance
CO2	Evaluate the parallel computing performance with different processors architectures
CO3	Design and development on parallel platform

Module No.	Unit No.	Details of Topic	Hrs.
Parallel Computing			
1		Parallel Processing approaches	12
	1.1	Introduction to parallel processing: Levels of parallelism (instruction, transaction, task, thread, memory, and function),	
	1.2	Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation etc).	
	1.3	Parallel platforms: Message-passing interface (MPI), Shared-memory thread-based OpenMP programs, and hybrid (MPI/OpenMP) programs, Hadoop, Cloud computing , Multi-core Processors (GPUs)	
2		Fundamental Design Issues and limitations in Parallel Computing	08
	2.1	Issues: Synchronization, Scheduling, Job Allocation, Job Partitioning, Dependency Analysis	
	2.2	Mapping Parallel Algorithms onto Parallel Architectures, Performance Analysis of Parallel Algorithms.	
	2.3	Limitations: Bandwidth Limitations, Latency Limitations, Latency Hiding/Tolerating Techniques and their limitations	
3		CUDA : GPU Parallel development Environment	06
	3.1	Compute Unified Device Architecture (CUDA) Architecture, CUDA programming model, execution model	
	3.2	Thread organization: Concept of grid, block and thread	
	3.3	Tread index generation, warp;	
4		GPU primitives, algorithms and applications	06
	4.1	GPU primitives: scan (exclusive or inclusive), scatter, gather, reduce, memory model	
	4.2	Introduction to global, shared, local memories, usage of cache, texture cache, constant memory.	

	4.3	CUDA structure, API and library (CUDPP, CUBLAS, FFT etc.) details.	
5		GPU parallel programming and application	07
	5.1	CUDA example programs (Vector dot product, Matrix multiplication (with the usage of tiling and shared memory) etc.	
	5.2	Graph algorithms, molecular dynamics, n-body simulations, dense linear algebra etc. using GPU	
		Total	39

Recommended Books:

1. Kai Hwang , Faye A. Briggs , “Computer Architecture and Parallel Processing”, McGraw-Hill
2. Multicore Programming , Increased Performance through Software Multi-threading by Shameem Akhter and Jason,Roberts , Intel Press , 2006
3. Edward Kandrot and Jason Sanders , “CUDA by Example: An Introduction to General-Purpose GPU Programming”, Addison-Wesley Professional © 2010
4. David Kirk, Wen-meiHwu, “UDA: Programming Massively Parallel Processors: A Hands-On Approach. © ELSEVIER Inc.
5. Michael J. Quinn , “Parallel Programming in C with MPI and OpenMP”, Tata McGraw-Hill Edition
6. AnanthGrama, Anshul Gupta, George Karypis, and Vipin Kumar, 2nd edition,” Introduction to Parallel Computing,” Addison-Welsey, © 2003.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEL801	Distributed & Cloud Computing Laboratory		02			01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEL801	Distributed & Cloud Computing Laboratory					25		25	50

Term Work:

Term work should consist of practical experiments and assignments based on the syllabus of the course **UCEC801 Distributed System & Cloud Computing**.

Term work assessment will be based on the overall performance of the student during practical with every experiment graded from time to time. The grades converted into marks as per Grade Table will be added and averaged as final TW marks.

The oral examination will be based on UCEC801 Distributed System & Cloud Computing and UCEL801 Distributed System & Cloud Computing Laboratory.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
UCEL802	Software Testing & Quality Assurance Laboratory		02			01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEL802	Software Testing & Quality Assurance Laboratory					25	--	25	50

Term Work:

Term work should consist of practical experiments and assignments based on the syllabus of the course **UCEC802 Software Testing & Quality Assurance**.

Term work assessment will be based on the overall performance of the student during practical with every experiment graded from time to time. The grades converted into marks as per Grade Table will be added and averaged as final TW marks.

The oral examination will be based on UCEC802 Software Testing & Quality Assurance and UCEL802 Software Testing & Quality Assurance Laboratory.

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial 1	Theory	Practical	Tutorial	Total
UCEL803	Advanced Internet Technology Laboratory		02			01	--	01

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEL803	Advanced Internet Technology Laboratory					25	--	25	50

Term Work:

Term work should consist of practical experiments based on the syllabus of the course **UCEC803 Advanced Internet Technology**

Term work assessment will be based on the overall performance of the student during practical with every experiment graded from time to time. The grades converted into marks as per Grade Table will be added and averaged as final TW marks.

The oral examination will be based on UCEC803 Advanced Internet Technology and UCEL803 Advanced Internet Technology Laboratory

Subject Code	Subject Name	Teaching Scheme			Credits Assigned			
		Theory	Practical/ Oral	Tutorial	Theory	Practical/ Oral	Tutorial	Total
UCEL80X	Elective III Laboratory		02			02		02

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical and Oral	Oral	Total
		Continuous Assessment (CA)			End Sem. Exam				
		Test 1	Test 2	IA					
UCEL80X	Elective III Laboratory					25		25	50

Term Work:

Term work should consist of practical experiments and assignments based on the syllabus of the course **Concerned Elective III Course**

Term work assessment will be based on the overall performance of the student during tutorial with every tutorial graded from time to time. The grades converted into marks as per Grade Table will be added and averaged as final TW marks.

The oral examination will be based on Concerned Elective III Course and Laboratory.

Elective III	
UCEE801	Machine Learning
UCEE802	Big Data Analytics
UCEE803	Software Architecture
UCEE804	Parallel Computing