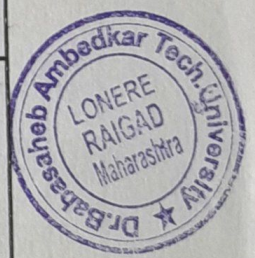
TEACHCHING AND EVALUATION SCHEME FOR FINAL YEAR B. TECH. PROGRAMME IN INFORMATION TECHNOLOGY (STUDENTS ADMITTED IN THE ACADEMIC YEAR 2016-17)

Semester VII															
Sr. No.	Course Code	Course Title	Teaching Scheme			Evaluation Scheme						Total Marks	Credits	Total Hours
			L	T	P	Mid Test	CA-I	CA-II	ESE	TW	PR			
1	IT701	Cloud Computing and Storage Management	2	-	-	20	10	10	60			100	2	2
2	IT702	Machine Learning	3	-	-	20	10	10	60			100	3	3
3	IT703	**Elective VII** Pattern Recognition Soft Computing	3	-	-	20	10	10	60			100	3	3
4	IT704	**Elective VIII** (open) Natural Language Processing Artificial Intelligence	3	-	-	20	10	10	60			100	3	3
5	IT705	**Elective IX** Real Time Systems Information Security Management Information Systems Distributed Computing Data Warehousing and Data Mining	3	-	-	20	10	10	60			100	3	3
6	IT706L	Cloud Computing and Storage Management Lab	-	-	2	-	30		-	10	10	50	1	2
7	IT707L	**Elective VII Lab** Pattern Recognition Lab Soft Computing Lab	-	-	2	-	30		-	10	10	50	1	2
8	IT708L	**Elective IX Lab** Real Time Systems Lab Information Security Lab Management Information Systems Lab Distributed Computing Lab Data Warehousing and Data Mining Lab	-	-	2	-	30		-	10	10	50	1	2
9	IT709	Project Phase I	-	-	4	-	30		-	10	10	50	2	4
10	IT 610	Field Training / Internship / Industrial Training Evaluation												
Summary of Semester Assessment Marks, Credit & Hours			**14**	**-**	**10**	**100**	**220**		**350**	**40**	**40**	**750**	**20**	**24**



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Semester VIII															
1	IT801	Internet of Things	2	-	-	20	10	10	60	-	-	100	2	2
2	IT802	**Elective X** (open) Mobile Computing	3	-	-	20	10	10	60	-	-	100	3	3
		Cryptography												
		Information Retrieval												
		Network Security												
		Big Data Analytics												
		Electronic Payment System												
3	IT803	**Elective XI** User Experience Design	3	-	-	20	10	10	60	-	-	100	3	3
		Infrastructure Auditing &Implementation												
		Cyber Law and IPR												
		Optical Networks												
		Web & Text Mining												
4	IT804	**Elective XII** Multimedia Applications	3	-	-	20	10	10	60	-	-	100	3	3
		Ethical Hacking												
		CRM & SCM												
		Wireless Networking												
		Deep Learning												
5	IT805L	Internet of Things Lab	-	-	2	-	30		-	10	10	50	1	2
6	IT806L	**Elective X Lab** Mobile Computing Lab	-	-	2	-	30		-	10	10	50	1	2
		Cryptography Lab												
		Information Retrieval Lab												
		Network Security Lab												
		Big Data Analytics Lab												
		Electronic Payment System Lab												
6	IT807L	**Elective XII Lab** Multimedia Applications Lab	-	-	2	-	30		-	10	10	50	1	2
		Ethical Hacking Lab												
		CRM & SCM Lab												
		Wireless Networking Lab												
		Deep Learning Lab												
7	IT808	Project Phase II	-	-	8	-	30		-	10	10	50	4	8
Summary of Semester Assessment Marks, Credit & Hours			**11**	**-**	**14**	**80**	**200**		**240**	**40**	**40**	**600**	**18**	**25**

Course Title:	**Cloud Computing and Storage Management**	**Semester VII**	
Course Code	**IT701**	**Course Type**	**Compulsory**
Pre-requisite	**Nil**	**L – T – P**	**2 – 0 – 0**
Stream	**Core**	**Credits**	**2**

Course Objectives:

1. To learn the concept of cloud computing.
2. To understand the trade-off between deploying applications in the cloud over local infrastructure.
3. To identify different storage virtualization technologies and their benefits.
4. To understand and articulate business continuity solutions including backup and recovery technologies, local and remote replication solutions.

Course Outcomes:

After learning the course the student will be able:

1. To understand the key dimensions of the challenge of Cloud Computing.
2. To assess the economics, financial and technological implications for selecting cloud computing for organization.
3. To describe and apply storage technologies.
4. To identify leading storage technologies that provide cost-effective IT solutions for medium to large scale businesses and data centers.
5. To describe important storage technology features such as availability, replication, scalability and performance.

Course Content:

UNIT I

Introduction: Distributed Computing and Enabling Technologies, Cloud Fundamentals: Cloud Definition, Evolution, Architecture, Applications, Deployment models and service models.

UNIT II

Virtualization: Issues with virtualization, Virtualization technologies and architectures, Internals of virtual machine monitors/hypervisors, Virtualization of data centers and Issues with Multi-tenancy.

UNIT III

Implementation: Study of Cloud computing Systems like Amazon EC2 and S3, Google App Engine and Microsoft Azure, Build Private/Hybrid Cloud using open source tools, Deployment of Web Services from inside and outside a Cloud Architecture, MapReduce and its extensions to Cloud Computing, HDFS and GFS.

UNIT IV

Storage virtualization: Fixed Content and Archives, Types, Features, Benefits, CAS Architecture, Object storage and retrieval, Examples: Storage Virtualization-forms of virtualization, SNIA Taxonomy – Storage virtualization configurations, Challenges, Types of storage virtualization - Business Continuity- Overview of emerging technologies such as Cloud storage, Virtual provisioning, Unified Storage, FCOE, FAST.

UNIT V

Business Continuity and Recovery: Information Availability, BC Terminology, Life cycle, Failure analysis: Backup and Recovery- Backup purpose, considerations, Backup Granularity, Recovery considerations- Backup methods, Process, backup and restore operations, Overview of emerging technologies: Duplication, Off site backup.

UNIT VI

Storage security and Management: Storage security framework, Securing the Storage infrastructure, Risk triad: Managing the storage infrastructure, Monitoring the storage infrastructure, identify key parameters and components to monitor in a storage infrastructure, List key management activities and examples, Define storage management standards and initiative-Industry trend.

Text Books:

1. Rajkumar Buyya, James Broberg, Andrzej Goscinski, ***"Cloud Computing Principles and Paradigms"***, Wiley Publishers, 2011.
2. Barrie Sosinsky, ***"Cloud Computing Bible"***, Wiley Publishers 2010.
3. Tim Mather, Subra Kumaraswamy, Shahed Latif, ***"Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance"***, O'Reilly 2010.
4. EMC Corporation, ***"Information Storage and Management"***, 1st Edition, Wiley India 2009..

Reference Books:

1. Rajkumar Buyya, Christian Vacchiola, S Thamarai Selvi, ***"Mastering Cloud Computing"***, McGraw Hill, 2013
2. Michael Miller, ***"Cloud Computing : Web-based Applications that change the way you work and collaborate online"***, Pearson Education, 2008
3. IBM, ***"Introduction to Storage Area Networks and System Networking"***, 5th Edition, November 2012.
4. Robert Spalding, ***"Storage Networks: The Complete Reference"***, Tata McGraw Hill, Osborne, 6th reprint 2003.
5. Marc Farley, ***"Building Storage Networks"***, Tata McGraw Hill, Osborne, 1st Edition, 2001.

Course Title:	**Machine Learning**	**Semester VII**	
Course Code	**IT702**	**Course Type**	**Compulsory**
Pre-requisite	**Engineering Mathematics III**	**L – T – P**	**3 – 0 – 0**
Stream	**Core**	**Credits**	**3**

Course Objectives:

1. To understand the basic concepts and methods of machine learning.
2. To make use of some elementary machine learning techniques in the design of computer systems.
3. To develop a broad perspective about the applicability of ML algorithms in different fields.
4. To understand the major machine learning algorithms, the problem settings and assumptions that underlies them.
5. To possess insights, concerning the relative strengths and weaknesses of various common machine learning methods.

Course Outcomes:

After learning the course the student will be able:

1. To demonstrate knowledge of the machine learning literature.
2. To describe how and why machine learning methods work.
3. To demonstrate results of parameter selection.
4. To explain relative strengths and weaknesses of different machine learning methods.
5. To select and apply appropriate machine learning methods to a selected problem.
6. To implement machine learning algorithms on real datasets.
7. To suggest ways to improve results.

Course Content:

UNIT-I

Introduction: Well-posed learning problems, Designing a Learning System, Perspectives and Issues in Machine learning, Concept Learning and General-to-specific Ordering: A concept learning task, Concept learning as Search, Finding a maximally specific hypothesis, Version Spaces and Candidate elimination algorithm, Inductive Bias.

UNIT-II

Decision Tree Learning: Decision tree learning algorithm, Hypothesis space search in decision tree Evaluating Hypothesis: Estimating Hypothesis accuracy, Basics of sampling theory, Deriving confidence intervals, Hypothesis testing, comparing learning algorithms.

UNIT-III

Bayesian Learning: Bayes theorem and concept learning, Maximum likelihood and least square error hypotheses, Minimum description length principle, Bayes optimal classifier, Gibbs algorithm, Naive Bayes classifier, Computational Learning Theory: Probably learning an approximately correct hypothesis, PAC learnability, The VC dimension, the mistake bound model for learning.

UNIT-IV

Linear Models for Regression: Linear basis function models, The Bias-Variance decomposition, Bayesian Linear Regression, Bayesian Model comparison

Kernel Methods: Constructing kernels, Radial basis function networks, Gaussian Processes

UNIT-V

Approximate Inferencing: Variational inference, Variational mixture of Gaussians, Variational linear regression, Variational logistic regression, Hidden Markov Models: Learning algorithms for HMM, the Viterbi algorithm, Linear Dynamical Systems.

UNIT-VI

Reinforcement Learning: The learning task, Q learning, Non-deterministic rewards and action, Temporal difference learning, Generalizing from examples.

Text Books:

1. Mitchell, Tom. M., *"Machine Learning"*, McGraw-Hill Education, 1st Edition, May 2013.
2. Segaran, Toby. **"*Programming Collective Intelligence- Building Smart Web 2.0 Applications"*,** O'Reilly Media, August 2007.

Reference Books:

1. Miroslav, Kubat. ***"An Introduction to Machine Learning",*** Springer Publishing.
2. Bishop, C. M., ***"Pattern Recognition and Machine Learning"***, Springer Publishing.
3. Conway, Drew and White, John Myles, ***"Machine Learning for Hackers"***, O'Reilly Media, February 2012.

Course Title:	**Pattern Recognition**	**Semester VII**	
Course Code	**IT703**	**Course Type**	**Elective**
Pre-requisite	**Nil**	**L – T – P**	**3 – 0 – 0**
Stream	**-**	**Credits**	**3**

Course Objectives:

1. To study pattern recognition topics and be exposed to recent developments in pattern recognition research.
2. To provide in-depth design concepts and implementation techniques of pattern recognitions.

Course Outcomes:

1. Identify and explain detailed aspects of internal structures of pattern recognitions.
2. Compare and contrast design issues for statistical pattern recognition.
3. Develop implementation skills for building pattern recognition.

Course Content:

UNIT I

Introduction: Machine Perception, Definition of Pattern Recognition (PR), Pattern Recognition system: Sensing, Segmentation & grouping, Feature extraction, Classification and Post processing, Design cycle: Data collection, Feature choice, Model choice, Training, Evaluation and computational complexity. Learning and adaptation: Supervised learning, Unsupervised learning and Reinforcement learning. Examples of PR Applications, Pattern Recognition Extensions. Machine learning : Components of learning, Learning models, Geometric models, Probabilistic models, Logic models, Grouping and grading, Learning versus design, Theory of learning, Feasibility of learning, Error and noise, Training versus testing, Theory of generalization, Generalization bound, Approximation-generalization tradeoff, Bias and variance, Learning curve.

UNIT II

Statistical Pattern Recognition (StatPR): Introduction to StatPR, Baye's theorem, Multiple features, Conditionally independent features, Decision boundaries, Unequal costs of error, Estimation of error rates, Characteristic curves, Estimating the composition of populations, Introduction to supervised parametric approaches and unsupervised approaches. Cluster analysis: Clustering techniques, Cluster analysis, Cluster validity. Feature selection & extraction: Feature selection criteria, Feature set search algorithm, Feature selection.

UNIT III

Tree Classifiers: (a) Decision Trees: CART, C4.5, ID3, (b) Random Forests, Linear Discriminants, Discriminative Classifiers: the Decision Boundary, (a) Separability, (b) Perceptrons, (c) Support Vector Machines.

UNIT IV

Parametric Techniques: Generative methods grounded in Bayesian Decision Theory (a) Maximum Likelihood Estimation (b) Bayesian Parameter Estimation (c) Sufficient Statistics. Non-Parametric Techniques :(a) Kernel Density Estimators (b) Parzen Window (c) Nearest Neighbor Methods.

UNIT V

Syntactic (Structural) Pattern Recognition (Syntpr): Introduction to SyntPR, Syntactic PR: primitive selection & pattern grammars, Higher dimensional grammars, Syntactic recognition, Automata, Error – correcting parsing, Shape & texture analysis, Image database management. Structural analysis using constraint satisfaction and structural matching, The Formal Language-based approach to SyntPR, Learning/Training in the Language-based Approach (Grammatical Inference). Problem solving methods for PR: Problem solving models, Problem solving algorithms.

UNIT VI

Unsupervised Methods : Exploring the Data for Latent Structure :(a) Component Analysis and Dimension Reduction: i. The Curse of Dimensionality, ii. Principal Component Analysis, iii. Fisher Linear Discriminant, iv. Locally Linear Embedding, (b) Clustering: i. K-Means, ii. Expectation Maximization, iii. Mean Shift. Classifier Ensembles : (a) Bagging, (b) Boosting / AdaBoost, Algorithm Independent, Topics Theoretical Treatments in the Context of Learned Tools: (a) No Free Lunch Theorem, (b) Ugly Duckling Theorem, (c) Bias-Variance Dilemma, (d) Jacknife and Bootstrap Methods.

Text Books:

1. Duda, R.O., Hart, P.E., Stork, D.G. ***"Pattern Classification",*** Wiley, 2nd Edition, 2001.
2. Eart Gose, Richard Johnsonburg and Steve Joust, ***"Pattern Recognition and Image Analysis"***, Prentice-Hall of India-2003.

Reference Books:

1. Bishop, C. M. ***"Pattern Recognition and Machine Learning"*** Springer, 2nd Edition, 2007.
2. Marsland, S., ***"Machine Learning: An Algorithmic Perspective"***, CRC Press. 2009.
3. Theodoridis, S. and Koutroumbas, K., ***"Pattern Recognition",*** 4th Edition, Academic Press, 2008.
4. Russell, S. and Norvig, N., ***"Artificial Intelligence: A Modern Approach",*** Prentice Hall, Series in Artificial Intelligence, 2003.

Course Title:	**Soft Computing**	**Semester VII**	
Course Code	**IT703**	**Course Type**	**Elective**
Prerequisite	**Nil**	**L – T – P**	**3 – 0 – 0**
Stream	**-**	**Credits**	**3**

Course Objectives:

1. To introduce a relatively new computing paradigm for creating intelligent machines useful for solving complex real world problems.
2. To gain insight into the tools that make up the soft computing technique: fuzzy logic, artificial neural networks and hybrid systems.
3. To create awareness of the application areas of soft computing technique.
4. To learn alternative solutions to the conventional problem solving techniques in image/signal processing, pattern recognition/classification, control system.

Course Outcomes:

After learning the course the student will be able:

1. To use a new tool /tools to solve a wide variety of real world problems.
2. To find an alternate solution, more adaptable, resilient and optimum.
3. To apply knowledge of soft computing domain to real world problems**.**

Course Content:

UNIT I

Artificial Neural Network: Biological neuron, Artificial neuron model, Concept of bias and threshold, McCulloch Pits Neuron Model, Implementation of logical AND, OR, XOR functions. Soft Topologies of neural networks, Learning paradigms: Supervised, Unsupervised, Reinforcement, Linear neuron model: Concept of error energy, Gradient descent algorithm and application of linear neuron for linear regression, Activation functions: Binary, Bipolar (linear, signup, log sigmoid, tan sigmoid) Learning mechanisms: Hebbian, Delta Rule of Perceptron and its limitations.

UNIT II

Artificial Neural Network: Multilayer perceptron (MLP) and back propagation algorithm, Application of MLP for classification and regression of self organizing Feature Maps, Clustering of Learning vector quantization. Radial Basis Function networks: Cover's theorem,Mapping functions (Gaussian, Multi-quadrics, Inverse multiquadrics, Application of RBFN for classification and regression of Hopfield network, Associative memories.

UNIT III

Fuzzy Logic: Concept of Fuzzy number, Fuzzy set theory (continuous, discrete) of operations on fuzzy sets, Fuzzy membership functions (core, boundary, support), Primary and composite linguistic terms, Concept of fuzzy relation, Composition operation (T-norm, T-conorm) of Fuzzy if-then rules.

UNIT IV

Fuzzy Logic: Fuzzification, Membership value assignment techniques, De-fuzzification (Maxmembership principle, Centroid method, Weighted average method), Concept of fuzzy inference, Implication rules: Dienes-Rescher Implication, Mamdani Implication, Zadeh Implication, Fuzzy Inference systems: Mamdani fuzzy model, Sugeno fuzzy model, Tsukamoto fuzzy model, Implementation of a simple two-input single output FIS employing Mamdani model Computing.

UNIT V

Fuzzy Control Systems: Control system design, Control (Decision) Surface, Assumptions in a Fuzzy Control System Design, Fuzzy Logic Controllers, Comparison with traditional PID control, Advantages of FLC, Architecture of a FLC: Mamdani Type, Example Aircraft landing control problem.

UNIT VI

Adaptive Neuro-Fuzzy Inference Systems (ANFIS): ANFIS architecture, Hybrid Learning Algorithm, Advantages and Limitations of ANFIS Application of ANFIS/CANFIS for regression.

Text Books:

1. Laurene Fausett, ***"Fundamentals of Neural Networks: Architectures, Algorithms And Applications"***, Pearson Education, 2008.
2. Timothy Ross, "***Fuzzy Logic With Engineering Applications"***, 3rd Edition, John Wiley & Sons, 2010.
3. J.S. Jang, C.T. Sun, E. Mizutani, ***"Neuro- Fuzzy and Soft Computing"***, PHI Learning Private Limited.
4. S. N. Sivanandam, S. N. Deepa, ***"Principles of Soft Computing"***, John Wiley & Sons, 2007.

Reference Books:

1. John Hertz, Anders Krogh, Richard Palmer, ***"Introduction to the theory of neural computation"***, Addison –Wesley Publishing Company, 1991.
2. Simon Haykin, ***"Neural Networks A comprehensive foundation"***, Prentice Hall International Inc-1999.
3. José C. Principe Neil R. Euliano , W. Curt Lefebvre, ***"Neural and Adaptive Systems: Fundamentals through Simulations"***, John-Wiley & Sons, 2000.
4. Peter E. Hart, David G. Stork Richard O. Duda, ***"Pattern Classification"***, 2nd Edition, 2000.
5. Sergios Theodoridis , Konstantinos Koutroumbas, ***"Pattern Recognition"***, 4th Edition, Academic Press, 2008.
6. Hung T. Nguyen, Elbert A. Walker, ***"A First Course in Fuzzy Logic"***, 3rd Edition, Taylor & Francis Group, LLC, 2008.
7. S. N. Sivanandam , S. Sumathi, S. N. Deepa, ***"Introduction to Fuzzy Logic using MATLAB"***, Springer Verlag, 2007.

Course Title:	**Natural Language Processing**	**Semester VII**	
Course Code	**IT704**	**Course Type**	**Elective**
Pre-requisite	**Nil**	**L – T – P**	**3 – 0 – 0**
Stream	**-**	**Credits**	**3**

Course Objectives:

1. To learn the leading trends and systems in natural language processing.
2. To understand the concepts of morphology, syntax, semantics and pragmatics of the language.
3. To recognize the significance of pragmatics for natural language understanding.
4. To describe simple system based on logic and demonstrate the difference between the semantic presentation and interpretation of that presentation.
5. To describe application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.

Course Outcomes:

After learning the course the student will be able:

1. To understand the models, methods and algorithms of statistical Natural Language Processing.
2. To implement probabilistic models in code, estimate parameters for such models and run meaningful experiments to validate such models.
3. To apply core computer science concepts and algorithms, such as dynamic programming.
4. To understand linguistic phenomena and explore the linguistic features relevant to each NLP task.
5. To identify opportunities and conduct research in NLP.
6. To analyze experimental results and write reports.

Course Content:

UNIT I

Introduction to NLP: Definition, Issues and strategies, Application domain, Tools for NLP, Linguistic organization of NLP, NLP vs. PLP.

UNIT II

Word Classes: Review of Regular Expressions, CFG and different parsing techniques. Morphology: Inflectional, derivational, Parsing and parsing with FST, Combinational Rules.

UNIT III

Phonology: Speech sounds, Phonetic transcription,Phoneme and phonological rules, Optimality theory, Machine learning of phonological rules, Phonological aspects of prosody and speech synthesis. Pronunciation, Spelling and N-grams: Spelling errors, Detection and elimination using probabilistic models, Pronunciation variation (lexical, allophonic, dialect), Decision tree model, Counting words in Corpora, Simple N-grams, smoothing (Add One, Written-Bell, Good-Turing), N-grams for spelling and pronunciation.

UNIT IV

Syntax: POS Tagging: Tagsets, Concept of HMM tagger, Rule based and stochastic POST, Algorithm for HMM tagging, Transformation based tagging. Sentence level construction & unification: Noun phrase, Co-ordination, Sub-categorization, Concept of feature structure and unification.

UNIT V

Semantics: Representing Meaning: Unambiguous representation, Canonical form, Expressiveness, Meaning structure of language, Basics of FOPC. Semantic Analysis: Syntax driven, Attachment & integration, Robustness. Lexical Semantics: Lexemes (homonymy, polysemy, synonymy, hyponymy), WordNet, Internal structure of words, Metaphor and metonymy and their computational approaches. Word Sense Disambiguation: Selectional restriction based, Machine learning based and dictionary based approaches.

UNIT VI

Pragmatics: Discourse: Reference resolution and phenomena, Syntactic and semantic constraints on coreference, Pronoun resolution algorithm, Text coherence, Discourse structure. Dialogues: Turns and utterances, Grounding, Dialogue acts and structures. Natural Language Generation: Introduction to language generation, Architecture, Discourse planning (text schemata, rhetorical relations).

Text Books:

1. D. Jurafsky & J. H. Martin, ***"Speech and Language Processing – An introduction to Language processing, Computational Linguistics, and Speech Recognition"***, Pearson Education.
2. Allen, James, ***"Natural Language Understanding"***, 2nd Edition, Benjamin/Cummings, 1996.

Reference Books:

1. Bharathi, A., Vineet Chaitanya and Rajeev Sangal, ***"Natural Language Processing-A Pananian Perspective",*** Prentice Hall India, 1995.
2. Eugene Cherniak, ***"Statistical Language Learning"***, MIT Press, 1993.
3. Manning, Christopher and Heinrich Schütze, ***"Foundations of Statistical Natural Language Processing",*** MIT Press, 1999.

Course Title:	**Artificial Intelligence**	**Semester VII**	
Course Code	**IT704**	**Course Type**	**Elective**
Pre-requisite	**Nil**	**L – T – P**	**3 – 0 – 0**
Stream	**-**	**Credits**	**3**

Course Objectives:

1. To acquaint the students with the theoretical and computational techniques in Artificial Intelligence.
2. To use various symbolic knowledge representation to specify domains and reasoning tasks of a situated software agent.
3. To use different logical systems for inference over formal domain representations and trace how a particular inference algorithm works on a given problem specification.
4. To understand the conceptual and computational trade-offs between the expressiveness of different formal representations.

Course Outcomes:

After learning the course the students should be able:

1. To find appropriate idealizations for converting real world problems into AI search problems formulated using the appropriate search algorithm.
2. To analyze, formalize and write algorithmic methods for search problem.
3. To explain important search concepts, the definitions of admissible and consistent heuristics and completeness and optimality.
4. To implement and execute by hand alpha-beta search.
5. To design good evaluation functions and strategies for game playing.
6. To carry out proofs in first order and propositional logic using techniques such as resolution, unification, backward and forward chaining.
7. To choose and implement learning algorithms such as decision trees, support vector machines, and boosting.

Course Content:

UNIT I

Introduction: Overview of Artificial intelligence- Problems of AI, AI techniques, Tic - Tac - Toe problem. Intelligent Agents: Agents & environment, Nature of environment, Structure of agents, Goal based agents, Utility based agents, Learning agents.

UNIT II

Problem Solving: Problems, Problem Space & search: Defining the problem as state space search, Production system, Problem characteristics and issues in the design of search programs. Search techniques: Solving problems by searching: problem solving agents, Searching for solutions; uniform search strategies: Breadth first search, Depth first search, Depth limited search, Bidirectional search, Comparing uniform search strategies.

UNIT III

Heuristic search strategies: Greedy best-first search, A* search, Memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, Simulated annealing search, Local beam search, Genetic algorithms; Constraint satisfaction problems, Local search for constraint satisfaction problems. Adversarial search: Games, optimal decisions & strategies in games, The minimax search procedure, Alpha-beta pruning, Additional refinements, Iterative deepening.

UNIT IV

Knowledge & reasoning: Knowledge representation issues, Representation & mapping, Approaches to knowledge representation, Issues in knowledge representation. Using predicate logic: Representing simple fact in logic, Representing instant & ISA relationship, Computable functions & predicates, Resolution, Natural deduction. Representing knowledge using rules: Procedural verses declarative knowledge, Logic programming, Forward verses backward reasoning, Matching, Control knowledge.

UNIT V

Probabilistic reasoning: Representing knowledge in an uncertain domain, The semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics, Planning: Overview, Components of a planning system, Goal stack planning, Hierarchical planning and other planning techniques.

UNIT VI

Natural Language processing: Introduction, Syntactic processing, Semantic analysis, Discourse & pragmatic processing. Learning: Forms of learning, Inductive learning, Learning decision trees, explanation based learning, Learning using relevance information, Neural net learning & genetic learning. Expert Systems: Representing and using domain knowledge, Expert system shells and knowledge acquisition.

Text Books:

1. Rich, E. and Knight K., ***"Artificial Intelligence"***, Tata McGraw- Hill.
2. Russell, S. and Norvig P., ***"Artificial Intelligence: A Modern Approach"***, Pearson Education.
3. Patterson, Dan W. , ***"Introduction to Artificial Intelligence & Expert Systems"***, PHI, 2005.

Reference Book:

1. Nilsson, N. J., Morgan Kaufmann, ***"Artificial Intelligence: A New Synthesis"***,Tata McGraw- Hill.

Course Title:	**Real Time Systems**	**Semester VII**	
Course Code	**IT705**	**Course Type**	**Elective**
Pre-requisite	**Operating Systems, Design and Analysis of Algorithms**	**L – T – P**	**3 – 0 – 0**
Stream	**Software Application and Development**	**Credits**	**3**

Course Objectives:

1. To introduce students to the fundamental problems, concepts and approaches in the design and analysis of real-time systems.
2. To study issues related to the design and analysis of systems with real-time constraints.
3. To learn real-time scheduling and schedulability analysis.
4. To understand formal specification and verification of timing constraints and properties.
5. To design methods for real-time systems.
6. To learn new techniques of state-of-the-art real-time systems research.

Course Outcomes:

After learning the course the student will be able:

1. To characterize real-time systems and describe their functions.
2. To analyze, design and implement a real-time system.
3. To apply formal methods to the analysis and design of real-time systems.
4. To apply formal methods for scheduling real-time systems.
5. To characterize and debug a real-time system.

Course Content:

UNIT I

Introduction: Hard vs. Soft real time systems, A reference model of real time system. Real-time scheduling: Clock driven approach, Weighted Round-robin approach, Priority driven approach, Dynamic vs. static system, Effective Release Times and Deadlines, EDF and LST algorithm, Optimality and Non-Optimality of the EDF and LST algorithms, Off line vs. online Scheduling.

UNIT II

Clock-Driven Scheduling: Static, Time-Driven scheduler, General structure of Cyclic Schedules, Cyclic Executives, Improving the Average Response Time of a-periodic Jobs, Scheduling Sporadic Jobs.

UNIT III

Priority Driven Scheduling of Periodic Tasks: Fixed priority vs. Dynamic priority algorithms, Maximum Schedulable Utilization, Optimality of the RM and DM algorithms, A Schedulability test for fixed-priority tasks with short response times, Sufficient Schedulability conditions for the RM and DM algorithms.

UNIT IV

Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems: Assumptions and Approaches, Deferrable Servers, Sporadic Servers, Constant Utilization, Total Bandwidth and Weighted Fair-Queuing Servers.

UNIT V

Resources and Resource Access control: Resource contention, Resource access control, Nonpreemptive critical section, Basic Priority-Inheritance protocol, Basic Priority Ceiling Protocol, Stack based, Priority-ceiling protocol, preemption ceiling protocol.

UNIT VI

Multiprocessor scheduling, Resource Access Control, and Synchronization: Model of multiprocessor & distributed systems, task assignment, multiprocessor Priority-ceiling protocol, Elements of Scheduling Algorithms for End-to-End Periodic Tasks- IPS protocols, PM protocols, MPM protocol.

Text Books:

1. Jane W. S. Liu, ***"Real-Time System"***, Pearson Education.
2. C. M. Krishna and K. G. Shin, ***"Real-Time Systems"***, McGraw Hill.

Reference Books:

1. Laplante, ***"Real Time System Design and Analysis: An Engineer Handbook"***, PHI.
2. Dr. K. V. K. Prasad, ***"Embedded Real Time System Concept Design and Programming"***, Wiley India.

Course Title:	**Information Security**	**Semester VII**	
Course Code	**IT705**	**Course Type**	**Elective**
Pre-requisite	**Internetworking Protocols**	**L – T – P**	**3 – 0 – 0**
Stream	**Infrastructure and Security Management**	**Credits**	**3**

Course Objectives:

1. To understand information security's importance in the increasingly computer-driven world.
2. To master the key concepts of information security and its working.
3. To develop a security mindset.
4. To learn to critically analyze situations of computer and network security usage.
5. To identify the salient issues, viewpoints and trade-offs of information security.

Course Outcomes:

After learning the course the student will be able:

1. To explain the challenges and scope of information security.
2. To explain security concepts as confidentiality, integrity and availability.
3. To explain the importance of cryptographic algorithms used in information security .
4. To identify and explain symmetric algorithms for encryption-based security of information.
5. To describe the access control mechanism used for user authentication and authorization.
6. To describe Secure Sockets Layer (SSL), Internet Protocol (IP) communications by using Internet Protocol Security (IPSec).
7. To explain the use of security tools as firewalls and intrusion prevention systems.
8. To explain malicious software issues introduced by software-based viruses and worms.
9. To describe the process of risk assessment in the context of IT security management.

Course Content:

UNIT I

Introduction to Information Systems: Security concepts, Computer security concepts, Threats, Attacks and Assets, Security functional requirements, A security architecture for Open Systems, Computer security trends, Computer security strategy.

UNIT II

Cryptographic Tools: Confidentiality with Symmetric Encryption, Message Authentication and Hash Functions, Public-Key Encryption, Digital Signatures and Key Management, Practical Application: Encryption of Stored Data.

UNIT III

Models, Frameworks, Standards & Legal Framework: A structure and framework of compressive security policy, policy infrastructure, policy design life cycle and design processes, PDCA model, Security policy standards and practices - ISO 27001, SSE-CMM, IA-CMM, ITIL & BS 15000, BS7799, Understanding Laws for Information Security: Legislative Solutions, Contractual Solutions, Evidential Issues, International Activity, Indian IT Act, Laws of IPR, Indian Copyright Act.

UNIT IV

Controls: Access control principles, Subjects, Objects and access rights, Discretionary access control, Role-based access control, Case study.

UNIT V

Virus and Malware: Introduction & types of Malicious Software (Malware), Propagation–Infected Content–Viruses, Propagation–Vulnerability Exploit–Worms, Propagation–Social Engineering–SPAM E-mail, Trojans, Payload–System Corruption, Payload–Attack, Agent–Zombie, Bots, Payload–Information Theft–Keyloggers, Phishing, Spyware, Payload–Stealthing–Backdoors, Rootkits, Countermeasures.

UNIT VI

Security issues: Database security challenge in the modern world, Federated Databases, securing Mobile databases, Network Security, Trusted and untrusted networks, Network attacks, Network security dimensions, Network attack – the stages; using firewalls effectively; Privacy – Privacy invasion due to direct marketing, Outsourcing using data masking ; privacy issues in smart card applications, Ethical Hacking ;Role of Cryptography in information security, digital signatures.

Text Books:

1. Nina Gobole, ***"Information Systems Security: Security Management, Metrics, Frameworks And Best Practices"***, Wiley, 2008.
2. Mark Rhodes –Ousley, ***"Information Security: The Complete Reference"***, McGraw-Hill Education, 2nd Edition, 2013.
3. Dhiren R Patel, ***"Information Security Theory and Practices"***, PHI Learning, 2008.
4. Mark Stamp, ***"Information Security: Principles and Practice"***, 2nd Edition, , Wiley, 2011.

Reference Books:

1. Gary R. McGraw, ***"Software Security: Building Security In"*** Addison Wesley, 2006.
2. Ankit Fadia, ***"Network Security: A Hacker's Perspective"***, 2006.

Course Title:	**Management Information Systems**	**Semester VII**	
Course Code	**IT705**	**Course Type**	**Elective**
Pre-requisite	**Decision Support Systems**	**L – T – P**	**3 – 0 – 0**
Stream	**Information Management & Quality Control**	**Credits**	**3**

Course Objectives:

1. To create interest and awareness about the proliferation of the Information Systems in today's organizations.
2. To understand categories of MIS: Operations Support System, Management Support System and Office automation system, Functional management system.
3. To learn Information Systems for strategic management and strategic role of information systems.
4. To plan for information systems: Identification of Applications, Business Application Planning, Systems and Critical Success Factors, Method of Identifying Applications.
5. To understand System Development Process and Approaches, System Implementation, System maintenance, Introduction to MIS Risks, System Evaluation, IT Procurement Options. Change management in IT Projects.

Course Outcomes:

After learning the course the student will be able:

1. To understand the usage and constituents of MIS in organizations.
2. To understand the classifications, understanding and the different functionalities of these MIS.
3. To explain the functions and issues at each stage of system development.
4. To identify emerging trends in MIS technologies.
5. To identify and assess MIS in real-life organization.

Course Content:

UNIT I

Management & organizational support systems for digital firm: Definition of MIS; Systems Approach to MIS: Report writing s/w, MIS and Human factor considerations, concept of organizational information sub-system, MIS & problem solving.

UNIT II

Information systems & business strategy: Information Management, Who are the users? Manager & Systems, Evolution of Computer based information system (CBIS), Model of CBIS. Information services organization: Trend to End-User computing, Justifying the CBIS, Achieving the CBIS, Managing the CBIS, Benefits & Challenges of CBIS implementation. Strategic Information System, Business level and Firm level Strategy.

UNIT III

Information systems in the enterprise: Systems from Management and functional perspective and their relationship: Executive Information System, Decision support system sales and Marketing Information System, Manufacturing Information System, Human-Resource Information System. Finance and Account Information System.

UNIT IV

Information technology for competitive advantage: Firm in its environment, What are the information resources? Who manages the information resources? Strategic planning for information resources. End-User Computing as a strategic issue, Information resource management concept.

UNIT V

E-commerce and international information system: Introduction to E-Commerce, Business Intelligence. E-Commerce strategy, Electronic Data Interchange, E-commerce methodology, E-commerce technology, Business application of the Internet. Electronic Business success strategies.

UNIT VI

Managing International Information Systems: IIS architecture, Global business Drivers, Challenges, Strategy: divide, conquer and appease, Cooptation, Business organization, Problems in implementing global information systems, Computer crime, ethics and social issues.

Text Book:

1. Kelkar, S.A., ***"Management Information Systems"***, Prentice Hall of India, 2003.

Reference Books:

1. Mark G. Simkin, ***"Introduction to computer Information System for Business"***, 1996.
2. James A. Senn, ***"Analysis & Design of Information Systems"***, McGraw-Hill.

Course Title:	**Distributed Computing**	**Semester VII**	
Course Code	**IT705**	**Course Type**	**Elective**
Pre-requisite	**Operating Systems**	**L – T – P**	**3 – 0 – 0**
Stream	**Networking**	**Credits**	**3**

Course Objectives:

1. To understand the major tools and techniques that allow programmers to effectively program the parts of the code that require substantial communication and synchronization.
2. To study the core ideas behind modern coordination and communication paradigms and distributed data structures
3. To introduce a variety of methodologies and approaches for reasoning about concurrent and distributed programs.
4. To realize basic principles and best practice engineering techniques of concurrent and distributed computing.
5. To study the safety and progress properties of concurrent and distributed algorithms.
6. To understand the performance of current multi-core and future many-core systems.

Course Outcomes:

After learning the course the student will be able:

1. To identify the core concepts of distributed systems.
2. To learn orchestration of multiple machines to correctly solve problems in an efficient, reliable and scalable way.
3. To examine concepts of distributed systems in designing large systems.
4. To apply distributed computing concepts to develop sample systems.

Course Content:

UNIT I

Introduction: Historical background, Key characteristics, Design goals and challenges, Review of networking and internetworking, Internet protocols.

UNIT II

Processes and Inter process Communication: Processes and threads, Virtualization, Code migration, The API for the Internet protocols, External data representation, Client-server communication, Multicast communication, Message oriented communication, Network virtualization, Overlay networks, RPC and MPI.

UNIT III

Naming: Name services and Domain Name System, Directory services, Case study: X.500 directory service.

UNIT IV

Time, Global States and Synchronization: Physical and logical clocks, Global states, Mutual exclusion, Election algorithms, Consistency and Replication: Consistency models, Replica management, Consistency protocols, Case studies of highly available services: the gossip architecture and Coda.

UNIT V

Fault Tolerance and Security: Distributed Commit, Recovery, Security Issues, Cryptography. Distributed File Systems: File service architecture, Case study: Sun Network File System, The Andrew File System.

UNIT VI

Peer to peer Systems: Introduction, Napster, Peer-to-peer middleware, Routing overlays, Case studies: Pastry, Tapestry. Distributed Object Based Systems: Distributed objects, Java beans, CORBA.

Text Books:

1. Tanenbaum A.S, ***"Distributed Systems: Principles and Paradigms"***, 2nd Edition, Pearson Education, 2006.
2. Coulouris G., Dollimore J., Kindberg T. and Blair G., ***"Distributed Systems: Concepts and Design"***, 5th Edition, Addison Wesley, 2011.
3. Mahajan S., Shah S., ***"Distributed Computing"***, 1st Edition, Oxford University Press, 2010.

Reference Books:

1. Hwang K., Dongarra J., Geoffrey C. Fox, ***"Distributed and Cloud Computing: From Parallel Processing to the Internet of Things"***, Morgan Kaufmann, 2011.
2. Comer D.E. and Droms, R.E., ***"Computer Networks and Internets"***, 4th Edition, Prentice-Hall, 2004.

Course Title:	**Data Warehousing and Data Mining**	**Semester VII**	
Course Code	**IT705**	**Course Type**	**Elective**
Pre-requisite	**Database Management Systems**	**L – T – P**	**3 – 0 – 0**
Stream	**Data Science**	**Credits**	**3**

Course Objectives:

1. Introduce the concepts, techniques, design and applications of data warehousing and data mining.
2. Enable students to understand and implement classical algorithms in data mining and data warehousing.
3. Enable students to learn how to analyze the data, identify the problems and choose the relevant algorithms to apply.

Course Outcomes:

After learning the course the student will be able:

1. Understand the functionality of the various data mining and data warehousing components.
2. Appreciate the strengths and limitations of various data mining and data warehousing models.
3. Compare the various approaches to data warehousing and data mining implementations.
4. Describe and utilize a range of techniques for designing data warehousing and data mining systems for real-world applications.

Course Content:

UNIT I

Introduction to data warehousing, Evolution of decision support systems, Modeling a data warehouse, granularity in the data warehouse, Data warehouse life cycle, building a data warehouse, Data Warehousing Components, Data Warehousing Architecture.

UNIT II

On Line Analytical Processing, Categorization of OLAP Tools, Introduction to Data mining and knowledge discovery, Relation to Statistics, Databases, Data Mining Functionalities, Steps In Data Mining Process, Architecture of a Typical Data Mining Systems, Classification of Data Mining Systems.

UNIT III

Overview of Data Mining Techniques, Data Preprocessing, Data Cleaning, Data Integration, Data Transformation and Data Reduction, Data Generalization and Summarization Based Characterization, Mining Association Rules In Large Databases.

UNIT IV

Classification and Prediction, Issues Regarding Classification and Prediction, Classification By Decision Tree Induction, Bayesian Classification, Other Classification Methods.

UNIT V

Prediction, Clusters Analysis, Types of Data In Cluster Analysis, Categorization of Major Clustering Methods, Partitioning methods, Hierarchical Methods.

UNIT VI

Applications of Data Mining, Social Impacts of Data Mining, Case Studies, Mining WWW, Mining Text Database, Mining Spatial Databases.

Text Books:

1. Adriaans, ***" Data mining"***, Addison- Wesley, 1996.
2. Margaret Dunham, ***"Data Mining: Introductory and Advanced Topics"***, Published by Prentice Hall.
3. Weiss, Sholom M.,***"Predictive data mining : a practical guide",*** Kaufmann Publishers, 1998.

Reference Books:

1. Pang-Ning Tan, Michael Steinback, Vipin Kumar, ***"Introduction to Data Mining"***, Pearson Education, 2008.
2. M.Humphires, M.Hawkins, ***"Data Warehousing: Architecture and Implementation"***, Pearson Education, 2009.
3. Anahory, Murray, ***"Data Warehousing in the Real World"***, Pearson Education, 2008.
4. Kargupta, Joshi, etc., ***"Data Mining: Next Generation Challenges and Future Directions"***, Prentice Hall of India Pvt. Ltd, 2007.

Course Title:	**Cloud Computing and Storage Management Lab**	**Semester VII**	
Course Code	**IT706L**	**Course Type**	**Compulsory**
Pre-requisite	**Internetworking Protocols**	**L – T – P**	**0 – 0 – 2**
Stream	**Core**	**Credit**	**1**

Lab Experiments Objectives:

Learner will be able to...

1. Appreciate cloud architecture.
2. Create and run virtual machines on open source OS.
3. Implement Infrastructure, storage as a Service.
4. Install and appreciate security features for cloud.

Lab Experiments List:

1. Study of Cloud Computing & Architecture.
2. Study and implementation of Infrastructure as a Service.
3. Implementation of Private cloud using Eucalyptus or Open stake.
   - Working with KVM to create VM.
   - Installation and configuration of Private cloud.
   - Bundling and uploading images on a cloud.
   - Creating web based UI to launch VM.
   - Working with Volumes – Attached to the VM.

Course Title:	**Pattern Recognition Lab**	**Semester VII**	
Course Code	**IT707L**	**Course Type**	**Elective**
Pre-requisite	**NIL**	**L – T – P**	**0 – 0 – 2**
Stream		**Credit**	**1**

Lab Experiments Objectives:

1. To study pattern recognition topics and be exposed to recent developments in pattern recognitions research.
2. To provide in-depth design concepts and implementation techniques of pattern recognitions.

Lab Experiments List:

1. Feature Representation.
2. Mean and Covariance.
3. Linear Perceptron Learning.
4. Generation of Random Variables.
5. Bayesian Classification.
6. MLE: Learning the classifier from data.
7. Data Clustering: K-Means, MST-based.

Course Title:	**Soft Computing Lab**	**Semester VII**	
Course Code	**IT707L**	**Course Type**	**Elective**
Pre-requisite	**Programming in Java/C/C++**	**L – T – P**	**0 – 0 – 2**
Stream		**Credit**	**1**

Lab Experiments Objectives:

1. To utilize Soft computing algorithms to solve engineering problems.
2. To compare results and provide a analysis of algorithms efficiency.
3. To apply soft computing thought process for solving issues.

Lab Experiments List:

1. Implement simple logic network using MP neuron model.
2. Implement a simple linear regression with a single neuron model.
3. Implement and test MLP trained with back-propagation algorithm.
4. Implement and test RBF network.
5. Implement SOFM for character recognition.
6. Implement fuzzy membership functions (triangular, trapezoidal, gbell, PI, Gamma, Gaussian)
7. Implement defuzzyfication (Max-membership principle, Centroid method, Weighted average method).
8. Implement FIS with Mamdani Inferencing mechanism.
9. A small project: may include classification or regression problem, using any soft computing technique studied earlier.

Course Title:	**Real Time Systems Lab**	**Semester VII**	
Course Code	**IT708L**	**Course Type**	**Elective**
Pre-requisite	**Programming in Java/C/C++**	**L – T – P**	**0 – 0 – 2**
Stream	**Software Application and Development**	**Credit**	**1**

Lab Experiments Objectives:

1. To design and write programs to demonstrate various real time system concepts of scheduling processes.
2. To demonstrate how real time principles can be applied to business problems by simulating business processes.

Lab Experiments List:

1. Execute a program to demonstrate real time scheduling EDF vs. LST to show a comparative result.
2. Demonstrate clock driven scheduler system.
3. Develop a random generator to set priority and demonstrate a priority driven scheduler system.
4. Simulate a manufacturing process to demonstrate resource and resource control scheduling system in real time.
5. Simulate a logistics service provider scheduling of product delivery system using the principles of real-time system learned in the course.

Course Title:	**Information Security Lab**	**Semester VII**	
Course Code	**IT708L**	**Course Type**	**Elective**
Pre-requisite	**Programming in Java/C/C++**	**L – T – P**	**0 – 0 – 2**
Stream	**Infrastructure and Security Management**	**Credit**	**1**

Lab Experiments Objectives:

1. To be familiar with the algorithms of data mining,
2. To be acquainted with the tools and techniques used for Knowledge Discovery in Databases.
3. To be exposed to web mining and text mining.

Lab Experiments List:

1. Implement the following SUBSTITUTION & TRANSPOSITION TECHNIQUES concepts:
    a. Caesar Cipher
    b. Playfair Cipher
    c. Hill Cipher
    d. Vigenere Cipher
    e. Rail fence – row & Column Transformation.
2. Implement the following algorithms
    a. DES
    b. RSA Algorithm
    c. Diffiee-Hellman
    d. MD5
    e. SHA-1
3. Implement the SIGNATURE SCHEME - Digital Signature Standard.
4. Demonstrate how to provide secure data storage, secure data transmission and for creating digital signatures (GnuPG).
5. Setup a honey pot and monitor the honeypot on network (KF Sensor).
6. Installation of rootkits and study about the variety of options.
7. Perform wireless audit on an access point or a router and decrypt WEP and WPA.(Net Stumbler).
8. Demonstrate intrusion detection system (ids) using any tool (snort or any other s/w).

Course Title:	**Management Information Systems Lab**	**Semester VII**	
Course Code	**IT708L**	**Course Type**	**Elective**
Pre-requisite	**Programming in Java/Python**	**L – T – P**	**0 – 0 – 2**
Stream	**Information Management & Quality Control**	**Credit**	**1**

Lab Experiments Objectives:

1. To prepare organizational data for MIS reports and dashboards.
2. To learn what data should be used to prepare MIS reports.
3. To write programs to produce MIS reports.
4. To depict data in a MIS report to support decision making.

Lab Experiments List:

1. Prepare a MIS report for HR system to depict the various grades of employee in an organization by years of service.
2. Prepare a EIS report of Sales of an organization.
3. Prepare a graphical EIS dashboard of the Sales over a period of 1 year.
4. Prepare a manufacturing MIS report of all orders fulfilled, in progress and pending for management.
5. Prepare a monthly MIS profit and loss dashboard from financial data.
6. Prepare an EIS for reporting population demographic.

Course Title:	**Distributed Computing Lab**	**Semester VII**	
Course Code	**IT708L**	**Course Type**	**Elective**
Pre-requisite	**Programming in Java/C/C++**	**L – T – P**	**0 – 0 – 2**
Stream	**Networking**	**Credit**	**1**

Lab Experiments Objective:

1. To implement distributed systems paradigms practically to understand impact on resources and processes.

Lab Experiments List:

1. Load Balancing Algorithm.
2. Scalability in Distributed Environment.
3. Client/server using RPC/RMI.
4. Inter-process communication.
5. Election Algorithm.
6. Distributed Deadlock.
7. Name Resolution protocol.
8. Clock Synchronization algorithms.
9. Mutual Exclusion Algorithm.
10. Group Communication.
11. CORBA architecture.
12. Parallel Algorithms.
13. Message Passing Interface.

Course Title:	**Data Warehousing and Data Mining Lab**	**Semester VII**	
Course Code	**IT708L**	**Course Type**	**Elective**
Pre-requisite	**SQL**	**L – T – P**	**0 – 0 – 2**
Stream	**Data Science**	**Credit**	**1**

Lab Experiments Objectives:

1. To be familiar with the algorithms of data mining.
2. To be acquainted with the tools and techniques used for Knowledge Discovery in Databases.
3. To be exposed to web mining and text mining.

Lab Experiments List:

1. Creation of a Data Warehouse.
2. Apriori Algorithm.
3. FP-Growth Algorithm.
4. K-means clustering.
5. One Hierarchical clustering algorithm.
6. Bayesian Classification.
7. Decision Tree.
8. Support Vector Machines.
9. Applications of classification for web mining.
10. Case Study on Text Mining or any commercial application.

Course Title:	**Project Phase I**	**Semester VII**	
Course Code	**IT709**	**Course Type**	**Compulsory**
Pre-requisite	**Nil**	**L – T – P**	**0–0 – 4**
Stream	**Core**	**Credits**	**2**

The project should enable the students to combine the theoretical and practical concepts studied in his/her academics. The project work should enable the students to exhibit their ability to work in a team, develop planning and execute skills and perform analyzing and trouble shooting of their respective problem chosen for the project. The students should be able to write technical report, understand the importance of teamwork and group task. The students will get knowledge about literature survey, problem definition, its solution, and method of calculation, trouble shooting, costing, application and scope for future development.

Project work

The project work is an implementation of learned technology. The knowledge gained by studying various subjects separately supposed to utilize as a single task. A group of 03/04 students will have to work on assigned work. The topic could be a product design, specific equipment, live industrial problem etc. The project work involves experimental/theoretical/computational work. It is expected to do necessary literature survey by referring current journals belonging to Information Technology reference books and internet. After finalization of project, requisites like equipments, data, tools etc. should be arranged.

Project Activity

The project groups should interact with guide, who in turn advises the group to carry various activities regarding project work on individual and group basis. The group should discuss the progress every week in the project hours and follow further advice of the guide to continue progress. Guide should closely monitor the work and help the students from time to time. The guide should also maintain a record of continuous assessment of project work progress on weekly basis.

Phase I

1. Submission of project/problem abstract containing problem in brief, requirements, broad area, applications, approximate expenditure if required etc.
2. Problem definition in detail.
3. Literature survey.
4. Requirement analysis.
5. System analysis (Draw DFD up to level 2, at least).
6. System design, Coding/Implementation (20 to 30%).

Course Title:	**Internet of Things**	**Semester**	**VIII**
Course Code	**IT801**	**Course Type**	**Compulsory**
Pre-requisite	**Microprocessor & Micro-controllers**	**L – T – P**	**2 – 0 – 0**
Stream		**Credits**	**2**

Course Objectives:

1. To understand the vision of IoT.
2. To understand IoT market perspective.
3. To study the data and knowledge management and use of devices in IoT technology.
4. To understand state of the art – IoT Architecture.
5. To study the real world IoT design constraints, industrial automation and commercial building automation in IoT.

Course Outcomes:

After learning the course the students should be able:

1. To interpret the vision of IoT from a global context.
2. To determine the market perspective of IoT.
3. To compare and contrast the use of devices, gateways and data management in IoT.
4. To implement state of the art architecture in IoT.
5. To illustrate the application of IoT in industrial automation and identify real world design constraints.

Course Content:

UNIT I

M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing characteristics.

UNIT II

M2M to IoT: A Market Perspective– Introduction, Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies, M2M to IoT. An architectural overview: Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, Standards considerations.

UNIT III

M2M and IoT Technology Fundamentals - Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management.

UNIT IV

IoT Architecture: State of the Art, Introduction, State of the art, Architecture Reference Model - Introduction, Reference model and architecture, IoT reference model.

UNIT V

IoT Reference Architecture: Introduction, Functional view, Information view, Deployment and operational View, Other relevant architectural views. Real-World Design Constraints - Introduction, Technical design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

UNIT VI

Industrial Automation: Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation: Introduction, Case study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future.

Text Book:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, ***"From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence"***, Academic Press, 1st Edition, 2014.

Reference Books:

1. Vijay Madisetti, Arshdeep Bahga, ***"Internet of Things (A Hands-on-Approach)"***, VPT, 1st Edition, 2014.
2. Francis da Costa, ***"Rethinking the Internet of Things: A Scalable Approach to Connecting Everything"***, 1st Edition, Apress Publications, 2013.

Course Title:	**Mobile Computing**	**Semester**	**VIII**
Course Code	**IT802**	**Course Type**	**Elective**
Pre-requisite	**Internetworking Protocols , Operating Systems**	**L – T – P**	**3 – 0 – 0**
Stream	**Software and Application Development**	**Credits**	**3**

Course Objectives:

1. To describe the basic concepts and principles in mobile computing.
2. To understand the concept of Wireless LANs, PAN, Mobile Networks, and Sensor Networks.
3. To explain the structure and components for Mobile IP and Mobility Management.
4. To understand positioning techniques and location-based services and applications.
5. To describe the important issues and concerns on security and privacy.
6. To design and implement mobile applications to realize location-aware computing.
7. To design algorithms for location estimations based on different positioning techniques and platforms.
8. To acquire the knowledge to administrate and to maintain a Wireless LAN.

Course Outcomes:

After learning the course the students should be able:

1. To describe wireless and mobile communications systems.
2. To choose an appropriate mobile system from a set of requirements.
3. To work around the weaknesses of mobile computing.
4. To interface a mobile computing system to hardware and networks.
5. To program applications on a mobile computing system and interact with servers and database systems.

Course Content:

UNIT I

Fundamental of Wireless and basics of wireless network: Digital communication, Wireless communication system and limitations, Wireless media, Frequency spectrum, Technologies in digital wireless communication, Wireless communication channel specification, Wireless network, Wireless switching technology, Wireless communication.

UNIT II

Mobile Communications and Computing: An Overview Mobile Communication, Mobile Computing, Mobile Computing Architecture, Mobile Devices, Mobile System Networks, Data Dissemination, Mobility Management, Security, Mobile Devices and Systems, Mobile Phones, Digital Music Players, Hand-held Pocket Computers, Hand-held Devices: Operating Systems, Smart Systems, Limitations of Mobile Devices, Automotive Systems.

UNIT III

GSM and other architectures: GSM-Services and System Architectures, Radio Interfaces, Protocols Localization, Calling, Handover, Security, New Data Services, modulation, Multiplexing, Controlling the medium access, Spread spectrum, Coding methods, CDMA, IMT 2000, WCDMA and CDMA 2000, 4G Networks.

UNIT IV

Mobile Network and Transport Layer: IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunneling and Encapsulation, Route optimization, Dynamic Host Configuration Protocol, Mobile Transport Layer, Conventional TCP/IP Transport Layer Protocol, Indirect TCP, Snooping TCP, Mobile TCP, Mobile Ad-hoc Networks (MANET), Routing and Routing Algorithms in MANET, Security in ad-hoc networks.

UNIT V

Data Dissemination and Data Synchronization in Mobile Computing: Communication Asymmetry, classification of data delivery mechanism, data dissemination broadcast models, selective tuning and indexing techniques, synchronization, synchronization software for mobile devices, synchronization protocols.

UNIT VI

Mobile Devices and Mobile Operating System: Mobile agent, Applications framework, Application server, Gateways, Service discovery, Device management, Mobile file system, Mobile Operating Systems, Characteristics, Basic functionality of Operating Systems: Window 8, iOS, Android OS.

Text Books:

1. Raj Kamal, "Mobile Computing", Oxford University Press-New Delhi, 2nd Edition.
2. Dr. Sunil kumar S. Manavi, Mahabaleshwar S. Kakkasageri, ***"Wireless and Mobile Networks, Concepts and Protocols"***, Wiley, India.

Reference Books:

1. Mark Ciampa, ***"Guide to Designing and Implementing wireless LANs"***, Thomson learning, Vikas Publishing House, 2001.
2. Ray Rischpater, ***"Wireless Web Development"***, Springer Publishing,
3. Sandeep Singhal, ***"The Wireless Application Protocol"***, Pearson Publication.
4. P.Stavronlakis, ***"Third Generation Mobile Telecommunication Systems"***, Springer Publishers.

Course Title:	**Cryptography**	**Semester**	**VIII**
Course Code	**IT802**	**Course Type**	**Elective**
Pre-requisite	**Computer Architecture & Organization**	**L – T – P**	**3 – 0 – 0**
Stream	**Infrastructure & Security Management**	**Credits**	**3**

Course Objectives:

1. To learn cryptography in information security implementation.
2. To know the methods of conventional encryption.
3. To understand the concepts of public key encryption and number theory.
4. To understand authentication and Hash functions.
5. To know the network security tools and applications.
6. To understand the system level security used.

Course Outcomes:

After learning the course the students should be able:

1. To compare and contrast a range of different cryptosystems.
2. To list and elaborate the differences between secret key and public key cryptosystems.
3. To identify the different approaches to quantifying secrecy.
4. To recognize the different modes of operation for block ciphers and their applications.
5. To explain the role of hash functions in Information Security.
6. To discuss the place of ethics in the Information Security Area.

Course Content:

UNIT I

Introduction: What is cryptology: (cryptography + cryptanalysis), Overview of cryptology: How cryptography works, how to break a cryptographic system, Classical conventional encryption, Modern conventional encryption, Public key encryption, Hashing algorithm, OSI security architecture, Cryptanalysis of classical cryptosystems, Shannon's theory.

UNIT II

Symmetric Cipher: Classical Encryption Techniques, Symmetric Cipher Model, Block Cipher principles, DES, Triple DES, Cryptanalysis of symmetric key ciphers: Differential and Linear Cryptanalysis, Block cipher design principle, The Euclidean algorithm, Finite field of form GP(p), Advance Encryption Standard (AES), AES cipher, Multiple encryption and triple DES, Stream Cipher and RC4, Placement of encryption function, Traffic confidentiality, Key distribution, Random number generation. System security: Intrusion detection, Password management, Virus countermeasure, Denial of service attack, Firewall design principles, Trusted System.

UNIT III

Public Key Cryptography: Key Management - The Discrete Logarithm Problem (DLP) and the Diffie Hellman Key Exchange algorithm, Cryptanalysis of DLP, Elliptic Curve Architecture and Cryptography : Confidentiality using Symmetric Encryption, Public Key Cryptography, RSA, Primality Testing, Factoring algorithms, Other attacks on RSA and semantic security of RSA ElGamal cryptosystems.

UNIT IV

Authentication and Hash Function: Authentication requirements, Authentication functions, Message Authentication codes, Hash functions, Security of hash functions, Hash functions: The Merkle Damgard Construction and MACs, MD5 message Digest algorithm - Secure Hash Algorithm, RIPEMD, HMAC, CMAC, Whirlpool and Comparative analysis. Digital Signatures, Authentication Protocols, Digital Signature Standard.

UNIT V

Network Security: Authentication Applications: Kerberos - X.509 Authentication Service, Electronic Mail Security - PGP - S/MIME - IP Security - Web security.

UNIT VI

System Level Security: Intrusion detection, Password management, Viruses and related Threats, Virus Counter measures, Firewall Design Principles, Trusted Systems. Cryptanalysis: Differential Cryptanalysis, Linear Cryptanalysis, Truncated differential cryptanalysis, etc. Assignments (not limited to this): including Cryptographic standards, application of cryptosystems, network security (IPSEC, VPN, Web Security), privilege management infrastructure (PMI) and Access Control, e-Commerce and Smart IC cards).

Text Book:

1. William Stallings, ***"Cryptography and Network Security - Principles and Practices"***, Prentice Hall of India, 3rd Edition, 2003.

Reference Books:

1. Atul Kahate, ***"Cryptography and Network Security"***, Tata McGraw-Hill, 2003.
2. Bruce Schneier, ***"Applied Cryptography"***, John Wiley & Sons Inc, 2001.
3. Charles B. Pfleeger, Shari Lawrence Pfleeger, ***"Security in Computing"***, Pearson Education, 3rd Edition, 2003.

Course Title:	**Information Retrieval**	**Semester**	**VIII**
Course Code	**IT802**	**Course Type**	**Elective**
Pre-requisite	**Design and Analysis of Algorithms**	**L – T – P**	**3 – 0 – 0**
Stream	**Information Management & Quality Control**	**Credits**	**3**

Course Objectives:

1. To learn the techniques used to retrieve useful information from repositories such as the Web.
2. To understand the concepts in information retrieval such as documents, queries, collections and relevance.
3. To learn approaches for efficient indexing for quick identification of candidate answer documents
4. To learn modern techniques for crawling data from the web.

Course Outcomes:

After learning the course the students should be able:

1. To apply information retrieval principles to locate relevant information in large collections of data.
2. To understand and deploy efficient techniques for the indexing of document objects that are to be retrieved.
3. To implement features of retrieval systems for web-based and other search tasks.
4. To analyze the performance of retrieval systems using test collections.
5. To make practical recommendations about deploying information retrieval systems in different search domains, including considerations for document management and querying.

Course Content

UNIT I

Introduction to the Course: Information retrieval problem, First take at building an inverted index, Processing of Boolean queries, Extended Boolean model vs. ranked retrieval. Term vocabulary and postings lists: document delineation and character sequence decoding, Determining vocabulary of terms, Faster postings list intersection via skip pointers, Positional postings and phrase queries.

UNIT II

Dictionaries, Tolerant Retrieval and Indexing: Search structures for dictionaries, Wildcard queries, Spelling correction, Phonetic correction; Index construction, Blocked sort-based indexing, Single-pass in-memory indexing, Distributed indexing, Dynamic indexing and other types; Index compression: Heaps' and Zipf's law, Dictionary compression and postings file compression.

UNIT III

Scoring and IR System Evaluation: Parametric and zone indexes, Term frequency and weighing, Vector space model for scoring, Variant tf-idf functions, Efficient scoring and ranking, Components of an IR system, Vector space scoring and query operator interaction, IR system evaluation, Standard test collections, Evaluation of unranked and ranked retrieval results, Assessing relevance, System quality and user utility; Relevance feedback and pseudo relevance feedback, Global methods for query reformulation.

UNIT IV

XML and Probabilistic Information Retrieval: Basic concepts of XML retrieval and challenges, vector space model for XML retrieval, Text-centric vs. data centric XML retrieval, Probability ranking principal, Binary independence model, Appraisal and some extensions, Language models for information retrieval, Query likelihood model, Language modeling vs. other approaches in IR.

UNIT V

Document Classification: Text classification problem, Naïve Bayes text classification, Bernoulli model, Feature selection, Evaluation of text classification; Vector space classification: Document representations and measure of relatedness in vector spaces, Rocchio classification, k nearest neighbor, Linear vs. Non-linear classifiers, Bias-variance tradeoff; Support vector machines, Extensions to SVM models, Issues in the classification of text documents, Machine learning methods in ad hoc information retrieval.

UNIT VI

Document Clustering and Matrix Decomposition: Flat clustering, Cardinality, Evaluation of clustering, K-means, Model based clustering, Hierarchical Agglomerative clustering, Singlelink and complete-link clustering, Group-average agglomerative clustering, Centroid clustering, Optimality of HAC, Divisive clustering, Cluster labeling; Matrix decompositions, Term document matrices and singular value decomposition, Low-rank approximations, Latent semantic indexing.

Web Search: Basics concepts, Web graph, Spam, Search user experience, Index size and estimation, Near-duplicates and shingling, Web crawling and indexes: Overview, Crawler architecture, DNS resolution, URL frontier, Distributing indexes and connectivity servers; Link analysis: Anchor text and web graph, Page Rank, Hubs and Authorities.

Text Books:

1. Manning, C. D., Raghavan, P., Schütze, H. ***"Introduction to Information Retrieval",*** Cambridge University Press, 2008.
2. Witten, I. H., Moffat, A., Bell, T. C. ***"Managing Gigabytes: Compressing and Indexing Documents and Images.",*** Morgan Kaufmann, 1999.
3. Grossman, D. A., ***"Information Retrieval: Algorithms and Heuristics"***, Springer, 2004.

Reference Books:

1. Baeza-Yates, R., Ribeiro-Neto, B. ***"Modern information Retrieval"***, ACM press, 1999
2. Belew, R. K. ***"Finding Out About: A Cognitive Perspective on Search Engine Technology and the WWW"***, Cambridge University Press, 2000.
3. Chakrabarti S. ***"Mining the Web: Discovering Knowledge from Hypertext Data"***, Morgan Kaufmann, 2003.
4. Manning, C. D. ***"Foundations of Statistical Natural Language Processing"***, H. Schütze (Ed.). MIT press, 1999.

Course Title:	**Network Security**	**Semester VIII**	
Course Code	**IT802**	**Course Type**	**Elective**
Pre-requisite	**Internetworking Protocols, Network Programming**	**L – T – P**	**3 – 0 – 0**
Stream	**Networks**	**Credits**	**3**

Course Objectives:

1. To understand the number theory used for network security.
2. To understand the design concept of cryptography and authentication.
3. To understand the design concepts of internet security.
4. To develop experiments on algorithm used for security.

Course Outcomes:

After learning the course the students should be able:

1. To describe network security awareness and a clear understanding of its importance.
2. To explain how threats to an organization are discovered, analyzed and dealt with.
3. To explain protocols for security services.
4. To describe network security threats and countermeasures
5. To explain network security designs using available secure solutions (such as PGP, SSL, IPSec, etc).
6. To demonstrate advanced security issues and technologies (such as DoS attack detection and containment, and anonymous communications).

Course Content

UNIT I

Model of network security, Security attacks, services and attacks, OSI security architecture, Classical encryption techniques, SDES, Block cipher Principles, DES, Strength of DES, Block cipher design principles, Block cipher mode of operation, Evaluation criteria for AES, RC4 - Differential and linear cryptanalysis, Placement of encryption function, traffic confidentiality.

UNIT II

Number Theory, Prime number, Modular arithmetic, Euclid's algorithm, Fermat's and Euler's theorem, Primality, Chinese remainder theorem, Discrete logarithm, Public key cryptography and RSA Key distribution, Key management, Diffie Hellman key exchange, Elliptic curve cryptography.

UNIT III

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

UNIT IV

Security Services for E-mail-establishing keys-privacy-authentication of the source-Message Integrity-Non-repudiation-Pretty Good Privacy-S/MIME.

UNIT V

SSL/TLS Basic Protocol-computing the keys- client authentication-PKI as deployed by SSL-Attacks fixed in v3-Exportability-Encoding-Secure Electronic Transaction (SET).

UNIT VI

Firewall Design Principles- Packet Filters- Application level Gateways-Tunnels-DoS attacks-Intrusion Detection-Password Management-Malicious Software.

Text Book:

1. William Stallings, ***"Cryptography & Network Security"***, Pearson Education, 4th Edition, 2010.

Reference Books:

1. Charlie Kaufman, Radia Perlman, Mike Speciner, ***"Network Security, Private Communication in Public World"***, PHI, 2nd Edition, 2002.
2. Bruce Schneier, Neils Ferguson, ***"Practical Cryptography"***, Wiley Dreamtech India Pvt. Ltd, 1st Edition, 2003.
3. Douglas R Simson, ***"Cryptography – Theory and Practice"***, CRC Press, 1st Edition, 1995.

Course Title:	**Big Data Analytics**	**Semester**	**VIII**
Course Code	**IT802**	**Course Type**	**Elective**
Pre-requisite	**Database Management Systems**	**L – T – P**	**3 – 0 – 0**
Stream	**Data Science**	**Credits**	**3**

Course Objectives:

1. To understand the concept of Big Data.
2. To learn Big Data file systems and their storage methods.
3. To learn to process Big Data information for analytics.
4. To discuss and understand Big Data implementations within large corporations like Google and Facebook.

Course Outcomes:

After learning the course the students should be able:

1. To model and implement efficient big data solutions for various application areas using appropriately selected algorithms and data structures.
2. To analyze methods and algorithms to compare and evaluate them with respect to time and space requirements and make appropriate design choices when solving real-world problems.
3. To explain trade-offs in big data processing techniques.
4. To explain the Big Data Fundamentals including the evolution of Big Data, the characteristics of Big Data and the challenges introduced.
5. To apply non-relational databases techniques for storing and processing large volumes of structured and unstructured data, as well as streaming data.
6. To apply the novel architectures and platforms introduced for Big data in particular Hadoop and MapReduce.

Course Content

UNIT I

Introduction to Big Data: Introduction to Big Data, The four dimensions of Big Data: Volume, Velocity, Variety, Veracity, Drivers for Big Data, Introducing the Storage, Query Stack, Revisit useful technologies and concepts, Real-time Big Data Analytics.

UNIT II

Distributed File Systems: Hadoop Distributed File System, Google File System, Data Consistency.

UNIT III

Big Data Storage Models: Distributed Hash-table, Key-Value Storage Model (Amazon's Dynamo), Document Storage Model (Facebook's Cassandra), Graph storage models.

UNIT IV

Scalable Algorithms: Mining large graphs with focus on social networks and web graphs. Centrality, Similarity, All-distances sketches, Community detection, Link analysis, Spectral techniques. Map-reduce, Pig Latin, and NoSQL, Algorithms for detecting similar items, Recommendation systems, Data stream analysis algorithms, Clustering algorithms, Detecting frequent items.

UNIT V

Big Data Applications: Advertising on the Web, Web Page Quality Ranking, Mining Social-Networking Group, Human Interaction with Big-Data. Recommendation systems with case studies of Amazon's Item-to-Item recommendation and Netfix Prize, Link Analysis with case studies of the PageRank algorithm and the Spam farm analysis, Crowd Sourcing.

UNIT VI

Big Data Issues: Privacy, Visualization, Compliance and Security, Structured vs. Unstructured Data.

Text Book:

1. Anand Rajaraman and Jeffrey Ullman, ***"Mining of Massive Datasets"***, Cambridge University Press, 2012.

Reference Books:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, ***"An Introduction to Information Retrieval"***, Cambridge University Press, 2008.
2. Jimmy Lin and Chris Dyer, ***"Data-Intensive Text Processing with MapReduce"***, Morgan and ClayPool Publishers, 2010.

Course Title:	**Electronic Payment System**	**Semester**	**VIII**
Course Code	**IT802**	**Course Type**	**Elective**
Pre-requisite	**Nil**	**L – T – P**	**3 – 0 – 0**
Stream	**-**	**Credits**	**3**

Course Objectives:

1. To understand common payment methods, working of different payment systems.
2. To learn basic payments processes and systems.
3. To understand emerging payments trend.
4. To gain knowledge on the underlying technologies governing payment systems.

Course Outcomes:

After learning the course, the students should be able:

1. To learn and speak financial services language.
2. To familiarize with banking regulations in the payment industry
3. Gain domain knowledge for career in financial industry: Banks, Insurance & NBFC

Course Content:

UNIT I

Evolution of payment systems in the digital world: Role of RBI in payment/clearing/settlement Indian payment systems: IMPS, NEFT/RTGS, eWallet, eKYC, AADHAR / AADHAR VAULT, RUPAY Debit/Credit cards, *99#, NACH,ABPS, BHIM, BHARAT PAY, CREDIT CARD, VISA/MASTER ROLE in CREDIT CARD PAYMENTS, CTS, UPI, BBPS, ATM.Transformation in Social media channels & Payments: ChatBot, WhatsApp, FB.

UNIT II

Risks in Payment Systems: Credit Risk, Liquidity Risk, Systemic Risk, Operational Risk. Risk mitigation techniques: Carefully chosen members, Novation, Central counterparty system, Loss sharing arrangements, Collateral, Other mitigation techniques like RECO.Relationship structures: Correspondent banking, Bilateral clearing, arrangements, Network managed banking.

UNIT III

Payment types:Book payments, Local payments, Domestic payments, Cross border payments.

Regional payments systems:USA payment systems:Fedwire, CHIPS, NSS, ACH, SEPA payment systems: TARGET2, STEP 2 (SCT/SDD) PE- AC, China payment system: CDFCPS/CIPS, Hong Kong payment system : CHATSCanadian payment system: LVTS, Indian payment systems: RTGS, NEFT, IMPS, UPI.

UNIT IV

Overview of SWIFT messaging:MT and MX messages, Role of SWIFT in payment systems, SWIFTnet Fin, File act, Interact, Browse SWIFT payment message processing – MT 1XX, MT 2XX, MT 9XX, MX PAIN/PACS, SWIFT Payment Messages examples, SWIFT for corporate.

UNIT V

Use of code in payment systems: Codes – IBAN, BBAN, BIC, BEI, UID, UPIC, ABA routing codes etc, IFSC, Foreign exchange transactions: Cash, TOM, Spot, Forwards, Interbank transactions, Merchant transactions, Exchange rate determination and rate computation.

UNIT VI

Cash management products: Concept of float, Cash concentration, notional pooling and sweep, Virtual account management (VAM), ACH filter/ACH block, Lockboxes. Impact of regulation: Basel, FATF/OFAC compliance, FATCA compliance, AML compliance, FRM compliance.
Practical: Working of ATMs, Insides of an ATM, Vulnerability Points, Care to be taken while using ATM.

Text Book:

1. S. K. Nippani, B. K. Murthy, ***"Digital India Governance Transformation"***, 2018.

Online Reference for books & documentations:

https://rbidocs.rbi.org.in/rdocs/

Course Title:	**User Experience Design**	**Semester**	**VIII**
Course Code	**IT803**	**Course Type**	**Elective**
Pre-requisite	**Software Engineering**	**L – T – P**	**3 – 0 – 0**
Stream	**Software and Application Development**	**Credits**	**3**

Course Objectives:

1. To understand user experience design principles
2. To understand the various elements and how the elements of user experience work together.
3. To understand strategy, structure, skeleton and scope as an element of user experience.
4. To identify business goals, user needs, content requirements.
5. To create a functional specification and an effective information design.
6. To learn to prioritize specs and requirements.
7. To architect information effectively and navigation.
8. To learn resources available to assist with User Experience Design Process.

Course Outcomes:

After learning the course the students should be able:

1. To design applications and web pages with effective and easy to use user experience.
2. To utilize tools and techniques for research and build user screens based on best practices.
3. To collect and document business, user and information specification.
4. To implement user screens and package information with ease of navigations.

Course Content:

UNIT I

UX Introduction: User Interaction with the products, Applications and services, Cognitive Model/Mental Model; Necessity of User Experience Design; Definition of User Experience (UX) Design.

UNIT II

Elements of UX Design: Core elements of User Experience, Working of elements, UX Design Process: Defining the UX Design Process and Methodology.

UNIT III

UX Design Process: Research and define: importance of research, Research methods and tools, Understanding the User needs and goals, Understanding the business goals, Deliverables of the research and define phase-Insight on User goals and business goals, Hands-on assignments and Quiz.

UNIT IV

UX Design Process: IDEATE/DESIGN - Visual design principles, Information design and data, Visualization: Interaction design, Information architecture, Wire-framing and story-boarding, UI elements and widgets, Screen design and layouts, Hands-on assignments and quiz.

UNIT V

UX Design Process: PROTOTYPE and TEST: Necessity of testing your design, Usability testing, Types of usability testing, Usability testing process, Plan for the usability tests, Prototype your design to test, Introduction of prototyping tools, Conduction and preparation of usability test results.

UNIT VI

UX Design Process: iterate/improve: Understanding the Usability test findings, Applying the Usability test feedback in improving the design. UX Design Process: Communication with implementation team UX Deliverables to be given to implementation team.

Text Books:

1. Jesse James Garrett, ***"The Elements of User Experience: User-Centered Design for the Web and Beyond"***, New Riders Publishing, 2nd Edition, 2002.
2. Steve Krug, ***"Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability"***, 3rd Edition, 2014.
3. Thomas Tullis, Willaim Albert, ***"Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics"***, Morgan Kaufman, 1st Edition, 2008.

Reference Books:

1. Jeff Gothelf, Josh Seiden, ***"Lean UX: Applying Lean Principles to Improve User Experience"***, O'Reilly, 1st Edition, 2013.
2. Kevin Mullet, Darrell Sano, ***"Designing Visual Interfaces: Communication Oriented Techniques"***, Soft Press, 1995.
3. Wilbert O. Galitz, ***"The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques"***, Wiley, 2002.

Course Title:	**Infrastructure Auditing & Implementation**	**Semester**	**VIII**
Course Code	**IT803**	**Course Type**	**Elective**
Pre-requisite	**IT Service Management**	**L – T – P**	**3 – 0 – 0**
Stream	**Infrastructure & Security Management**	**Credits**	**3**

Course Objectives:

1. To know the goals and objectives of IT audit and its role in internal control system.
2. To learn the techniques of audit planning and audit performance, gathering of audit related information and audit evidence.
3. To understand how to audit and evaluate effectiveness of the IT internal controls system.
4. To learn the fundamentals of information risk management and audit of information security.

Course Outcomes:

After learning the course the students should be able:

1. To describe the need for information security audit.
2. To define the requirements of IT risks, security and policies required for organizations.
3. To explain the mandatory items that need to be checked.

UNIT I

Fundamentals of infrastructure audit: meaning and definition, Overview, Choice of correct methods, Need, Scope and objectives.

UNIT II

Introduction to risk assessment: Entity area, strategies and policies in operation, support, External Drivers, User Interaction, Consequences-Importance of demonstrating control over network and security staffs, Risk of operator access controls over device and server settings.

UNIT III

Checklist for IT audit: Alignment with business strategy, Long term IT strategy, Short range IT plans, Information system security policy, Implementation of security policy, Information system audit guidelines, Acquisition and implementation of packaged software.

UNIT IV

Requirement identification and analysis Configuration audits: Need for an audit trail, A real-time live-network change review, Automatically verify compliance with both external best practices and internal standards.

UNIT V

Vendor selection criteria and process: Tracking the vendor selection criteria, Contracting- The issues of site licenses, Usage of open sources software, Annual maintenance contracts.

UNIT VI

Implementation: Importance of regulations and standards such as Sarbanes-Oxley, ISO 17799 and Visa's Cardholder Information Security Program (CISP), On-demand historical reports, Governance and Cobit as a model for IT compliance. Benefits of infrastructure audit, Strong change management process.

Text Books:

1. Richard E. Cascarino, ***"Auditor's Guide to Information Systems Auditing"***, Wiley, 2007.
2. Chris Jackson, ***"Network Security Auditing"***, Cisco Press, 2010.

References:

1. www.netwrix.com
2. www.rbi.org

Course Title:	**Cyber Law and IPR**	**Semester**	**VIII**
Course Code	**IT803**	**Course Type**	**Elective**
Pre-requisite	**Nil**	**L – T – P**	**3 – 0 – 0**
Stream	**Information Management & Quality Control**	**Credits**	**3**

Course Objectives:

2. To understand cyber laws and its applicability in India.
3. To learn the basic concepts of technology and law, digital contracts, rights of netizens and E-governance. To study cyber space and the cyber laws and regulating them through relevant Acts.
4. To learn the comparative study of national and international laws keeping in view international scenario in a no-barrier world.
5. To be aware about IPR in scientific and technical community for protecting their inventions.
6. To understand IPR from a non-lawyers perspective like senior managers, administrators etc.
7. To experience practices and procedures in various government offices administering IPR Laws.

Course Outcomes:

After learning the course the students should be able:

1. To describe the cyber world and cyber law in general.
2. To explain about the various facets of cyber crimes.
3. To explain the problems arising out of online transactions and provoke them to find solutions.
4. To clarify the Intellectual Property issues in the cyber space and the growth and development of the law in this regard.
5. To educate about the regulation of cyber space at national and international level.

Course Content

UNIT I

Introduction to Cyber crimes: Definition, Cybercrime and information security, Classes of cybercrime and categories, Cyber offences, Cybercrimes with mobile and wireless devices.

UNIT II

Jurisdiction in the cyber world across the world: Cybercrime law in Asia, Cybercrime and federal laws, Legal principles on jurisdiction and jurisdictional disputes w.r.t. the internet in United States of America, Cybercrime legislation in African region, Foreign judgments in India.

UNIT III

Indian IT act: Information Technology Act, 2000(Complete including digital signature, certifying authorities and E-governance), Positive aspects, Weak areas, Amendments to the Information Technology Act, 2008. Challenges to Indian law and cyber crime scenario in India. Protection of cyber consumers in India.

UNIT IV

Emerging Electronic System: E – commerce; E – governance; Concept of Electronic Signature; Credit Cards; Secure Electronic Transactions.

UNIT V

Intellectual property Rights: Intellectual Property law basics, Types of Intellectual Property, Agencies responsible for Intellectual Property registration. International organizations, Agencies and Treaties. Increasing importance of Intellectual Property Law.

UNIT VI

Copyright issues in Cyberspace: Relevant provisions under Copyright Act, 1957, regulating copyright issues in Cyberspace; Online Software Piracy – legal issues involved; Analysis of sufficiency of provisions of Copyright Act to deals with Online Software.

Piracy: Trademark issues in Cyberspace – Domain Name; Cyber squatting as a form of Domain Name dispute; Case law.

Case studies: Highlight the cybercrimes, cyber laws and Intellectual property Rights with the help of minimum 5 cases with reference to Indian IT act for better understanding.

Text Books:

1. Herman T. Tavani, ***"Ethics & Technology, Ethical Issues in an Age of Information and Communication Technology"***, John Wiley & Sons, 3rd Edition, 2011.
2. Syed Shakil Ahmed, Reheja Rajiv, ***"A Guide to Information Technology (Cyber Laws & E-commerce)"***, Capital Law House, 2001.
3. Kamath Nandan, ***"Law Relating to Computers Internet & E-commerce (A guide to Cyber Laws & the Information Technology Act, 2000 with Rules & Notification)"***, Universal Book Traders, 2nd Edition, Reprint: 2002.

Reference Books:

1. Ahmad Tabrez, "***Cyber law , E-commerce & M-Commerce"***, A. P. H. Publishing Corporation, 2003.
2. Bakshi P.M and Suri R.K, ***"Cyber and E-commerce Laws"***, Bharat Publishing House, 1st Edition, 2002.
3. Vishwanathan Suresh T, ***"The Indian Cyber Law"***, Bharat Law House, 2nd Edition, 2001.
4. Prasad T.V.R. Satya, ***"Law Relating to Information Technology (Cyber Laws)"***, Asia Law House , 1st Edition, 2001.
5. Reed Chris, ***"Computer Law"***, 3rd Edition, Universal Law Publishing Co. Pvt. Ltd., 1996 (First Indian Reprint 2000).
6. P. Narayanan, ***"Intellectual Property (Trade Marks & the Emerging concepts of Cyber property rights (HB)"***, 3rd Edition. (HB), 2002.

Course Title:	**Optical Networks**	**Semester**	**VIII**
Course Code	**IT803**	**Course Type**	**Elective**
Pre-requisite	**Internetworking Protocols**	**L – T – P**	**3 – 0 – 0**
Stream	**Networking**	**Credits**	**3**

Course Objectives:

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
3. To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes.
4. To learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration.
5. To learn the fiber optical network components, variety of networking aspects, FDDI, SONET/SDH and operational principles WDM to acquire knowledge about fault and congestion management.

Course Outcomes:

The student will be able to:

1. Design a system, component or process as per needs and specification.
2. Gain knowledge on optical network architectures ranging from optical access networks to backbone optical transport networks.
3. Gain the knowledge on methodologies of optical network design optimization.
4. Explore techniques of optical network survivability.
5. Solve the Problems in the discipline of optical networks.

Course Content

UNIT I

Optical Layer: SONET/SDH: Multiplexing, CAT and LCAS, Sonnet/SDH Layers, SONET Frame Structure, SONET/SDH physical layer, Elements of a SONET/SDH infrastructure, Optical Transport Network: Hierarchy, Frame Structure, Multiplexing, Generic framing procedure Ethernet: Frame structure, Switches, Ethernet Physical layer, Carrier transport IP: Routing and forwarding, Quality of service. Multiprotocol label switching: Labels and forwarding, Quality of service, Signaling and routing, Carrier transport, Resilient packet ring: Quality of service, Node structure, Fairness storage area networks: Fiber channel.

UNIT II

WDM Network Elements: Optical line terminals, Optical line amplifiers, Optical Add/Drop Multiplexers: OADM Architectures, Reconfigurable OADMs, Optical cross connects: All-Optical OXC configurations.

UNIT III

Control and Management: Network management functions: Management framework, Information model, Management protocols. Optical layer services and interfacing, Layers within the Optical layer, Multi vendor Interoperability.

UNIT IV

Performance and Fault Management: The Impact of transparency, BER measurement, Optical trace, Alarm management, Data Communication Network (DCN) and Signaling, Policing, Optical layer overhead, Client layers. Configuration management: Equipment management, Connection management, Adaptation management. Optical Safety: Open Fiber Control protocol.

UNIT V

Protection in SONET/SDH: Point-to-Point links, Self-healing rings, Unidirectional line-switched rings, Bidirectional line-switched rings, Ring Interconnection and dual homing. Protection in the client layer: Protection in Resilient Packet Rings, Protection in Ethernet, Protection in IP, Protection in MPLS, Why Optical Layer protection: Service classes based on protection. Optical Layer protection schemes: 1+1 OMS Protection, 1:1 OMS Protection, OMS-DPRing, OMS-SPRing, 1:N Transponder Protection, 1+1 OCh Dedicated Protection, OCh-SPRing, OCH-Mesh Protection, GMPLS Protection, Interworking between layers.

UNIT VI

WDM Network Design: Cost Trade-OFFS: A detailed ring network example LTD and RWA problems, Light path topology design, Routing and wavelength assignment, Wavelength conversion. Dimensioning, Wavelength- routing networks, Statistical dimensioning models: First-passage model, Blocking model, Maximum load dimensioning models: Offline light path requests, Online RWA in rings.

Text Book:

1. Rajeev Ramaswamy, Kumar N Sivarajan, "***Optical Networks***" , Elsevier Publication, 3rd Edition, 2009.

Reference Book:

1. Uyless Black," ***Optical Networks-Third generation transport system***" Pearson Publication, 2013.

Course Title:	**Web & Text Mining**	**Semester**	**VIII**
Course Code	**IT803**	**Course Type**	**Elective**
Pre-requisite	**Data Warehouse and Data Mining**	**L – T – P**	**3 – 0 – 0**
Stream	**Data Science**	**Credits**	**3**

Course Objectives:

1. To learn the concepts of database technology evolutionary path which has led to the need for data mining and its applications.
2. To learn the essential techniques of data and text mining.
3. To understand data mining standard predictive methods to unstructured text.
4. To discuss the standard techniques of preparation and handling methods to transform that can be mined.

Course Outcomes:

After learning the course the students should be able:

1. To examine the types of the data to be mined and present a general classification of tasks and primitives to integrate a data mining system.
2. To explore DWH and OLAP and devise efficient and cost effective methods for maintaining DWHs.
3. To discover interesting patterns from large amounts of data to analyze and extract patterns to solve problems, make predictions of outcomes.
4. To comprehend the roles that data mining plays in various fields and manipulate different data mining techniques.
5. To evaluate systematically supervised and unsupervised models and algorithms w.r.t. their accuracy.

Course Content

UNIT I

Introduction to Information Retrieval: Inverted indices and Boolean queries, Query optimization, The nature of unstructured and semi-structured text.

UNIT II

Text encoding: Tokenization, Stemming, Lmmatization, Stop words, Phrases, Further optimizing indices for query processing, Proximity and phrase queries, Positional indices.

UNIT III

Index compression: Lexicon compression and postings lists compression, Gap encoding, Amma codes, Zipf's Law. Blocking. Extreme compression, Query expansion: spelling correction and synonyms. Wild-card queries, Permuterm indices, N-gram indices. Edit distance, Soundex, Language detection. Index construction. Postings size estimation, Merge sort, Dynamic indexing, Positional indexes, N-gram indexes, Real-world issues.

UNIT IV

Parametric or fielded search: Document zones, The vector space retrieval model, Scoring documents, Vector space scoring, The cosine measure, Efficiency considerations, Nearest neighbor techniques, Reduced dimensionality approximations, Random projection. Results summaries: Static and dynamic, Evaluating search engines.

User happiness, Precision, Recall, F-measure, Creating test collections: kappa measure, interjudge agreement. Relevance, approximate vector retrieval.

UNIT V

Feedback: Relevance feedback, Pseudo relevance feedback, Query expansion, Automatic thesaurus generation, Sense-based retrieval, Experimental results of performance effectiveness.
Probabilistic models for text problems, Classical probabilistic IR, Language models, Introduction to text classification, Naive Bayes models, Spam filtering, Probabilistic language models for IR, Bayesian nets for IR.

UNIT VI

Introduction to the problem: Partitioning methods, K-means clustering, Mixture of Gaussians model, Clustering versus classification, Hierarchical agglomerative clustering, Clustering terms using documents, Labelling clusters, Evaluating

clustering, Text-specific issues, Reduced dimensionality/spectral methods, Latent semantic indexing (LSI), Applications to clustering and to information retrieval.
Vector space classification using hyperplanes, centroids, k Nearest Neighbors, Support Vector machine classifiers, Kernel functions, Text classification, Exploiting text-specific features, Feature selection, Evaluation of classification, Micro- and macro averaging, Comparative results.

Text Books:

1. Michael Geatz and Richard Roiger, ***"Data Mining: A Tutorial Based Primer"***, Pearson Education.
2. Thomas W. Miller, ***"Data and Text Mining: A Business Applications Approach"***, Pearson Education.
3. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, ***"Introduction to Data Mining"***, Pearson Education.

Reference Books:

1. R. Baeza-Yates and B. Ribeiro-Neto, ***"Modern Information Retrieval"***, Pearson Education, 1999.
2. D.A. Grossman, O. Frieder, ***"Information Retrieval: Algorithms and Heuristics"***, Springer, 2004.
3. W. Frakes and R. Baeza-Yates, ***"Information Retrieval: Data Structures and Algorithms"***, 1st Edition, Pearson Education.

Course Title:	**Multimedia Applications**	**Semester**	**VIII**
Course Code	**IT804**	**Course Type**	**Elective**
Pre-requisite	**Nil**	**L – T – P**	**3 – 0 – 0**
Stream	**Software and Application Development**	**Credits**	**3**

Course Objectives:

1. To understand the overview of basic topics in multimedia.
2. To learn the software technologies of non-traditional interfaces.
3. To learn the development of interactive multimedia applications.

Course Outcomes:

After learning the course the students should be able:

1. To understand basic concepts related to MM including data standards, algorithms and softwares.
2. To experience development of multimedia software by utilizing existing libraries and descriptions of algorithms.
3. To demonstrate cutting-edge multimedia topics through independent study and presentations in class.

Course Content:

UNIT I

Introduction: Components of Multimedia, Multimedia and Hypermedia multimedia building blocks, Communication and information transfer model, Multimedia information systems, Application purposes of multimedia, Electronics performance support systems. Interaction Technologies and devices: Human Computer Interface, Input/output technologies, Combined I/O device, Storage technologies, Processing technologies.

UNIT II

Multimedia Authoring and data representation: Multimedia Authoring: Production, Presentation and auto authoring, Image data types, Image representation, Image acquisition, Picture display, Working with image.

UNIT III

Compression Technologies for multimedia: Need for data compression, Compression basics, Llossless and lossy compression, Image compression standards, Video compression standards, Basic audio compression standards.

UNIT IV

Text, Hypertext and Hypermedia, and Digital audio: Visual representation of text, Digital representation of characters, Formatting aspect text, Hypertext and hypermedia, Producing digital audio, Psychoacoustics, Processing sound, Representation of audio files, Digitization of sound, MIDI, Quantization and transmission of audio.

UNIT V

Designing multimedia: Development phases and teams, Analysis phase, Design phase, Development phase, Implementation phase, Evaluation and testing.

UNIT VI

Multimedia networks and communication: Multimedia in the Internet, Streaming stored audio/video, Streaming live audio/video, real-time interactive audio/video, Real-time interactive protocols: RTP, RTCP, Session Initialization protocol (SIP), H.323, SCTP. QoS: Data flow, Flow classes, Flow control, Integrated services, Differentiated services. Multimedia content management systems, Multimedia indexing, Multimedia retrieval.

Text Books:

1. Li. Z., Drew M., ***"Fundamentals of Multimedia"***, Pearson Education publishers, 2004.
2. Chow V. W. S., ***"Multimedia Technology and Applications"***, Springer.

Reference Books:

1. Banerji A., and Ghosh A.M., ***"Multimedia Technologies"***, McGraw Hill International, 2009.
2. Stamou G., and Kollias S., ***"Multimedia Contents and the Semantic Web"***, John Wiley & Sons., 2005.

Course Title:	**Ethical Hacking**	**Semester**	**VIII**
Course Code	**IT804**	**Course Type**	**Elective**
Pre-requisite	**Operating Systems**	**L – T – P**	**3 – 0 – 0**
Stream	**Infrastructure & Security Management**	**Credits**	**3**

Course Objectives:

1. To understand how intruders escalate privileges.
2. To understand Intrusion Detection, Policy Creation, Social Engineering, Buffer Overflows and different types of attacks and their protection mechanisms.
3. To learn about ethical laws and tests.

Course Outcomes:

After successful completion of the course, the student will be able:

1. To understand the core concepts related to malware, hardware and software vulnerabilities and their causes.
2. To understand ethics behind hacking and vulnerability disclosure.
3. To appreciate the Cyber Laws and impact of hacking.
4. To exploit the vulnerabilities related to computer system and networks using state of the art tools and technologies.

Course Content:

UNIT I

Types of data stolen from the organizations, Elements of Information Security, Authenticity and non-repudiation, Security challenges, Effects of hacking, Types of hacker, Ethical hacker.

UNIT II

Hacktivism - role of security and penetration tester, Penetration testing methodology, Networking and computer attacks – Malicious software (Malware), Protection against malware, Intruder attacks on networks and computers, Addressing physical security, Key loggers and Back doors.

UNIT III

Web tools for foot printing, Conducting competitive intelligence, Google hacking, Scanning, Enumeration, Trojans and backdoors, Virus and worms, Proxy and packet filtering, Denial of service, Sniffer, Social Engineering: Shoulder surfing, Dumpster Diving, Piggybacking.

UNIT IV

Physical Security: Attacks and protection, Steganography: Methods, Attacks and measures, Cryptography : Methods and types of attacks, Wireless hacking, Windows hacking, Linux hacking.

UNIT V

Routers, Firewall and Honeypots, IDS and IPS, Web filtering, Vulnerability, Penetration testing, Session hijacking, Web server, SQL Injection, Cross site scripting, Exploit writing, Buffer overflow, Reverse engineering, Email hacking, Incident handling and response, Bluetooth hacking, Mobiles phone hacking.

UNIT VI

An introduction to the particular legal, Professional and ethical issues likely to face the domain of ethical hacking, Ethical responsibilities, Professional integrity and making appropriate use of the tools and techniques associated with ethical hacking, Social Engineering, Host Reconnaissance, Session Hijacking, Hacking - Web Server, Database, Password Cracking, Network and Wireless, Trojan, Backdoor, UNIX, LINUX, Microsoft, NOVEL Server, Buffer Overflow, Denial of Service Attack, Methodical Penetration Testing.

Text Books:

1. Michael T. Simpson, Kent Backman, James E., ***"Corley, Hands-On Ethical Hacking and Network Defense"***, CENGAGE Learning, 2nd Edition, 2010.
2. Patrick Engebretson, ***"The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy"***, Syngress Basics Series – Elsevier, August 4, 2011.

Reference Books:

1. Steven DeFino, Barry Kaufman, Nick Valenteen, ***"Official Certified Ethical Hacker Review Guide"***, CENGAGE Learning, 2009-11-01.
2. Whitaker, Newman, ***"Penetration Testing and Network Defense"***, Cisco Press, Indianapolis, IN, 2006.

Course Title:	**CRM & SCM**	**Semester**	**VIII**
Course Code	**IT804**	**Course Type**	**Elective**
Pre-requisite	**Enterprise Resource Planning**	**L – T – P**	**3 – 0 – 0**
Stream	**Information Management and Quality Control**	**Credits**	**3**

Course Objectives:

1. To make students understand the how IT is an enabler for SCM and CRM.
2. To understand supply chain strategy framework and supply chain strategies.
3. To comprehend the functionalities of CRM in service sector.

Course Outcomes:

After learning the course the students should be able:

1. To understand the concept of logistics and supply chain management.
2. To appreciate the importance of logistics function in overall success of any business/industrial sector.
3. To understand the interrelationship between logistics and supply chain management.
4. To understand the importance and dynamics of supply chain management in any business/industrial sector.
5. To know the world class best practices being carried out in supply chain management.
6. To understand the procurement and outsourcing strategies.
7. To understand the impact of customer relationship management in effective supply chain management.
8. To know how to measure the performance of supply chain operations.

Course Content:

UNIT I

Introduction to CRM: What is CRM? Why we need CRM? Definition of CRM, Architecture of CRM, Technology considerations of CRM, Technology components of CRM, Customer life cycle, Customer lifetime value computation, Implications of globalization on customer relationship management.

UNIT II

Introduction to e-CRM: Definition of e-CRM, Its need, Features, Framework of e-CRM, Six e's of e-CRM, CRM Vs e-CRM, Architecture of e-CRM, Implementing a technology based CRM solution.

UNIT III

Introduction to Supply Chain: What is SCM?, Why SCM? Generic types of supply chain, Major drivers of Supply chain, Supply Chain strategies, Value in Supply Chain- quality, Delivery, Flexibility, Core competencies in Supply Chain.

UNIT IV

Source management in Supply Chain: Insourcing, outsourcing, Partner selection, Sourcing strategies, Procurement strategies, Managing Inventory in Supply chain, Definition of inventories, Selective inventory control, Vendor managed inventory systems, Inventory performance measures- financial, operational & inventory turnover ratio (ITR), Transportation decisions in a Supply Chain – Transportation Strategy, Transportation selection, Mode of transportation, Transportation management system (TMS).

UNIT V

e- SCM: Information technology in Supply Chain: Typical IT solutions- EDI, Intranet, Extranet, Data Warehousing, E-commerce, E-procurement, Bar coding technology, GPS, RFID.

UNIT VI

Information Systems in Supply Chain Case Study – A live case of use of IT, Case Studies for SCM & CRM, For SCM: Mumbai Tiffinwala, For CRM: Sales Force.

Text Books:

1. Bowersox, Closs & Cooper , ***"Supply Chain & Logistic Management"***, Tata McGraw Hill 2nd Edition.
2. Paul Greenberg, ***"CRM at the speed of light"***, YMH 2nd Edition.

Reference Book:

1. Kristin Anderson and Carol Kerr, ***"Customer Relationship Management"***, Tata McGraw Hill.

Course Title:	**Wireless Networking**	**Semester**	**VIII**
Course Code	**IT804**	**Course Type**	**Elective**
Pre-requisite	**Internetworking Protocols**	**L – T – P**	**3 – 0 – 0**
Stream	**Networking**	**Credits**	**3**

Course Objectives:

1. To study the evolving wireless technologies and standards.
2. To understand the architectures of various access technologies such as 3G, 4G, WiFi etc.
3. To understand various protocols and services provided by next generation netwoks.

Course Outcomes:

After learning the course the students should be able:

1. To keep himself updated on latest wireless technologies and trends in the communication field.
2. To understand the transmission of voice and data through various networks..

Course Content:

UNIT I

Introduction, Technology and service trends of emerging Wireless technologies, The amazing growth of Mobile Communications, A little history, Mobile Communications fundamentals, Mobile data, WiFi, Bluetooth, Cable systems, Wireless migration options, Harmonization process.

UNIT II

WiFi (802.11), 802.11 Standards, WiFi protocols, Frequency allocation, Modulation and coding schemes, Network architecture, Typical WiFi configurations, Security, 802.11 Services, Hot spots, Virtual Private Networks (VPNs), Mobile VPN, VPN types, WiFi Integration with 3G/4G, Benefits of convergence of WiFi and Wireless Mobile.

UNIT III

Introduction, Universal mobile telecommunications service (UMTS), UMTS services, The UMTS air interface, Overview of the 3GPP release 1999 Network Architecture, Overview of the 3GPP Release 4 Network Architecture, Overview of the 3GPP Release 5, All-IP Network Architecture, Overview CDMA2000, TD-CDMA, TD-SCDMA, Commonality among WCDMA, CDMA2000, TD-CDMA, and TD-SCDMA.

UNIT IV

LTE Ecosystem, Standards, Radio spectrum, LTE architecture, User Equipment (UE), Enhanced Node B (eNodeB), Core network (EPC), Radio channel components, TD-LTE, Multiple Input Multiple Output, LTE scheduler, Carrier aggregation, Cell search, Cell reselection, Attach and default bearer activation, Handover (X2, S1, Inter-MME), Self-Organizing Networks (SONs), Relay cells, Heterogeneous Network (HetNET), Remote radio heads (RRH), VoLTE, LTE advanced.

UNIT V

Introduction, Standards, Generic WiMAX Architecture, Core network, Radio network, WiMAX Spectrum, Modulation, Channel structure, Mixed mode, Interference Mitigation techniques, Frequency planning, Features and applications, Security, QoS, Profiles, Origination, Handover, Femto and SON.

UNIT VI

Why VoIP?, The Basics of IP transport, VoIP challenges, H.323, The Session Initiation Protocol (SIP), Distributed architecture and media gateway control, VoIP and SS7, VoIP Quality of Service.

Text Books:

1. Clint Smith, P.E., Daniel Collins, ***"Wireless Networks: Design and Integration for LTE, EVDO, HSPA, and WiMAX"***, McGraw Hill 3rd Edition,
2. Eldad Perahia, Robert Stacey, ***"Next Generation Wireless LANs"***, Cambridge University Press, 2nd Edition.

Reference Books:

1. Yi-Bang Lin, Imrich Chlamtac, ***"Wireless and Mobile Network Architecture"***, Wiley India Edition.
2. Dipankar Ray chaudhary, Maria Gerla, ***"Emerging Wireless Technologies and the Future Mobile Internet"***, Cambridge University Press.

Course Title:	**Deep Learning**	**Semester VIII**	
Course Code	**IT804**	**Course Type**	**Elective**
Pre-requisite	**Machine Learning**	**L – T – P**	**3 – 0 – 0**
Stream	**Data Science**	**Credits**	**3**

Course Objectives:

1. To study the architecture of deep neural networks.
2. To understand various types of deep neural network.
3. To understand various applications of deep neural network.

Course Outcomes:

After learning the course the student will be able:

1. To understand basics of deep learning and its applications.
2. To use deep learning in real life data science applications.

Course Content:

UNIT-I

Introduction: Feedforward Neural networks, Gradient descent and the backpropagation algorithm, Unit saturation, aka the vanishing gradient problem and ways to mitigate it, RelU Heuristics for avoiding bad local minima, Heuristics for faster training, Nestors accelerated gradient descent, Regularization, Dropout.

UNIT-II

Convolutional Neural Networks Architectures, convolution pooling layers. Recurrent Neural Networks LSTM, GRU, Encoder Decoder architectures.

UNIT-III

Deep Unsupervised Learning:Autoencoders (standard, sparse, denoising, contractive etc), Variational Autoencoders, Adversarial Generative Networks, Autoencoder and DBM Attention and memory models, Dynamic memory networks.

UNIT-IV

Applications of Deep Learning to Computer Vision: Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with LSTM models. Attention models for computer vision tasks.

UNIT-V

Applications of Deep Learning to NLP: Introduction to NLP and Vector Space, Model of Semantics Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of- Words model (CBOW), Glove, Evaluations and Applications in word similarity, analogy reasoning, Named Entity Recognition, Opinion Mining using Recurrent Neural Networks.

UNIT-VI

Parsing and Sentiment Analysis using Recursive Neural Networks, Sentence Classification using Convolutional Neural Networks, Dialogue Generation with LSTMs, Applications of Dynamic Memory Networks in NLP, Recent Reseearch in NLP using Deep Learning: Factoid Question Asnwering, similar question detection, Dialogue topic tracking, Neural Summarization.

Text Books:

1. Bengio, Yoshua, ***"Deep learning."*** An MIT Press book in preparation (2015).
2. Aggarwal, Charu C., "***Neural Networks and Deep Learning***", Springer International Publishing, 1st edition.

Course Title:	**Internet of Things Lab**	**Semester VIII**	
Course Code	**IT805L**	**Course Type**	**Compulsory**
Pre-requisite	**Programming in Java/Python**	**L – T – P**	**0 – 0 – 2**
Stream	**-**	**Credit**	**1**

Lab Experiments Objectives:

1. Understand key IoT concepts on sensing devices, actuation, processing and communications.
2. To build industry capable talent for IoT.

List of Lab Experiments:

1. Study and Install Python in Eclipse and WAP for data types in python.
2. Study and Install IDE of Arduino and different types of Arduino.
3. Write program using Arduino IDE for Blink LED.
4. Study the Temperature sensor and Write Program for monitor temperature using Arduino.
5. Study and Implement RFID, NFC using Arduino.
6. Study and Configure Raspberry Pi
7. WAP for LED blink using Raspberry Pi.
8. Study the Temperature sensor and Write Program foe monitor temperature using Raspberry Pi.

Course Title:	**Mobile Computing Lab**	**Semester VIII**	
Course Code	**IT806L**	**Course Type**	**Elective**
Pre-requisite	**Programming in Java**	**L – T – P**	**0 – 0 – 2**
Stream	**Software and Application Development**	**Credit**	**1**

Lab Experiments Objectives:

1. Know the components and structure of mobile application development frameworks for Android and windows OS based mobiles.
2. Understand how to work with various mobile application development frameworks.
3. Learn the basic and important design concepts and issues of development of mobile applications.
4. Understand the capabilities and limitations of mobile devices.

List of Lab Experiments:

1. Develop an application that uses GUI components, Font and Colours.
2. Develop an application that uses Layout Managers and event listeners.
3. Develop a native calculator application.
4. Write an application that draws basic graphical primitives on the screen.
5. Develop an application that makes use of database.
6. Develop an application that makes use of RSS Feed.
7. Implement an application that implements Multi threading.
8. Develop a native application that uses GPS location information.
9. Implement an application that writes data to the SD card.
10. Implement an application that creates an alert upon receiving a message.
11. Write a mobile application that creates alarm clock.

Course Title:	**Cryptography Lab**	**Semester VIII**	
Course Code	**IT806L**	**Course Type**	**Elective**
Pre-requisite	**Programming in Java/C/C++**	**L – T – P**	**0 – 0 – 2**
Stream	**Infrastructure & Security Management**	**Credit**	**1**

Lab Experiments Objectives:

1. Know the components and structure of mobile application development frameworks for Android and windows OS based mobiles.
2. Understand how to work with various mobile application development frameworks.
3. Learn the basic and important design concepts and issues of development of mobile applications.
4. Understand the capabilities and limitations of mobile devices.

List of Lab Experiments:

1. Encryption using binary/byte addition.
2. Encryption using binary Exclusive-OR (XOR).
3. Triple DES with CBC mode and Weak DES keys.
4. RSA Encryption and Factorization Attacks.
5. Attack on RSA encryption with short RSA modulus
6. Hash generation and sensitivity of hash functions to plaintext modifications.
7. Digital Signature Visualization.
8. RSA Signature.
9. Study of Attack on Digital Signature/Hash Collision.

Course Title:	**Information Retrieval Lab**	**Semester VIII**	
Course Code	**IT806L**	**Course Type**	**Elective**
Pre-requisite	**Design and Analysis of Algorithms lab**	**L – T – P**	**0 – 0 – 2**
Stream	**Information Management & Quality Control**	**Credit**	**1**

Lab Experiments Objectives:

1. To implement various information retrieval (IR) algorithms across data and web successfully.
2. To compare results and discuss the merits and demerits of various algorithms.

Lab Experiments List:

1. Representation of a Text Document in Vector Space Model and Computing Similarity between two documents.
2. Pre-processing of a Text Document: stop word removal and stemming.
3. Construction of an Inverted Index for a given document collection comprising of at least 50 documents with a total vocabulary size of at least 1000 words.
4. Classification of a set of Text Documents into known classes (You may use any of the Classification algorithms like Naive Bayes, Max Entropy, Rochio's, Support Vector Machine). Standard Datasets will have to be used to show the results.
5. Text Document Clustering using K-means. Demonstrate with a standard dataset and compute performance measures- Purity, Precision, Recall and F-measure.
6. Crawling/ Searching the Web to collect news stories on a specific topic (based on user input). The program should have an option to limit the crawling to certain selected websites only.
7. To parse XML text, generate Web graph and compute topic specific page rank.
8. Matrix Decomposition and LSI for a standard dataset.
9. Mining Twitter to identify tweets for a specific period (and/or from a geographical location) and identify trends and named entities.
10. Implementation of PageRank on Scholarly Citation Network.

Course Title:	**Network Security Lab**	**Semester VIII**	
Course Code	**IT806L**	**Course Type**	**Elective**
Pre-requisite	**Programming in Java / C / C++**	**L – T – P**	**0 – 0 – 2**
Stream	**Networks**	**Credit**	**1**

Lab Experiments Objectives:

1. To highlight the issues with computer and network security by giving the hands on knowledge of various things like monitoring and analyzing network traffic.
2. To install and configure different tools like Wireshark, SNORT, NMAP and Port Scanners etc.

Lab Experiments List:

1. Perform An Experiment To Grab A Banner With Telnet And Perform The Task Using Netcat Utility.
2. Perform An Experiment For Port Scanning With Nmap, Superscan Or Any Other Software.
3. Using Nmap.
4. Find Open Ports On A System.
5. Find The Machines Which Are Active.
6. Find The Version Of Remote Os On Other Systems.
7. Find The Version Of S/W Installed On Other System.
8. Perform An Experiment On Active And Passive Finger
9. Printing Using Xprobe2 and Nmap.
10. Perform an experiment to demonstrate how to sniff for Router Traffic by Using the Tool Wireshark.
11. Perform an experiment How To Use Dumpsec.
12. Perform a Wireless Audit Of An Access Point / Router And Decrypt WEP And WPA.
13. Perform an Experiment To Sniff Traffic Using Arp Poisoning.
14. Install Jcrypt Tool (Or Any Other Equivalent) And Demonstrate Asymmetric, Symmetric Cryptography Algorithm, Hash And Digital/PKI Signatures.
15. Demonstrate Intrusion Detection System (Ids) Using Any Tool e.g. Snort Or Any Other S/W.
16. Install Rootkits And Study Variety Of Options.
17. Generating Password Hashes With Openssl.
18. Setup A Honey Pot And Monitor The Honeypot On Network.

Course Title:	**Big Data Analytics Lab**	**Semester VIII**	
Course Code	**IT806L**	**Course Type**	**Elective**
Pre-requisite	**Programming in Java / C / C++ / Python**	**L – T – P**	**0 – 0 – 2**
Stream	**Data Science**	**Credit**	**1**

Lab Experiments Objective:

1. To learn the concepts of Big data processing techniques by writing programs in Hadoop and MapReduce algorithms.

Lab Experiments List:

1. Study of Hadoop ecosystem.
2. Two programming exercises on Hadoop.
3. Two programming exercises in No SQL.
4. Implementing simple algorithms in MapReduce: Matrix multiplication, Aggregates, joins, sorting, searching.
5. Implementing any one frequent item set algorithm using MapReduce.
6. Implementing any one clustering algorithm using MapReduce.
7. Implementing any one data streaming algorithm using MapReduce.
8. Mini Project: one real life large data application to be implemented (use standard datasets available on the web).

Course Title:	**Electronic Payment System Lab**	**Semester VIII**	
Course Code	**IT806L**	**Course Type**	**Elective**
Pre-requisite	**-**	**L – T – P**	**0 – 0 – 2**
Stream	**-**	**Credit**	**1**

Assignments based on syllabus.

Course Title:	**Multimedia Applications Lab**	**Semester VIII**	
Course Code	**IT807L**	**Course Type**	**Elective**
Pre-requisite	**Programming in Java / C / Python**	**L – T – P**	**0 – 0 – 2**
Stream	**Software and Application Development**	**Credit**	**1**

Lab Experiments Objectives:

1. To write programs to edit and modify multimedia files into different formats.
2. To write programs to service multimedia information on demand through streaming.
3. To transfer multimedia data from one system to other.

Lab Experiments List:

1. Assignment on: Image editing using Photoshop (or other image editing software).
2. Audio editing using Sound Forge or Audacity (or other sound editing software).
3. Animation using Flash Video editing using Premier or Adobe.
4. Write a program to convert audio files from one format to other.
5. Write a program to convert video files from one format to other.
6. Write a program to embed multimedia files on a webpage and stream them.
7. Write programs to transfer multimedia files from one device to another.

Course Title:	**Ethical Hacking Lab**	**Semester VIII**	
Course Code	**IT807L**	**Course Type**	**Elective**
Pre-requisite	**Operating Systems lab**	**L – T – P**	**0 – 0 – 2**
Stream	**Infrastructure & Security Management**	**Credit**	**1**

Lab Experiments Objectives:

1. To understand the different kinds of hacker attacks to information and computer systems.
2. To simulate hacker attacks.
3. To change system parameters to prevent hacker attacks.
4. To write programs to prevent attacks and make system more resilient.

Lab Experiments List:

1. Use any 2 of the following hacking tools to expose system vulnerability (Nmap, Nessus, John the Ripper, Cain & Abel, Netstumbler, SQLMap).
2. Conduct and experiment to crack a password of an Application using the Cain & Abel tool.
3. Simulate a Denial of Service attack.
4. Execute a network sniffing exercise using Wireshark.
5. Discover vulnerabilities in a web server.
6. Create a simple website and write programs protect it from hacks such as (SQL injection, DoS, Cross Site Scripting XSS, Cookie/Session Poisoning, Form Tampering, Code injection and Defacement).

Course Title:	**CRM & SCM Lab**	**Semester VIII**	
Course Code	**IT807L**	**Course Type**	**Elective**
Pre-requisite	**Enterprise Resource Planning**	**L – T – P**	**0 – 0 – 2**
Stream	**Information Management & Quality Control**	**Credit**	**1**

Lab Experiments Objectives:

1. To understand CRM and SCM as candidates to understand ERP applications deployed in organization.
2. To demonstrate the workings of various sub functions of CRM and SCM as learned in theory.

Lab Experiments List:

Students can download any open source CRM and SCM systems available to conduct the lab assignments

1. Set up an organizations customers, sales, product/services, departments and markets in the CRM/SCM system
2. Enter data for orders, customers, products, orders, quotes, invoices, payments in the CRM/SCM
3. Generate various CRM reports and alert with all the data entered

Course Title:	**Wireless Networking Lab**	**Semester VIII**	
Course Code	**IT807L**	**Course Type**	**Elective**
Pre-requisite	**Internetworking Protocols**	**L – T – P**	**0 – 0 – 2**
Stream	**Networking**	**Credit**	**1**

Lab Experiments Objectives:

1. To give the practical exposure on wireless networks.
2. To configure and understand real issues in maintaining wireless networks.
3. To understand administrator functions.

Lab Experiments List:

1. Wireless Component and Media Identification.
2. Install a WLAN Adapter Card.
3. Wireless Mathematics.
4. Topology Design with Cisco Network Designer (CND).
5. Configuring Basic AP Settings.
6. Resetting the Bridge.
7. Antenna Setup.
8. Wireless Attacks and Countermeasures.
9. WLAN Design.
10. Site Survey Active Mode.

Course Title:	**Deep Learning Lab**	**Semester VIII**	
Course Code	**IT807L**	**Course Type**	**Elective**
Pre-requisite	**Machine Learning**	**L – T – P**	**0 – 0 – 2**
Stream	**Data Science**	**Credit**	**1**

Lab Experiments Objective:

1. To implement various deep learning techniques to solve problems.

Lab Experiments List:

1. Setting up environment for deep learning implementation.
2. Learning basics of Python for deep learning implementation.
3. Study of Tensorflow/ Theano(background tool).
4. Implementation of convolution neural network.
5. Implementation of recurrent neural network.
6. Implementation of auto encoders.
7. Study of how to use NLTK for NLP.
8. Mini project on deep learning.

Course Title:	**Project Phase II**		
Course Code	**IT808**	**Semester VIII**	
Pre-requisite	**Nil**	**Course Type**	**Mandatory**
Stream	**Core**	**L – T – P**	**0 – 0 – 8**
		Credits	**4**

This is continuous work to the project phase I. Every students will have to submit a completed report (3 copies)* of the project work. Report preparation guidelines should be followed as per given format. The students will prepare a power point presentation of the work. Panel of examiners comprising of guide, internal examiner, senior faculty, external examiner, etc. will assess the performance of the students considering their quality of work.

Phase II

1. Coding/Implementation.
2. Use cases.
3. Testing/Trouble shooting.
4. Data dictionary/ Documentation.
5. Finalization of project in all respect.

*(For guide, Personal copy, Departmental library.)

In a presentation, the students should focus to clarify problem definition and analysis of the problem.

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