DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY, UTTAR PRADESH, LUCKNOW

EVALUATION SCHEME & SYLLABUS

FOR

MASTER OF COMPUTER APPLICATION (MCA)

(Two Year Course)

AS PER

AICTE MODEL CURRICULUM

[Effective from the Session: 2021-22]

MASTER OF COMPUTER APPLICATION (MCA)
MCA SECOND YEAR, 2021-22

SEMESTER-III

S. No.	Subject Code	Subject Name	Periods			Sessional			ESE	Total	Credit
			L	T	P	CT	TA	Total			
1.	KCA301	Artificial Intelligence	3	0	0	30	20	50	100	150	3
2.	KCA302	Software Engineering	4	0	0	30	20	50	100	150	4
3.	KCA303	Computer Based Optimization Techniques	3	1	0	30	20	50	100	150	4
4.		Elective – 1	3	0	0	30	20	50	100	150	3
5.		Elective – 2	3	1	0	30	20	50	100	150	3
6.	KCA351	Artificial Intelligence Lab	0	0	3	30	20	50	50	100	2
7.	KCA352	Software Engineering Lab	0	0	3	30	20	50	50	100	2
8.	KCA353	Mini Project**	0	0	4	30	20	50	50	100	2
		Total								**1050**	**23**

CT: Class Test **TA**: Teacher Assessment **L/T/P**: Lecture/ Tutorial/ Practical

SEMESTER-IV

S. No.	Subject Code	Subject Name	Periods			Sessional			ESE	Total	Credit
			L	T	P	CT	TA	Total			
1.		Elective – 3	3	0	0	30	20	50	100	150	3
2.		Elective – 4	3	0	0	30	20	50	100	150	3
3.		Elective – 5	3	0	0	30	20	50	100	150	3
4.	KCA451	Project	-	-	-	-	200	200	500	700	14
		Total								**1050**	**23**

CT: Class Test **TA**: Teacher Assessment **L/T/P**: Lecture/ Tutorial/ Practical

** The Mini Project (6 weeks) conducted during summer break after II semester and will be assessed during III semester. The Course will be carried out at the Institute under the guidance of a Faculty Members.

Elective-1	KCA011	Cryptography & Network Security
	KCA012	Neural Network
	KCA013	Software Project Management
	KCA014	Big Data
	KCA015	Introduction to Machine Learning

Elective-2	KCA021	Web Technology
	KCA022	Cloud Computing
	KCA023	Simulation & Modeling
	KCA024	Soft Computing
	KCA025	Android Operating System

Elective-3	KCA031	Blockchain Architecture
	KCA032	Data Warehousing & Data Mining
	KCA033	Pattern Recognition
	KCA034	Data Analytics
	KCA035	Computer Networks

Elective-4	KCA041	Digital Image Processing
	KCA042	Software Testing and Quality Assurance
	KCA043	Internet of Things
	KCA044	Modern Application Development
	KCA045	Distributed Database Systems

Elective-5	KCA051	Mobile Computing
	KCA052	Computer Graphics and Animation
	KCA053	Natural Language Processing
	KCA054	Compiler Design
	KCA055	Deep Learning

SECOND SEMESTER SYLLABUS

SEMESTER-III

KCA301: Artificial Intelligence		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO 1	Define the meaning of intelligence and study various intelligent agents.	K_1
CO 2	Understand, analyze and apply AI searching algorithms in different problem domains.	K_2 , K_3, K_4
CO 3	Study and analyze various models for knowledge representation.	K_1, K_3
CO 4	Understand the basic concepts of machine learning to analyze and implement widely used learning methods and algorithms.	K_2 , K_4, K_6
CO 5	Understand the concept of pattern recognition and evaluate various classification and clustering techniques	K_2 , K_5
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Artificial Intelligence:** Introduction to artificial intelligence, Historical development and foundation areas of artificial intelligence, Tasks and application areas of artificial intelligence. Introduction, types and structure of intelligent agents, Computer Vision, Natural language processing.	**08**
II	**Searching Techniques:** Introduction, Problem solving by searching, Searching for solutions, Uniformed searching techniques, Informed searching techniques, Local search algorithms, Adversarial search methods, Search techniques used in games, Alpha-Beta pruning.	**08**
III	**Knowledge Representation and Reasoning:** Propositional logic, Predicate logic, First order logic, Inference in first order logic, Clause form conversion, Resolution. Chaining- concept, forward chaining and backward chaining, Utility theory and Probabilistic reasoning, Hidden Markov model, Bayesian networks.	**08**
IV	**Machine Learning:** Introduction, types and application areas, Decision trees, Statistical learning methods, Learning with complete data - concept and Naïve Bayes models, Learning with hidden data- concept and EM algorithm, Reinforcement learning.	**08**
V	**Pattern Recognition:** Introduction and design principles, Statistical pattern recognition, Parameter estimation methods - Principle component analysis and Linear discrimination analysis, Classification techniques - Nearest neighbor rule and Bayes classifier, K-means clustering, Support vector machine.	**08**

Suggested Readings:

1. Russell S. and Norvig P., "Artificial Intelligence – A Modern Approach", Pearson Education.
2. Rich E. and Knight K., "Artificial Intelligence", McGraw Hill Publications.
3. Charnik E. and McDermott D., "Introduction to Artificial Intelligence", Pearson Education.
4. Patterson D. W., "Artificial Intelligence and Expert Systems", Prentice Hall of India Publications.
5. Khemani D., "A First Course in Artificial Intelligence", McGraw Hill.
6. Winston P. H., "Artificial Intelligence", Pearson Education.
7. Thornton C. and Boulay B.," Artificial Intelligence- Strategies, Applications and Models through Search", New Age International Publishers.

KCA302: Software Engineering		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO 1	Explain various software characteristics and analyze different software Development Models.	K_1, K_2
CO 2	Demonstrate the contents of a SRS and apply basic software quality assurance practices to ensure that design, development meet or exceed applicable standards.	K_1, K_2
CO 3	Compare and contrast various methods for software design.	K_2, K_3
CO 4	Formulate testing strategy for software systems, employ techniques such as unit testing, Test driven development and functional testing.	K_3
CO 5	Manage software development process independently as well as in teams and make use of various software management tools for development, maintenance and analysis.	K_5
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Quality Attributes. Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.	**08**
II	**Software Requirement Specifications (SRS):** Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modelling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS. Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.	**08**
III	**Software Design:** Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.	**08**
IV	**Software Testing:** Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top Down and Bottom- Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards.	**08**
V	**Software Maintenance and Software Project Management:** Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version	**08**

	Control, An Overview of CASE Tools. Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.	

Suggested Readings:

1. R S Pressman, "Software Engineering: A Practitioners Approach", McGraw Hill.
2. Pankaj Jalote, "Software Engineering", Wiley
3. Rajib Mall, "Fundamentals of Software Engineering", PHI Publication.
4. K K Aggarwal and Yogesh Singh, "Software Engineering", New Age International Publishers.
5. Ghezzi, M. Jarayeri, D. Manodrioli, "Fundamentals of Software Engineering", PHI Publication.
6. Ian Sommerville, "Software Engineering", Addison Wesley.
7. Kassem Saleh, "Software Engineering", Cengage Learning
8. Pfleeger, "Software Engineering", Macmillan Publication

KCA303: Computer Based Optimization Techniques		
Course Outcome (CO)	**Bloom's Knowledge Level (KL)**	
At the end of course, the student will be able to understand		
CO 1	Students will be able to describe characteristics and scope of OR and also to formulate LPP and obtain graphical solutions & acquire general idea of the simplex method.	K_1, K_2
CO 2	To understand and solve transportation problem & assignment models.	K_3, K_4
CO 3	To understand and solve integer linear programming and non-linear problems.	K_2, K_3
CO 4	To know optimal inventory model and to identify right time for replacement of equipment.	K_5, K_6
CO 5	Students will be able to evaluate optimum solution using dynamic programming for different applications and to understand concepts of queuing theory.	K_2, K_5
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to OR & Linear Programming Problems (LPP):** Nature and meaning of OR, Principles of Modeling, General methods for solving OR Models, Main characteristics of OR, Main phases of OR, Scope of OR, Role of OR in decision making. Definition of LPP, Graphical Solutions of Linear Programming Problems, Simplex Method and Artificial Variable Method, Two Phase Method, Big-M method, Duality, Dual Simplex Method.	**08**
II	**Transportation Problems:** Introduction to Transportation Model, Matrix form of TP, Various methods of finding Initial basic feasible solution-North West Corner Method, Least Cost Method & VAM Method. Technique for obtaining optimal basic feasible Solution using MODI Method, Maximization Transportation Problem. **Assignment Problems:** Hungarian Algorithm and its applications, Maximization Assignment Problem.	**08**
III	**Integer Linear Programming Problems:** Integer Linear Programming Problems, Mixed Integer Linear Programming Problems, Cutting Plane Method, Branch and Bound Method. **Introduction to NLP:** Definition of NLP, Convex Programming Problems, Quadratic Programming Problems, Wolfe's Method for Quadratic Programming, Kuhn-Tucker Conditions, Geometrical Interpretation of KT-Conditions, KT-Points etc.	**08**
IV	**Inventory Models:** Various costs-deterministic inventory models, Single period inventory model with shortest cost, Stochastic models, Application of inventory models, Economic lot sizes-price breaks. **Replacement Problems**: Capital equipment-discounting costs-replacement in anticipation of failure- group replacement-stochastic nature underlying the failure phenomenon.	**08**
V	**Dynamic Programming**: Bellman's Principle of optimality of Dynamic Programming, Multistage decision problem and its solution by Dynamic Programming with finite number of stages, Solution of linear programming problems as a Dynamic Programming problem. **Queuing Theory:** Introduction to Queues, Characteristics of M/M/I Queue model, Role of Exponential and Poisson Distributions, Markovian Process, Erlang Distribution, Distribution of Arrivals, Distribution of Service Times, Definition of Steady and Transient State, Poisson Queues.	**08**

Suggested Readings:

1. Taha H. A., "Operations Research – An Introduction", Prentice-Hall India.
2. Wagner H. M.,"Principles of Operations Research with Applications to Managerial Decisions", PHI.
3. Swarup K., "Operations Research", Sultan Chand & Sons.
4. Chawla K. K., Gupta V. and Bhushan K. S., "Operations Research- Quantitative Analysis for Management", Kalyani Publishers.
5. Sharma J. K. "Operations Research", Pearson, 3rd Edition.

ELECTIVE-1

KCA011: Cryptography & Network Security		
Course Outcome (CO)	**Bloom's Knowledge Level (KL)**	
At the end of course, the student will be able to understand		
CO 1	Understand various security attacks and their protection mechanism.	K_2
CO 2	Apply and analyze various encryption algorithms.	K_3, K_4
CO 3	Understand functions and algorithms to authenticate messages and study and apply different digital signature techniques.	K_1, K_2, K_3
CO 4	Analyze different types of key distributions.	K_4
CO 5	Study and appraise different IP and system security mechanism.	K_1, K_5
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	Introduction to security attacks, Services and mechanism, Classical encryption techniques substitution ciphers and transposition ciphers, Cryptanalysis, Steganography, Stream and block ciphers. **Modern Block Ciphers:** Block ciphers principles, Shannon's theory of confusion and diffusion, Feistel structure, Data encryption standard(DES), Strength of DES, Idea of differential cryptanalysis, Block cipher modes of operations, Triple DES	**08**
II	Introduction to group, field, finite field of the form GF(p), Modular arithmetic, Prime and relative prime numbers, Extended Euclidean Algorithm, Advanced Encryption Standard (AES). Fermat's and Euler's theorem, Primality testing, Chinese Remainder theorem, Discrete Logarithmic Problem, Principals of public key crypto systems, RSA algorithm, Security of RSA	**08**
III	**Message Authentication Codes:** Authentication requirements, Authentication functions, Message authentication code, Hash functions, Birthday attacks, Security of hash functions, Secure hash algorithm (SHA). **Digital Signatures:** Digital Signatures, Elgamal Digital Signature Techniques, Digital signature standards (DSS), Proof of digital signature algorithm.	**08**
IV	**Key Management and distribution:** Symmetric key distribution, Diffie-Hellman Key Exchange, Public key distribution, X.509 Certificates, Public key Infrastructure. **Authentication Applications:** Kerberos Electronic mail security: pretty good privacy (PGP), S/MIME.	**08**
V	**IP Security:** Architecture, Authentication header, Encapsulating security payloads, Combining security associations, Key management. Introduction to Secure Socket Layer, Secure electronic transaction (SET). **System Security:** Introductory idea of Intrusion, Intrusion detection, Viruses and related threats, firewalls.	**08**

Suggested Readings:

1. Stallings W., "Cryptography and Network Security: Principals and Practice", Pearson Education.
2. Frouzan B. A., "Cryptography and Network Security", McGraw Hill.
3. Kahate A., "Cryptography and Network Security", Tata McGraw Hill.

KCA012: Neural Networks

Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course, the student will be able to understand		
CO 1	Study of basic concepts of Neuro Computing, Neuroscience and ANN. Understand the different supervised and unsupervised and neural networks performance.	K_1, K_2
CO 2	Study of basic Models of neural network. Understand the Perception network. and Compare neural networks and their algorithm.	K_2, K_3
CO 3	Study and Demonstrate different types of neural network. Make use of neural networks for specified problem domain.	K_2 K_3, K_4
CO 4	Understand and Identify basic design requirements of recurrent network and Self-organizing feature map.	K_1, K_2
CO 5	Able to understand the some special network. Able to understand the concept of Soft computing.	K_1, K_2 K_3
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Neurocomputing and Neuroscience**: The human brain, biological neurons, neural processing, biological neural network. **Artificial Neural Networks:** Introduction, historical notes, neuron model, knowledge representation, comparison with biological neural network, applications. **Learning process:** Supervised learning, unsupervised learning, error correction learning, competitive learning, adaptation learning, Statistical nature of the learning process.	**08**
II	**Basic Models:** McCulloch-Pitts neuron model, Hebb net, activation functions, aggregation functions. **Perceptron networks:** Perceptron learning, single layer perceptron networks, multilayer perceptron networks. Least mean square algorithm, gradient descent rule, nonlinearly separable problems and bench mark problems in NN.	**08**
III	**Multilayer neural network:** Introduction, comparison with single layer networks. **Back propagation network**: Architecture, back propagation algorithm, local minima and global minima, heuristics for making back propagation algorithm performs better, applications. **Radial basis function network**: Architecture, training algorithm, approximation properties of RBF networks, comparison of radial basis function network and back propagation networks.	**08**
IV	**Recurrent network**: Introduction, architecture and types. **Self-organizing feature map**: Introduction, determining winner, Kohonen Self Organizing feature maps (SOM) architecture, SOM algorithm, properties of feature map; Learning vector quantization-architecture and algorithm. Principal component and independent component analysis.	**08**
V	**Special networks:** Cognitron, Support vector machines. Complex valued NN and complex valued BP. **Soft computing:** Introduction, Overview of techniques, Hybrid soft computing techniques.	**08**

Suggested Readings:

1. Kumar S., "Neural Networks- A Classroom Approach", McGraw Hill.
2. Haykin S., "Neural Networks – A Comprehensive Foundation", Pearson Education.
3. Yegnanarayana B. "Artificial Neural Networks", Prentice Hall of India.
4. Freeman J. A., "Neural Networks", Pearson Education.
5. James F., "Neural Networks – Algorithms, Applications and Programming Techniques", Pearson Education.

KCA013: Software Project Management

Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course, the student will be able to understand		
CO 1	Identify project planning objectives, along with various cost/effort estimation models.	K_3
CO 2	Organize & schedule project activities to compute critical path for risk analysis	K_3
CO 3	Monitor and control project activities.	K_4, K_5
CO 4	Formulate testing objectives and test plan to ensure good software quality under SEI-CMM	K_6
CO 5	Configure changes and manage risks using project management tools.	K_2, K_4
DETAILED SYLLABUS		**3-0-0**

Unit	Topic	Proposed Lecture
I	**Project Evaluation and Project Planning:** Importance of Software Project Management – Activities – Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.	**08**
II	**Project Life Cycle and Effort Estimation:** Software process and Process Models – Choice of Process models – Rapid Application development – Agile methods – Dynamic System Development Method – Extreme Programming– Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points – COCOMO II – a Parametric Productivity Model.	**08**
III	**Activity Planning and Risk Management:** Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning –Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of Critical paths – Cost schedules.	**08**
IV	**Project Management and Control:** Framework for Management and control – Collection of data – Visualizing progress – Costmonitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control Software Configuration Management – Managing contracts – Contract Management.	**08**
V	**Staffing in Software Projects:** Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham – Hackman job characteristic model – Stress – Health and Safety – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – Dispersed and Virtual teams – Communications genres – Communication plans – Leadership.	**08**

Suggested Readings:

1. Bob Hughes, Mike Cotterell and Rajib Mall: "Software Project Management" – Fifth Edition, McGraw Hill,New Delhi, 2012.
2. Robert K. Wysocki — "Effective Software Project Management" – Wiley Publication, 2011.
3. Walker Royce: — "Software Project Management" - Addison-Wesley, 1998.
4. Gopalaswamy Ramesh, — "Managing Global Software Projects" – McGraw Hill Education (India), FourteenthReprint 2013.
5. Koontz Harold & Weihrich Heinz, "Essentials of Management", McGraw Hill 5th Edition 2008.
6. Robbins and Coulter, "Management", Prentice Hall of India, 9th edition.
7. James A. F., Stoner, "Management", Pearson Education Delhi.
8. P. D. Chaturvedi, "Business Communication", Pearson Education.

KCA014: Big Data		
Course Outcome (CO)	**Bloom's Knowledge Level (KL)**	
At the end of course, the student will be able to understand		
CO1	Demonstrate knowledge of Big Data Analytics concepts and its applications in business.	K_1, K_2
CO2	Demonstrate functions and components of Map Reduce Framework and HDFS.	K_1, K_2
CO3	Develop queries in NoSQL environment.	K_6
CO4	Explain process of developing Map Reduce based distributed processing applications.	K_2, K_5
CO5	Explain process of developing applications using HBASE, Hive, Pig etc.	K_2,K_5
	DETAILED SYLLABUS	**4-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Big Data**: Types of digital data, history of Big Data innovation, introduction to Big Data platform, drivers for Big Data, Big Data architecture and characteristics, 5 Vs of Big Data, Big Data technology components, Big Data importance and applications, Big Data features – security, compliance, auditing and protection, Big Data privacy and ethics, Big Data Analytics, Challenges of conventional systems, intelligent data analysis, nature of data, analytic processes and tools, analysis vs reporting, modern data analytic tools.	**08**
II	**Hadoop:** History of Hadoop, Apache Hadoop, the Hadoop Distributed File System, components of Hadoop, data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, Hadoop Echo System. **Map-Reduce:** Map-Reduce framework and basics, how Map Reduce works, developing a Map Reduce application, unit tests with MR unit, test data and local tests, anatomy of a Map Reduce job run, failures, job scheduling, shuffle and sort, task execution, Map Reduce types, input formats, output formats, Map Reduce features, Real-world Map Reduce	**08**
III	**HDFS (Hadoop Distributed File System):** Design of HDFS, HDFS concepts, benefits and challenges, file sizes, block sizes and block abstraction in HDFS, data replication, how does HDFS store, read, and write files, Java interfaces to HDFS, command line interface, Hadoop file system interfaces, data flow, data ingest with Flume and Scoop, Hadoop archives, Hadoop I/O: Compression, serialization, Avro and file-based data structures. Hadoop Environment: Setting up a Hadoop cluster, cluster specification, cluster setup and installation, Hadoop configuration, security in Hadoop, administering Hadoop, HDFS monitoring & maintenance, Hadoop benchmarks, Hadoop in the cloud	**08**
IV	**Hadoop Eco System and YARN:** Hadoop ecosystem components, schedulers, fair and capacity, Hadoop 2.0 New Features – Name Node high availability, HDFS federation, MRv2, YARN, Running MRv1 in YARN. **NoSQL** Databases: Introduction to NoSQL MongoDB: Introduction, data types, creating, updating and deleing documents, querying, introduction to indexing, capped collections **Spark**: Installing spark, spark applications, jobs, stages and tasks, Resilient Distributed Databases, anatomy of a Spark job run, Spark on YARN **SCALA:** Introduction, classes and objects, basic types and operators, built-in control structures, functions and closures, inheritance.	**08**
V	**Hadoop Eco System Frameworks**: Applications on Big Data using Pig, Hive and HBase **Pig** : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators, **Hive** - Apache Hive architecture and installation, Hive shell, Hive services, Hive	**08**

	metastore, comparison with traditional databases, HiveQL, tables, querying data and user defined functions, sorting and aggregating, Map Reduce scripts, joins & subqueries. **HBase** – Hbase concepts, clients, example, Hbase vs RDBMS, advanced usage, schema design, advance indexing, Zookeeper – how it helps in monitoring a cluster, how to build applications with Zookeeper. IBM Big Data strategy, introduction to Infosphere, BigInsights and Big Sheets, introduction to Big SQL.	

Suggested Readings:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley.
2. Big-Data Black Book, DT Editorial Services, Wiley.
3. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, “Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data”, McGrawHill.
4. Thomas Erl, Wajid Khattak, Paul Buhler, “Big Data Fundamentals: Concepts, Drivers and Techniques”, Prentice Hall.
5. Bart Baesens “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEY Big Data Series)”, John Wiley & Sons
6. Arshdeep Bahga, Vijay Madisetti, “Big Data Science & Analytics: A Hands On Approach “, VPT
7. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, CUP
8. Tom White, "Hadoop: The Definitive Guide", O'Reilly.
9. Eric Sammer, "Hadoop Operations", O'Reilly.
10. Chuck Lam, “Hadoop in Action”, MANNING Publishers
11. Deepak Vohra, “Practical Hadoop Ecosystem: A Definitive Guide to Hadoop-Related Frameworks and Tools”, Apress
12. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilly
13. Lars George, "HBase: The Definitive Guide", O'Reilly.
14. Alan Gates, "Programming Pig", O'Reilly.
15. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer.
16. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons.
17. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons
18. Pete Warden, “Big Data Glossary”, O’Reilly

KCA015: Introduction to Machine Learning		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO 1	Understanding about Machine Learning and their perspectives.	K_1, K_2
CO 2	Understanding and Applying the concepts of Machine Learning Algorithms	K_2,K_4
CO 3	Design and implement supervised and unsupervised machine learning algorithms for real-world applications	K_3,K_4
CO 4	Appreciate the underlying mathematical relationships within and across Machine Learning algorithms.	K_2,K_3
CO 5	Ability to solve real problems by implementing machine learning	K_5
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Overview and Introduction to Machine Learning:** Data Science, AI & ML , Introduction of Machine intelligence and its applications, Machine learning concepts, Components of a learning problem, supervised, unsupervised and reinforcement learning, inductive learning, deductive learning.	**08**
II	**Foundations of Machine Learning:** Hypothesis Space and Inductive Bias, feature selection. Classification, regression linear and polynomial, logistic regression, decision tree, random forest, naïve bayes, SVM.	**08**
III	**Clustering and dimensionality Reduction:** Adaptive hierarchical clustering, SVD PCA, K-means , association analysis, apriori, hidden Markov model.	**08**
IV	**Reinforcement learning:** Elements of Reinforcement Learning, Characteristics of reinforcement learning, various techniques used in reinforcement, Model-Based Learning, Temporal Difference Learning, Markov decision process, Deep Learning.	**08**
V	**Learning with Neural Networks:** Introduction to Artificial Neuron, Architectures, Learning Methods, Taxonomy of NN Systems, Single-Layer NN System, Applications. Back Propagation Network**:** Background, Back-Propagation Learning, Back-Propagation Algorithm.	**08**

Suggested Readings:

1. E. Alpaydin, "Introduction to Machine Learning", Prentice Hall of India.
2. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (India) Private Limited.
3. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", CRC Press.
4. Bishop C., "Pattern Recognition and Machine Learning", Berlin: Springer-Verlag.

ELECTIVE-2

KCAE21: Web Technology		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO 1	Apply the knowledge of the internet and related internet concepts that are vital in understanding web application development and analyze the insights of internet programming to implement complete application over the web.	K_3, K_6
CO 2	Understand, analyze and apply the role of markup languages like HTML, DHTML, and XML in the workings of the web and web applications.	K_2, K_3
CO 3	Use web application development software tools i.e. XML, Apache Tomcat etc. and identifies the environments currently available on the market to design web sites	K_3, K_6
CO 4	Understand, analyze and build dynamic web pages using client side programming JavaScript and also develop the web application using servlet and JSP.	K_2, K_4, K_6
CO 5	Understand the impact of web designing by database connectivity with JDBC in the current market place where everyone use to prefer electronic medium for shopping, commerce, fund transfer and even social life also.	K_2, K_3, K_4
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Introduction and Web Development Strategies, History of Web and Internet, Protocols Governing Web, Writing Web Projects, Connecting to Internet, Introduction to Internet services and tools, Introduction to client-server computing. **Core Java:** Introduction, Operator, Data type, Variable, Arrays, Methods & Classes, Inheritance, Package and Interface, Exception Handling, Multithread programming, I/O, Java Applet, String handling, Event handling, Introduction to AWT, AWT controls, Layout managers	**08**
II	**Web Page Designing:** HTML: List, Table, Images, Frames, forms, CSS, Document type definition, XML: DTD, XML schemes, Object Models, presenting and using XML, Using XML Processors: DOM and SAX, Dynamic HTML	**08**
III	**Scripting:** Java script: Introduction, documents, forms, statements, functions, objects; introduction to AJAX, Networking : Internet Addressing, InetAddress, Factory Methods, Instance Methods, TCP/IP Client Sockets, URL, URL Connection, TCP/IP Server Sockets, Datagram	**08**
IV	**Enterprise Java Bean:** Preparing a Class to be a JavaBeans, Creating a JavaBeans, JavaBeans Properties, Types of beans, Stateful Session bean, Stateless Session bean, Entity bean Java Database Connectivity (JDBC): Merging Data from Multiple Tables: Joining, Manipulating, Databases with JDBC, Prepared Statements, Transaction Processing, Stored Procedures.	**08**
V	**Servlets:** Servlet Overview and Architecture, Interface Servlet and the Servlet Life Cycle, Handling HTTP get Requests, Handling HTTP post Requests, Redirecting Requests to Other Resources, Session Tracking, Cookies, Session Tracking with Http Session. Java Server Pages (JSP): Introduction, Java Server Pages Overview, A First Java Server Page Example, Implicit Objects, Scripting, Standard Actions, Directives, Custom Tag Libraries.	**08**

Suggested Readings:

1. Burdman, Jessica, "Collaborative Web Development" Addison Wesley
2. Xavier, C, " Web Technology and Design" , New Age International
3. Ivan Bayross," HTML, DHTML, Java Script, Perl & CGI", BPB Publication
4. Bhave, "Programming with Java", Pearson Education
5. Herbert Schieldt, "The Complete Reference:Java", TMH.
6. Hans Bergsten, "Java Server Pages", SPD O'Reilly
7. Margaret Levine Young, "The Complete Reference Internet", TMH
8. Naughton, Schildt, "The Complete Reference JAVA2", TMH
9. Balagurusamy E, "Programming in JAVA", TMH

KCAE22: Cloud Computing		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO 1	Understand the concepts of Cloud Computing, key technologies, strengths and limitations of cloud computing.	K_1, K_2
CO 2	Develop the ability to understand and use the architecture to compute and storage cloud, service and models.	K_1, K_3
CO 3	Understand the application in cloud computing.	K_4, K_5
CO 4	Learn the key and enabling technologies that help in the development of cloud.	K_3, K_4
CO 5	Explain the core issues of cloud computing such as resource management and security.	K_2, K_6
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed, History of Cloud Computing - Cloud Architecture - Types of Clouds - Business models around Clouds – Major Players in Cloud Computing- issues in Clouds - Eucalyptus - Nimbus - Open Nebula, CloudSim.	08
II	**Cloud Services:** Types of Cloud services: Software as a Service- Platform as a Service –Infrastructure as a Service - Database as a Service - Monitoring as a Service –Communication as services. Service providers- Google, Amazon, Microsoft Azure, IBM, Sales force.	08
III	**Collaborating Using Cloud Services:** Email Communication over the Cloud - CRM Management – Project Management-Event Management - Task Management – Calendar - Schedules - Word Processing – Presentation – Spreadsheet - Databases – Desktop - Social Networks and Groupware.	08
IV	**Virtualization for Cloud:** Need for Virtualization – Pros and cons of Virtualization – Types of Virtualization –System VM, Process VM, Virtual Machine monitor – Virtual machine properties - Interpretation and binary translation, HLL VM - supervisors – Xen, KVM, VMware, Virtual Box, Hyper-V.	08
V	**Security, Standards and Applications:** Security in Clouds: Cloud security challenges – Software as a Service Security, Common Standards: The Open Cloud Consortium – The Distributed management Task Force – Standards for application Developers – Standards for Messaging – Standards for Security, End user access to cloud computing, Mobile Internet devices and the cloud. Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine	08

Suggested Readings:

1. David E.Y. Sarna, "Implementing and Developing Cloud Application", CRC press 2011.
2. Lee Badger, Tim Grance, Robert Patt-Corner, Jeff Voas, NIST, Draft cloud computing synopsis and recommendation, May 2011.
3. Anthony T Velte, Toby J Velte, Robert Elsenpeter, "Cloud Computing : A Practical Approach", Tata McGraw-Hill 2010.
4. Haley Beard, "Best Practices for Managing and Measuring Processes for On-demand Computing, Applications and Data Centers in the Cloud with SLAs", Emereo Pty Limited, July 2008.
5. G. J. Popek, R.P. Goldberg, "Formal requirements for virtualizable third generation Architectures, Communications of the ACM", No.7 Vol.17, July 1974

KCAE23 : Simulation and Modelling		
Course Outcome (CO)	**Bloom's Knowledge Level (KL)**	
At the end of course , the student will be able to understand		
CO 1	Study the concept of system, its components and types.	K_1
CO 2	Understand and analyze nature and techniques of major simulation models.	K_2, K_4
CO 3	Study and analyze the idea of continuous and discrete system simulation.	K_1, K_4
CO 4	Understand the notion of system dynamics and system dynamics diagrams.	K_2
CO 5	Finding critical path computation and understanding PERT networks	K_1, K_4
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	System definition and components, stochastic activities, continuous and discrete systems, System modeling, Types of models, static and dynamic physical models, static and dynamic mathematical models, full corporate model, types of system study.	**08**
II	System simulation, Need of simulation, Basic nature of simulation, techniques of simulation, comparison of simulation and analytical methods, types of system Simulation, real time simulation, hybrid simulation, simulation of pursuit problem, single-server queuing system and an inventory problem, Monte-Carlo simulation, Distributed Lag model, Cobweb model.	**08**
III	Simulation of continuous Systems, analog vs digital simulation, simulation of water reservoir system, simulation of a servo system, simulation of an auto-pilot. Discrete system simulation, fixed time step vs. event-to-event model, generation of random numbers, test of randomness, Monte-Carlo computation vs. stochastic simulation.	**08**
IV	System dynamics, exponential growth models, exponential decay models, logistic curves, system dynamics diagrams, world model.	**08**
V	Simulation of PERT networks, critical path computation, uncertainties in activity duration, resource allocation and consideration, Simulation languages, object oriented simulation	**08**

Suggested Readings:

1. Geoffrey Gordon, "System Simulation", PHI
2. Narsingh Deo, "System Simulation with digital computer", PHI.
3. Averill M. Law and W. David Kelton, "Simulation Modelling and Analysis", TMH.

KCAE24: Soft Computing

Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course, the student will be able to understand		
CO 1	Recognize the need of soft computing and study basic concepts and techniques of soft computing.	K_1, K_2
CO 2	Understand the basic concepts of artificial neural network to analyze widely used neural networks.	K_2, K_4
CO 3	Apply fuzzy logic to handle uncertainty in various real-world problems.	K_3
CO 4	Study various paradigms of evolutionary computing and evaluate genetic algorithm in solving optimization problems.	K_1, K_5
CO 5	Apply hybrid techniques in applications of soft computing.	K_3
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Soft Computing:** Introduction, Comparison with hard computing, Concept of learning and adaptation, Constituents of soft computing, Applications of soft computing. **Artificial Neural Networks:** Basic concepts of neural networks, Human brain, Biological neural network, History of artificial neural networks, Basic building blocks of an artificial neuron, Neural network architectures, Activation functions, Characteristics and limitation of neural networks.	**08**
II	**Artificial Neural Networks:** Learning methods - Supervised, Unsupervised, Reinforcement, Hebbian, Gradient descent, Competitive, Stochastic. **Major classes of neural networks:** Perceptron networks, Multilayer perceptron model, Back-propagation network, Radial basis function network, Recurrent neural network, Hopfield networks, Kohonen self-organizing feature maps.	**08**
III	**Fuzzy Logic:** Introduction to Fuzzy Logic, Comparison with crisp logic, Properties of classical sets, Operations on classical sets, Properties of fuzzy sets, Operations on fuzzy sets, Classical relations, Fuzzy relations, Features and types of fuzzy membership functions, Fuzzy arithmetic, Fuzzy measures. **Fuzzy Systems:** Crisp logic, Predicate logic, Fuzzy logic, Fuzzy propositions, Inference rules, Fuzzy inference systems- Fuzzification, Inference, Defuzzification, Types of inference engines.	**08**
V	**Evolutionary Computing:** Introduction, Evolutionary algorithm, Biological evolutionary process, Paradigms of evolutionary computing – Genetic algorithm and Genetic programming, Evolutionary strategies, Evolutionary programming. **Genetic Algorithm:** Introduction, Traditional optimization and search techniques, Comparison with traditional algorithms, Operations- Encoding, Selection, Crossover and Mutation, Classification of Genetic algorithm.	**08**
V	**Hybrid Soft Computing Techniques:** Introduction, Classification of hybrid systems, Neuro-fuzzy hybrid systems, Neuro-genetic hybrid systems, Fuzzy-genetic hybrid systems. **Other Soft Computing Techniques:** Tabu Search, Ant colony based optimization, Swarm Intelligence.	**08**

Suggested Readings:

1. Sivanandam S.N. and Deepa S.N., "Principles of Soft Computing", Wiley-India.
2. Rajasekaran S. and Vijayalakshmi Pai G.A., "Neural Networks, Fuzzy Logic and Genetic Algorithms- Synthesis and Applications", PHI Learning.
3. Chakraverty S., Sahoo D.M. and Mahato N. R., "Concepts of Soft Computing- Fuzzy and ANN with Programming", Springer.
4. Kaushik S. and Tiwari S., "Soft Computing – Fundamentals, Techniques and Applications', McGrawHill Education.
5. Jang J.-S.R., Sun C.-T. and Mizutani E., "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India.
6. Karray F. O. and Silva C. D., "Soft Computing and Intelligent Systems Design – Theory, Tools and Applications", Pearson Education.
7. Freeman J. A. and Skapura D. M., "Neural Networks: Algorithms, Applications and Programming Techniques", Pearson.
8. Siman H., "Neural Netowrks", Prentice Hall of India.

KCA025: Android Operating System		
Course Outcome (CO)	**Bloom's Knowledge Level (KL)**	
At the end of course, the student will be able to understand		
CO 1	Understand the basic concepts and functions of Mobile Application and Android Studio.	K_1, K_2
CO 2	Describe the working and architecture of Android Operating System.	K_2, K_3
CO 3	Design Android UI Layout and Describe activities.	K_2, K_6
CO 4	Design and develop an application using Database.	K_6
CO 5	Ability to debug the Performance and Security of Android Applications.	K_5
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Android Architecture**: Introduction to Android, Layouts, Views and Resources, Activities and Intents, Activity Lifecycle and Saving State, Activities and Implicit Intents, Testing & Debugging App , Android Support Libraries.	**08**
II	**User Interaction and Intuitive Navigation:** Input Controls, Menus, Widgets, Screen Navigation, Recycler View, ListView, Adapters and Data Binding, Drawables, Themes and Styles.	**08**
III	**Background Tasks:** Async Task and AsyncTask Loader, Broadcast receivers, Services, Notifications, Alarn managers, Date transferring, Internet access.	**08**
IV	**Storing, Sharing and Retrieving Data in Android Applications:** Overview to storing data, Shared preferences, App settings, Store and query data in Android's SQLite database. Content Providers , Content Resolver, Loading data using loaders.	**08**
V	**Permissions, Performance and Security:** Firebase and AdMob, Publish your app, Packaging and deployment, Interaction with server side applications-Using Google Maps, GPS and Wi-Fi, HTML and XML Parsing.	**08**

Suggested Readings:

1. Meier R.,"Professionai Android 2 Application Development", Wiley.
2. Hashimi S., KomatineniS. and MacLeanD., "Pro Android 2", Apress.
3. Murphy M., "Beginning Android 2", Apress.
4. Delessio C. and Darcey L., "Android Application Development", Pearson Education.
5. DiMarzio J.F., "Android a Programming Guide", Tata McGraw Hill.

KCA351: Artificial Intelligence Lab		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO 1	Study and understand LISP and Prolog	K_1, K_2
CO 2	Apply Prolog statements to solve simple mathematical problems.	K_3
CO 3	Apply LISP / Prolog statements to analyze and solve common AI problems.	K_3, K_4
CO 4	Implement and compare various AI searching algorithms.	K_5, K_6
CO 5	Design and implement programs for machine learning problems.	K_6

DETAILED SYLLABUS

1. Study of Prolog and LISP.
2. Write simple fact for the statements using PROLOG.
3. Write predicates for simple problems such as conversion of temperature from Fahrenheit to centigrade or vice-versa, calculating area of rectangle, square and circle, etc.
4. Write program to solve the Monkey Banana problem.
5. Write program in Prolog for medical diagnosis.
6. Write program to solve mathematical problem such as calculate factorial, generate Fibonacci series, etc.
7. Write program to solve 4-Queen / 8-Queen problem.
8. Write program to solve traveling salesman problem.
9. Write program to solve water jug problem.
10. Write program to solve tic-tac-toe problem.
11. Write program to implement uninformed searching algorithms.
12. Write program to implement informed searching algorithms.

Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner.

KCA352: Software Engineering Lab		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO 1	Identify ambiguities, inconsistencies and incompleteness from a requirements specification and state functional and non-functional requirement.	K_2, K_4
CO 2	Identify different actors and use cases from a given problem statement and draw use case diagram to associate use cases with different types of relationship.	K_3, K_5
CO 3	Draw a class diagram after identifying classes and association among them.	K_4, K_5
CO 4	Graphically represent various UML diagrams and associations among them and identify the logical sequence of activities undergoing in a system, and represent them pictorially.	K_4, K_5
CO 5	Able to use modern engineering tools for specification, design, implementation and testing.	K_3, K_4
DETAILED SYLLABUS		
For any given case/ problem statement do the following; 1. Prepare a SRS document in line with the IEEE recommended standards. 2. Draw the use case diagram and specify the role of each of the actors. 3. Prepare state the precondition, post condition and function of each use case. 4. Draw the activity diagram. 5. Identify the classes. Classify them as weak and strong classes and draw the class diagram. 6. Draw the sequence diagram for any two scenarios. 7. Draw the collaboration diagram. 8. Draw the state chart diagram. 9. Draw the component diagram. **10.** Draw the deployment diagram.		
Note: The Instructor may add/delete/modify/tune experiments, wherever he/she feels in a justified manner. Draw the deployment diagram		

SECOND YEAR SYLLABUS
SEMESTER-IV

ELECTIVE-3

KCA031: Blockchain Architecture		
Course Outcome (CO)	**Bloom's Knowledge Level (KL)**	
At the end of course, the student will be able to understand		
CO1	Study and understand basic concepts of blockchain architecture.	K_1, K_2
CO2	Analyze various requirements for consensus protocols.	K_4
CO3	Apply and evaluate the consensus process.	K_3, K_5
CO4	Understand the concepts of Hyperledger fabric.	K_1
CO5	Analyze and evaluate various use cases in financial software and supply chain.	K_4, K_5
	DETAILED SYLLABUS	**4-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Blockchain:** Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. **Blockchain Architecture and Design:** Basic crypto primitives: Hash, Signature, Hashchain to Blockchain, Bitcoin Basic, Basic consensus mechanisms.	**08**
II	**Consensus:** Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols, distributed consensus, consensus in Bitcoin. **Permissioned Blockchains:** Design goals, Consensus protocols for Permissioned Blockchains	**08**
III	**Hyperledger Fabric:** Decomposing the consensus process, Hyperledger fabric components. **Chaincode Design and Implementation Hyperledger Fabric:** Beyond Chaincode: fabric SDK and Front End, Hyperledger composer tool.	**08**
IV	**Use case 1:** Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance. **Use case 2:** Blockchain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc.	**08**
V	**Use case 3:** Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social welfare systems, Blockchain Cryptography, Privacy and Security on Blockchain	**08**

Suggested Readings:

1. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly
2. Melanie Swa, "Blockchain", O'Reilly
3. "Hyperledger Fabric", https://www.hyperledger.org/projects/fabric
4. Bob Dill, David Smits, "Zero to Blockchain - An IBM Redbooks course", https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

KCA032: Data Warehousing & Data Mining		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO1	Demonstrate knowledge of Data Warehouse and its components.	K_1, K_2
CO2	Discuss the process of Warehouse Planning and Implementation.	K_1, K_2
CO3	Discuss and implement various supervised and Non supervised learning algorithms on data.	K_6
CO4	Explain the various process of Data Mining and decide best according to type of data.	K_2, K_5
CO5	Explain process of knowledge discovery in database (KDD). Design Data Mining model.	K_2, K_5
	DETAILED SYLLABUS	**4-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Data Warehousing**: Overview, Definition, Data Warehousing Components, Building a Data Warehouse, Warehouse Database, Mapping the Data Warehouse to a Multiprocessor Architecture, Difference between Database System and Data Warehouse, Multi Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept.	08
II	**Data Warehouse Process and Technology:** Warehousing Strategy, Warehouse /management and Support Processes, Warehouse Planning and Implementation, Hardware and Operating Systems for Data Warehousing, Client/Server Computing Model & Data Warehousing. Parallel Processors & Cluster Systems, Distributed DBMS implementations, Warehousing Software, Warehouse Schema Design	08
III	**Data Mining**: Overview, Motivation, Definition & Functionalities, Data Processing, Form of Data Pre-processing, Data Cleaning: Missing Values, Noisy Data, (Binning, Clustering, Regression, Computer and Human inspection), Inconsistent Data, Data Integration and Transformation. Data Reduction:-Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Discretization and Concept hierarchy generation, Decision Tree	08
IV	**Classification:** Definition, Data Generalization, Analytical Characterization, Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases, Statistical-Based Algorithms, Distance-Based Algorithms, Decision Tree-Based Algorithms. **Clustering**: Introduction, Similarity and Distance Measures, Hierarchical and Partitional Algorithms. Hierarchical Clustering- CURE and Chameleon. Density Based Methods DBSCAN, OPTICS. Grid Based Methods- STING, CLIQUE. Model Based Method – Statistical Approach, Association rules: Introduction, Large Item sets, Basic Algorithms, Parallel and Distributed Algorithms, Neural Network approach.	08
V	**Data Visualization and Overall Perspective**: Aggregation, Historical information, Query Facility, OLAP function and Tools. OLAP Servers, ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse. Warehousing applications and Recent Trends: Types of Warehousing	08

	Applications, Web Mining, Spatial Mining and Temporal Mining.	

Suggested Readings:

1. Alex Berson, Stephen J. Smith "Data Warehousing, Data-Mining & OLAP", TMH.
2. Mark Humphries, Michael W. Hawkins, Michelle C. Dy, "Data Warehousing: Architecture and Implementation", Pearson.
3. I. Singh, "Data Mining and Warehousing", Khanna Publishing House.
4. Margaret H. Dunham, S. Sridhar,"Data Mining:Introductory and Advanced Topics" Pearson Education 5. Arun K. Pujari, "Data Mining Techniques" Universities Press.
6. Pieter Adriaans, Dolf Zantinge, "Data-Mining", Pearson Education

KCA033: Pattern Recognition		
Course Outcome (CO)	**Bloom's Knowledge Level (KL)**	
At the end of course, the student will be able to understand		
CO 1	Study of basics of Pattern recognition. Understand the designing principles and Mathematical foundation used in pattern recognition.	K_1, K_2
CO 2	Analysis the Statistical Patten Recognition.	K_3, K_4
CO 3	Understanding the different Parameter estimation methods.	K_1, K_2
CO 4	Understanding the different Nonparametric Techniques.	K_1, K_2,
CO 5	Understand and Make use of unsupervised learning and Clustering in Pattern recognition.	K_2 K_3, K_4
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction:** Basics of pattern recognition, Design principles of pattern recognition system, Learning and adaptation, Pattern recognition approaches, Mathematical foundations – Linear algebra, Probability Theory, Expectation, mean and covariance, Normal distribution, multivariate normal densities, Chi squared test.	**08**
II	**Statistical Patten Recognition:** Bayesian Decision Theory, Classifiers, Normal density and discriminant functions	**08**
III	**Parameter estimation methods:** Maximum-Likelihood estimation, Bayesian Parameter estimation, Dimension reduction methods - Principal Component Analysis (PCA), Fisher Linear discriminant analysis, Expectation-maximization (EM), Hidden Markov Models (HMM), Gaussian mixture models.	**08**
IV	**Nonparametric Techniques:** Density Estimation, Parzen Windows, K-Nearest Neighbor Estimation, Nearest Neighbor Rule, Fuzzy classification.	**08**
V	**Unsupervised Learning & Clustering:** Criterion functions for clustering, Clustering Techniques: Iterative square - error partitional clustering – K means, agglomerative hierarchical clustering, Cluster validation.	**08**

Suggested Readings:

1. Duda R. O., Hart P. E. and Stork D. G., "Pattern Classification", John Wiley.
2. Bishop C. M., "Neural Network for Pattern Recognition", Oxford University Press.
3. Singhal R., "Pattern Recognition: Technologies & Applications", Oxford University Press.
4. Theodoridis S. and Koutroumbas K., "Pattern Recognition", Academic Press.

KCA034: Data Analytics		
Course Outcome (CO)	**Bloom's Knowledge Level (KL)**	
At the end of course, the student will be able to understand		
CO1	Describe the life cycle phases of Data Analytics through discovery, planning and building.	K_1, K_2
CO2	Understand and apply Data Analysis Techniques.	K_2, K_3
CO3	Implement various Data streams.	K_3
CO4	Understand item sets, Clustering, frame works & Visualizations.	K_2
CO5	Apply R tool for developing and evaluating real time applications.	K_3, K_5, K_6
	DETAILED SYLLABUS	**4-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Data Analytics**: Sources and nature of data, classification of data (structured, semi-structured, unstructured), characteristics of data, introduction to Big Data platform, need of data analytics, evolution of analytic scalability, analytic process and tools, analysis vs reporting, modern data analytic tools, applications of data analytics. **Data Analytics Lifecycle**: Need, key roles for successful analytic projects, various phases of data analytics lifecycle – discovery, data preparation, model planning, model building, communicating results, operationalization	08
II	**Data Analysis:** Regression modeling, multivariate analysis, Bayesian modeling, inference and Bayesian networks, support vector and kernel methods, analysis of time series: linear systems analysis & nonlinear dynamics, rule induction, Neural Networks: Learning and generalisation, competitive learning, principal component analysis and neural networks, fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, stochastic search methods.	08
III	**Mining Data Streams:** Introduction to streams concepts, stream data model and architecture, stream computing, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, decaying window, Real-time Analytics Platform (RTAP) applications, Case studies – Real time sentiment analysis, stock market predictions.	08
IV	**Frequent Itemsets and Clustering:** Mining frequent itemsets, market based modelling, Apriori algorithm, handling large data sets in main memory, limited pass algorithm, counting frequent itemsets in a stream, Clustering techniques: hierarchical, K-means, clustering high dimensional data, CLIQUE and ProCLUS, frequent pattern based clustering methods, clustering in non-euclidean space, clustering for streams and parallelism.	08
V	**Frame Works and Visualization**: MapReduce, Hadoop, Pig, Hive, HBase, MapR, Sharding, NoSQL Databases, S3, Hadoop Distributed File Systems, Visualization: visual data analysis techniques, interaction techniques, systems and applications. **Introduction to R** - R graphical user interfaces, data import and export, attribute and data types, descriptive statistics, exploratory data analysis, visualization before analysis, analytics for unstructured data.	08

Suggested Readings:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer.
2. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press.
3. Bill Franks, "Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", John Wiley & Sons.
4. John Garrett, "Data Analytics for IT Networks : Developing Innovative Use Cases", Pearson

Education.
5. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley.
6. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big Data Analytics”, EMC Education Series, John Wiley.
7. Frank J Ohlhorst, “Big Data Analytics: Turning Big Data into Big Money”, Wiley and SAS Business Series.
8. Colleen Mccue, “Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis”, Elsevier.
9. Michael Berthold, David J. Hand,” Intelligent Data Analysis”, Springer.
10. Paul Zikopoulos, Chris Eaton, Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGraw Hill.
11. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer.
12. Mark Gardner, “Beginning R: The Statistical Programming Language”, Wrox Publication.
13. Pete Warden, “Big Data Glossary”, O’Reilly.
14. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons.
15. Peter Bühlmann, Petros Drineas, Michael Kane, Mark van der Laan, "Handbook of Big Data", CRC Press.
16. Jiawei Han, Micheline Kamber “Data Mining Concepts and Techniques”, Second Edition, Elsevier.

KCA035: Computer Networks

Course Outcome (CO)		Bloom's Knowledge Level (KL)
At the end of course, the student will be able to understand		
CO 1	Explain basic concepts, OSI reference model, services and role of each layer of OSI model and TCP/IP, networks devices and transmission media, Analog and digital data transmission.	K_1, K_2
CO 2	Apply channel allocation, framing, error and flow control techniques.	K_3
CO 3	Describe the functions of Network Layer i.e. Logical addressing, subnetting & Routing Mechanism.	K_2, K_3
CO 4	Explain the different Transport Layer function i.e. Port addressing, Connection Management Error control and Flow control mechanism.	K_2, K_3
CO 5	Explain the functions offered by session and presentation layer and their Implementation.	K_2, K_3
DETAILED SYLLABUS		**3-1-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introductory Concepts**: Goals and applications of networks, Categories of networks, Organization of the Internet, ISP, Network structure and architecture (layering principles, services, protocols and standards), The OSI reference model, TCP/IP protocol suite, Network devices and components. **Physical Layer:** Network topology design, Types of connections, Transmission media, Signal transmission and encoding, Network performance and transmission impairments, Switching techniques andmultiplexing.	**08**
II	**Link layer:** Framing, Error Detection and Correction, Flow control (Elementary Data LinkProtocols, Sliding Window protocols). **Medium Access Control and Local Area Networks:** Channel allocation, Multiple access protocols, LAN standards, Link layer switches & bridges (Learning bridge and Spanning tree algorithms).	**08**
III	**Network Layer:** Point-to-point networks, Logical addressing, Basic internetworking (IP, CIDR, ARP, RARP, DHCP, and ICMP), Routing, forwarding and delivery, Static and dynamic routing, Routing algorithms and protocols, Congestion control algorithms, IPv6.	**08**
IV	**Transport Layer:** Process-to-process delivery, Transport layer protocols (UDP and TCP), Multiplexing, Connection management, Flow control and retransmission, Window management, TCP Congestion control, Quality of service.	**08**
V	**Application Layer:** Domain Name System, World Wide Web and Hyper Text Transfer Protocol, Electronic mail, File Transfer Protocol, Remote login, Network management, Data compression,Cryptography – basic concepts..	**08**

Suggested Readings:

1. Behrouz Forouzan, "Data Communication and Networking", McGraw Hill
2. Andrew Tanenbaum "Computer Networks", Prentice Hall.
3. William Stallings, "Data and Computer Communication", Pearson.
4. Kurose and Ross, "Computer Networking- A Top-Down Approach", Pearson.
5. Peterson and Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann
6. W. A. Shay, "Understanding Communications and Networks", Cengage Learning.
7. D. Comer, "Computer Networks and Internets", Pearson.
8. Behrouz Forouzan, "TCP/IP Protocol Suite", McGraw Hill.

ELECTIVE-4

KCA041: Digital Image Processing		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO 1	Explain the basic concepts of two-dimensional signal acquisition, sampling, quantization and color model.	K_1, K_2
CO 2	Apply image processing techniques for image enhancement in both the spatial and frequency domains.	K_2, K_3
CO 3	Apply and compare image restoration techniques in both spatial and frequency domain.	K_2, K_3
CO 4	Compare edge based and region based segmentation algorithms for ROI extraction.	K_3, K_4
CO 5	Explain compression techniques and descriptors for image processing.	K_2, K_3
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Digital Image Fundamentals:** Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – Color image fundamentals – RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms – DFT, DCT.	**08**
II	**Image Enhancement:** Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.	**08**
III	**Image Restoration:** Image Restoration – degradation model, Properties, Noise models – Mean Filters – Order Statistics –Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering	**08**
IV	**Image Segmentation:** Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.	**08**
V	**Image Compression and Recognition:** Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching.	**08**

Suggested Readings:

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson, Third Edition, 2010.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson, 2002.
3. Kenneth R. Castleman, "Digital Image Processing" Pearson, 2006.
4. D, E. Dudgeon and R M. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 1990.
5. William K. Pratt, "Digital Image Processing" John Wiley, New York, 2002.
6. Milan Sonka et al, "Image processing, analysis and machine vision Brookes/Cole", Vikas Publishing House, 2nd edition,1999.

KCA042: Software Testing & Quality Assurance		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO 1	Test the software by applying testing techniques to deliver a product free from bugs.	K_3
CO 2	Investigate the scenario and select the proper testing technique.	K_1, K_4
CO 3	Explore the test automation concepts and tools and estimation of cost, schedule based on standard metrics.	K_2, K_4
CO 4	Understand how to detect, classify, prevent and remove defects.	K_1, K_2
CO 5	Choose appropriate quality assurance models and develop quality. Ability to conduct formal inspections, record and evaluate results of inspections.	K_3, K_4
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Software Testing Basics:** Testing as an engineering activity, Role of process in software quality, Testing as a process, Basic definitions, Software testing principles, The tester's role in a software development organization, Origins of defects, Defect classes, The defect repository and test design, Defect examples, Developer / Tester support for developing a defect repository.	**08**
II	**Testing Techniques and Levels of Testing:** Using White Box Approach to Test design– Static Testing Vs. Structural Testing, Code Functional Testing, Coverage and Control Flow Graphs, Using Black Box Approaches to Test Case Design, Random Testing, Requirements based testing, Decision tables, State-based testing, Cause-effect graphing, Error guessing, Compatibility testing, Levels of Testing -Unit Testing, Integration Testing, Defect Bash Elimination. System Testing - Usability and Accessibility Testing, Configuration Testing, Compatibility Testing.	**08**
III	**Software Test Automation And Quality Metrics:** Software Test Automation, Skills needed for Automation, Scope of Automation, Design and Architecture for Automation, Requirements for a Test Tool, Challenges in Automation Tracking the Bug, Debugging. Testing Software System Security - Six-Sigma, TQM - Complexity Metrics and Models, Quality Management Metrics, Availability Metrics, Defect Removal Effectiveness, FMEA, Quality Function Deployment, Taguchi Quality Loss Function, Cost of Quality.	**08**
IV	**Fundamentals of Software Quality Assurance:** SQA basics, Components of the Software Quality Assurance System, software quality in business context, planning for software quality assurance, product quality and process quality, software process models, 7 QC Tools and Modern Tools.	**08**
V	**Software Assurance Models:** Models for Quality Assurance, ISO-9000 series, CMM, CMMI, Test Maturity Models, SPICE, Malcolm Baldrige Model- P-CMM. **Software Quality Assurance Trends:** Software Process- PSP and TSP, OO Methodology, Clean room software engineering, Defect Injection and prevention, Internal Auditing and Assessments, Inspections & Walkthroughs, Case Tools and their affect on Software Quality.	**08**
Suggested Readings: 1. Srinivasan Desikan, Gopalaswamy Ramesh, "Software Testing: Principles and Practices",		

Pearson.
2. Daniel Galin, “Software Quality Assurance: From Theory to Implementation”, Pearson Addison Wesley.
3. Aditya P. Mathur, “Foundations of Software Testing”, Pearson.
4. Paul Ammann, Jeff Offutt, “Introduction to Software Testing”, Cambridge University Press.
5. Paul C. Jorgensen, “Software Testing: A Craftsman's Approach”, Auerbach Publications.
6. William Perry, “Effective Methods of Software Testing”, Wiley Publishing, Third Edition.
7. Renu Rajani, Pradeep Oak, “Software Testing – Effective Methods, Tools and Techniques”, Tata McGraw Hill.
8. Stephen Kan, “Metrics and Models in Software Quality”, Addison – Wesley, Second Edition.
9. S. A. Kelkar, “Software quality and Testing”, PHI Learning Pvt, Ltd.
10. Watts S Humphrey, “Managing the Software Process”, Pearson Education Inc.

KCA043: Internet of Things		
Course Outcome (CO)	**Bloom's Knowledge Level (KL)**	
At the end of course, the student will be able to understand		
CO 1	Explain the architecture of lnternet of Things.	K_1, K_2
CO 2	Demonstrate the different technologies for IoTs.	K_1, K_2
CO 3	Apply Python Programming skills to develop IoT application.	K_3
CO 4	Analyze the architecture of Arduino and Raspberry Pi.	K_5
CO 5	Create Small IoT Applications using Sensors.	K_6
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Getting Familiar with internet of Things (IoT):** Definition, Characteristics, History and Evolution of loT. Physical Design of IoT: Things in IoT, IoT Protocols. Logical Design of IoT: Functional block, Communication Models and APIs, IoT Stack	**08**
II	**Enabling Technologies:** Sensors, Cloud Computing, Big Data analytics, Embedded Computing Boards, Communication Protocols, IoT Challenges, IoT Levels, Overview of Domain Specific IoTs applications Like Smart Cities, Smart Agriculture and industrial IoT Applications. **The IoT Paradigm:** Comparison with User interface related Technologies like SCADA, M2M, SDN. IoT Design Methodology: IoT Components.	**08**
III	**Transport Protocols:** BLE, LiFi, Network Protocol: 6LoWPAN. **Physical Design of IoT:** Functional Block, Cloud Storage Models, Communication Models, and Communication APls: REST based, Web Socket Based, Cloud for IoT: Challenges, Fog Computing.	**08**
IV	**Physical Devices and Endpoints:** Arduino Pin diagram, Arduino Architecture, Arduino Programming, Raspberry Pi Pin diagram, Raspberry Pi Architecture. **Sensors and lnterfacing:** Types of Sensors. lntegrating Sensors: HDT (Humidity and Temperature Sensor), Gas Detector, HC-05 (Bluetooth Module), Ultrasonic Sensor, ESP8266 (Wi-Fi Module).	**08**
V	**Logical Design of IoT:** Revisiting Python Programming for loT (Data types, Operators, Control Structures, List, Tuples, Dictionaries, Functions, Modules and File Handling). **Python Packages for connecting IoT Devices:** Bluetooth, Sockets, Time, Requests, Sys, Adafruit Python DHT, paho-mqtt, Python JSON, Python pip.	**08**

Suggested Readings:

1. S. K. Vasudevan, A. S. Nagarajan, RMD Sundaram, "lnternet of Things", Wiley, 1st Edition, 2014.
2. G. C. Hillar, "lnternet of Things with Python", PACKT Publications, 1st Edition, 2016.
3. V. Madlsetti, A. Bahga, "lnternet of Things: A Hands-on Approach", United Kingdom: Arsheep Bahga & Vijay Madisetti, 1st Edition, 2015.
4. J. C. Shovic, "Raspberry Pi loT Projects: Prototyping Experiments for Makers", Apress, 1st Edition, 2016.
5. M. Schwartz, "lnternet of things with the Arduino Yun", Packt Publishing Ltd., 1st Edition, 2014.
6. O. Hersent, D. Boswarthick, O. Elloumi, "The lnternet of Things: Key Applications and Protocols", John Wiley & Sons, 1st Edition, 2012.
7. C. Dierbach, "lntroduction to Computer Science using Python: A Computational Problem-Solving Focus", Wiley Publishing, 1st Edition, 2013.

KCA044: Modern Application Development		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO 1	Equip students with principles, knowledge and skills for the design and construction of web-enabled internet applications.	K_1, K_2
CO 2	Design, implement and deploy an inhouse project using MongoDB, Express.js, AnjularJS, Node.js.	K_3, K_6
CO 3	Get acquainted with the latest web application development trends in the IT industry.	K_4
CO 4	Evaluate different web application development alternatives and choose the appropriate one for a specific scenario.	K_5
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	Basics of HTML, CSS, and Javascript HTML, CSS, Bootstrap, Javascript basics – Variables, functions, and scopes, Logic flow and loops, Events and Document object model, Handling JSON data, Understanding JSON callbacks.	**08**
II	Introduction to Node JS Installation, Callbacks, Installing dependencies with npm, Concurrency and event loop fundamentals, Node JS callbacks, Building HTTP server, Importing and exporting modules, Building chat application using web socket.	**08**
III	Building REST services using Node JS REST services, Installing Express JS, Express Node project structure, Building REST services with Express framework, Routes, filters, template engines - Jade, ejs.	**08**
IV	MongoDB Basics and Communication with Node JS Installation, CRUD operations, Sorting, Projection, Aggregation framework, MongoDB indexes, Connecting to MongoDB with Node JS, Introduction to Mongoose, Connecting to MongoDB using mongoose, Defining mongoose schemas, CRUD operations using mongoose.	**08**
V	Building Single Page Applications with AngularJS Single Page Application – Introduction, Two-way data binding(Dependency Injection), MVC in Angular JS, Controllers, Getting user input, Loops, Client side routing – Accessing URL data, Various ways to provide data in Angular JS – Services and Factories, Working with filters, Directives and Cookies.	**08**

Suggested Readings:

1. Simon Holmes , "Getting MEAN with Mongo, Express, Angular, and Node", Second Edition, Manning Publications; 1 edition (31 October 2015).
2. Ken Williamson, "Learning Angular JS", O′Reilly; 1 edition (24 March 2015).
3. MithunSatheesh, "Web development with MongoDB and Node JS", Packt Publishing Limited; 2nd Revised edition (30 October 2015).

KCA045: Distributed Database Systems		
Course Outcome (CO)	**Bloom's Knowledge Level (KL)**	
At the end of course, the student will be able to understand		
CO 1	Aware of fundamentals of transactions and schedules.	K_1, K_2
CO 2	Familiar with locking protocols.	K_3
CO 3	Set the rules over management of transaction and concurrency control.	K_1, K_4
CO 4	Enhance the knowledge about issues of recovery and atomicity in distributed databases.	K_3, K_4
CO 5	Use the different techniques of distributed query processing.	K_1, K_3
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	Transaction and schedules, Concurrent Execution of transaction, Conflict and View Serializability, Testing for Serializability, Concepts in Recoverable and Cascade less schedules.	**08**
II	Lock based protocols, time stamp-based protocols, Multiple Granularity and Multi version Techniques, enforcing serializability by Locks, Locking system with multiple lock modes, architecture for Locking scheduler	**08**
III	Distributed Transactions Management, Data Distribution, Fragmentation and Replication Techniques, Distributed Commit, Distributed Locking schemes, Long duration transactions, Moss Concurrency protocol.	**08**
IV	Issues of Recovery and atomicity in Distributed Databases, Traditional recovery techniques, Log based recovery, Recovery with Concurrent Transactions, Recovery in Message passing systems, Checkpoints, Algorithms for recovery line, Concepts in Orphan and Inconsistent Messages.	**08**
V	Distributed Query Processing, Multiday Joins, Semi joins, Cost based query optimization for distributed database, Updating replicated data, protocols for Distributed Deadlock Detection, Eager and Lazy Replication Techniques.	**08**

Suggested Readings:

1. Silberschatz, Korth and Sudershan, "Database System Concept", McGraw Hill.
2. Ramakrishna and Gehrke,"Database Management System", McGraw Hill.
3. Garcia-Molina, Ullman, Widom,"Database System Implementation", Pearson Education.
4. Ceei and Pelagatti,"Distributed Database", TMH.
5. Munesh C. Trivedi, " Distributed System", Khanna Publishing House.
6. Singhal and Shivratri, "Advance Concepts in Operating Systems", McGraw Hill.

ELECTIVE-5

KCA051: Mobile Computing		
Course Outcome (CO)	**Bloom's Knowledge Level (KL)**	
At the end of course, the student will be able to understand		
CO 1	Study and aware fundamentals of mobile computing.	K_1, K_2
CO 2	Study and analyze wireless networking protocols, applications and environment.	K_1, K_4
CO 3	Understand various data management issues in mobile computing.	K_2
CO 4	Analyze different type of security issues in mobile computing environment.	K_4
CO 5	Study, analyze, and evaluate various routing protocols used in mobile computing.	K_1, K_4, K_5
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	Introduction, Issues in mobile computing, Overview of wireless telephony, Cellular concept, GSM- air interface, channel structure; Location management- HLR-VLR, hierarchical, handoffs; Channel allocation in cellular systems, CDMA, GPRS, MAC for cellular system.	**08**
II	Wireless Networking, Wireless LAN Overview- MAC issues, IEEE 802.11, Blue Tooth, Wireless multiple access protocols, TCP over wireless, Wireless applications, Data broadcasting, Mobile IP, WAP-architecture, protocol stack, application environment, applications.	**08**
III	Data management issues in mobile computing, data replication for mobile computers, adaptive clustering for mobile wireless networks, File system, Disconnected operations.	**08**
IV	Mobile Agents computing, Security and fault tolerance, Transaction processing in mobile computing environment.	**08**
V	Adhoc networks, Localization, MAC issues, Routing protocols, Global state routing (GSR), Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Adhoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA), QoS in Adhoc Networks, applications	**08**

Suggested Readings:

1. Schiller J., "Mobile Communications", Pearson
2. Upadhyaya S. and Chaudhury A., "Mobile Computing", Springer
3. Kamal R., "Mobile Computing", Oxford University Press.
4. Talukder A. K. and Ahmed H., "Mobile Computing Technology, Applications and Service Creation", McGraw Hill Education
5. Garg K., "Mobile Computing Theory and Practice", Pearson.
6. Kumar S., "Wireless and Mobile Communication", New Age International Publishers
7. Manvi S. S. and Kakkasageri M. S., "Wireless and Mobile Networks- Concepts and Protocols", Wiley India Pvt. Ltd.

KCA052: Computer Graphics and Animation		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO 1	Understand the graphics hardware used in field of computer graphics.	K_2
CO 2	Understand the concept of graphics primitives such as lines and circle based on different algorithms.	K_2, K_4
CO 3	Apply the 2D graphics transformations, composite transformation and Clipping concepts.	K_4
CO 4	Apply the concepts and techniques used in 3D computer graphics, including viewing transformations, projections, curve and hidden surfaces.	K_2, K_3
CO 5	Perform the concept of multimedia and animation in real life.	K_2, K_3
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction and Line Generation:** Types of computer graphics, Graphic Displays- Random scan displays, Raster scan displays, Frame buffer and video controller, Points and lines, Line drawing algorithms, Circle generating algorithms, Mid-point circle generating algorithm, and parallel version of these algorithms.	**08**
II	**Transformations:** Basic transformation, Matrix representations and homogenous coordinates, Composite transformations, Reflections and shearing. **Windowing and Clipping:** Viewing pipeline, Viewing transformations, 2-D Clipping algorithms- Line clipping algorithms such as Cohen Sutherland line clipping algorithm, Liang Barsky algorithm, Line clipping against non rectangular clip windows; Polygon clipping – Sutherland Hodgeman polygon clipping, Weiler and Atherton polygon clipping, Curve clipping, Text clipping.	**08**
III	**Three Dimensional:** 3-D Geometric Primitives, 3-D Object representation, 3-D Transformation, 3-D viewing, projections, 3-D Clipping. **Curves and Surfaces:** Quadric surfaces, Spheres, Ellipsoid, Blobby objects, Introductory concepts of Spline, Bspline and Bezier curves and surfaces.	**08**
IV	**Hidden Lines and Surfaces:** Back Face Detection algorithm, Depth buffer method, A- buffer method, Scan line method, basic illumination models– Ambient light, Diffuse reflection, Specular reflection and Phong model, Combined approach, Warn model, Intensity Attenuation, Color consideration, Transparency and Shadows.	**08**
V	**Multimedia Systems:** Design Fundamentals, Back ground of Art, Color theory overview, Sketching & illustration, Storyboarding, different tools for animation. **Animation:** Principles of Animations, Elements of animation and their use, Power of Motion, Animation Techniques, Animation File Format, Making animation for Rolling Ball, making animation for a Bouncing Ball, Animation for the web, GIF, Plugins and Players, Animation tools for World Wide Web.	**08**

Suggested Readings:

1. Hearn D. and Baker M. P., "Computer Graphics C Version", Pearson Education
2. Foley, Vandam, Feiner, Hughes,"Computer Graphics principle", Pearson Education.
3. Rogers, " Procedural Elements of Computer Graphics", McGraw Hill
4. Newman W. M., Sproull R. F., "Principles of Interactive computer Graphics", McGraw Hill.
5. Sinha A. N. and Udai A. D.," Computer Graphics", McGraw Hill.
6. Mukherjee, "Fundamentals of Computer graphics & Multimedia", PHI Learning Private Limited.
7. Vaughan T., "Multimedia, Making IT Work",Tata McGraw Hill.

KCA053: Natural Language Processing		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO 1	Study and understand basic concepts, background and representations of natural language.	K_1, K_2
CO 2	Analyze various real-world applications of NLP.	K_4
CO 3	Apply different parsing techniques in NLP.	K_3
CO 4	Understand grammatical concepts and apply them in NLP.	K_2, K_3
CO 5	Apply various statistical and probabilistic grammar methods to handle and evaluate ambiguity.	K_3, K_5
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Natural Language Understanding:** The study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural language Understanding Systems, Linguistic Background: An outline of English syntax.	**08**
II	Introduction to semantics and knowledge representation, some applications like machine translation, database interface.	**08**
III	Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top- Down Chart Parsing. Feature Systems and Augmented Grammars: Basic Feature system for English, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.	**08**
IV	**Grammars for Natural Language:** Auxiliary Verbs and Verb Phrases, Movement Phenomenon in Language, Handling questions in Context-Free Grammars. Human preferences in Parsing, Encoding uncertainty, Deterministic Parser.	**08**
V	**Ambiguity Resolution:** Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part-of Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best First Parsing. Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.	**08**

Suggested Readings:

1. Akshar Bharti, Vineet Chaitanya and Rajeev Sangal, "NLP: A Paninian Perspective", Prentice Hall, New Delhi.
2. James Allen, "Natural Language Understanding", Pearson Education.
3. D. Jurafsky, J. H. Martin, "Speech and Language Processing", Pearson Education.
4. L. M. Ivansca, S. C. Shapiro, "Natural Language Processing and Language Representation", AAAI Press, 2000.
5. T. Winograd, Language as a Cognitive Process, Addison-Wesley.

KCA054: Compiler Design		
Course Outcome (CO)		**Bloom's Knowledge Level (KL)**
At the end of course, the student will be able to understand		
CO 1	Acquire knowledge of different phases and passes of the compiler and also able to use the compiler tools like LEX, YACC, etc.	K_3, K_6
CO 2	Understand the parser and its types i.e. Top-Down and Bottom-up parsers and construction of LL, SLR, CLR, and LALR parsing table.	K_2, K_6
CO 3	Implement the compiler using syntax-directed translation method and get knowledge about the synthesized and inherited attributes.	K_4, K_5
CO 4	Acquire knowledge about run time data structure like symbol table organization and different techniques used in that.	K_2, K_3
CO 5	Understand the target machine's run time environment, its instruction set for code generation and techniques used for code optimization.	K_2, K_4
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Introduction to Compiler**: Phases and passes, Bootstrapping, Finite state machines and regular expressions and their applications to lexical analysis, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical-analyzer generator, LEX compiler, Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC. The syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG.	**08**
II	**Basic Parsing Techniques:** Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables.	**08**
III	**Syntax-directed Translation:** Syntax-directed Translation schemes, Implementation of Syntax-directed Translators, Intermediate code, postfix notation, Parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser. More about translation: Array references in arithmetic expressions, procedures call, declarations and case statements.	**08**
IV	**Symbol Tables**: Data structure for symbols tables, representing scope information. Run-Time Administration: Implementation of simple stack allocation scheme, storage allocation in block structured language. Error Detection & Recovery: Lexical Phase errors, syntactic phase errors semantic errors.	**08**
V	**Code Generation:** Design Issues, the Target Language. Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Code Generator. Code optimization: Machine-Independent Optimizations, Loop optimization, DAG representation of basic blocks, value numbers and algebraic laws, Global Data-Flow analysis.	**08**

Suggested Readings:

9. Aho, Sethi & Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education.
10. K. Muneeswaran, "Compiler Design", First Edition, Oxford University Press.
11. J. P. Bennet, "Introduction to Compiler Techniques", Second Edition, McGraw-Hill, 2003.
12. Henk Alblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001.
13. V Raghvan, " Principles of Compiler Design", McGraw-Hill.
14. Kenneth Louden, "Compiler Construction", Cengage Learning.
15. Charles Fischer and Ricard LeBlanc," Crafting a Compiler with C", Pearson Education.

KCA055: Deep Learning		
Course Outcome (CO)	**Bloom's Knowledge Level (KL)**	
At the end of course, the student will be able to understand		
CO 1	Understand the concept of machine learning and artificial neural networks.	K_2
CO 2	Understand the basic concepts of deep learning to analyze and implement widely used deep networks.	K_2, K_4, K_6
CO 3	Study and analyze various convolutional and recurrent neural networks.	K_1, K_4
CO 4	Study the concept of optimization in deep learning.	K_1
CO 5	Apply concept of deep learning in solving various real world problem domains.	K_3
DETAILED SYLLABUS		**3-0-0**
Unit	**Topic**	**Proposed Lecture**
I	**Machine Learning**- Introduction, Types, Linear models, Introduction of Neural Network, Training a neural network, Activation functions, Loss functions, Hyper parameters, Neural networks as universal function approximates, Road to deep learning.	**08**
II	**Deep Networks** : Introduction and history of deep learning, probabilistic theory of Deep learning, Common architectural principles of deep networks, building blocks of deep networks, Comparison with shallow networks, Deep belief networks, Generative Adversarial Networks (GAN), Semi-supervised Learning.	**08**
III	**Convolutional Neural Networks:** From fully connected network to convolutions, Common convolutional architectural patterns, Configuring convolutional layers, Configuring pooling layers, Transfer learning, Convolutional neural network – LeNet, AlexNet, VGG, NiN, GoogLeNet, Batch normaization, ResNet, DenseNet.	**08**
IV	**Recurrent Neural Networks:** Sequence models, Language models, Implementation of recurrent neural networks, GRU, LSTM, Deep recurrent neural networks, Bidirectional recurrent neural networks, Machine translation, Encoder-decoder architecture, Sequence to sequence.	**08**
V	**Optimization:** Optimization in deep learning, Convexity, Gradient descent, Stochastic gradient descent. **Applications:** Speech and audio processing, Natural language processing, Information retrieval, Object recognition and computer vision.	**08**

Suggested Readings:

1. Goodfellow I., Bengio Y. and Courville A., "Deep Learning", MIT Press.
2. Shalizi C. R., "Advanced Data Analysis from an Elementary Point of View", Cambridge University Press.
3. Deng L. and Yu D., "Deep Learning- Methods and Applications", Now Publishers.
4. Nielsen M., "Neural Networks and Deep Learning", Determination Press.
5. Patterson J. and Gibson A., "Deep Learning – A Practitioner's Approach", O Reilly.