



# **SIR PADAMPAT SINGHANIA UNIVERSITY**

**Udaipur**

## **SCHOOL OF ENGINEERING**

### **Course Curriculum of Ph.D. Degree Programme in Computer Science & Engineering (Batch-2018-19)**

#### **Credit Structure**

<b>Category</b>	<b>Credits</b>
Departmental Major Subjects	6
Minor Subject	3
Total	9

Note: The student has to select the courses of minimum 6 credits from the departmental major subjects and a compulsory Research Methodology course (common to all PhD Scholars) of 3 credits.

## Course Structure: Ph.D. Degree (2018-19)

### Departmental Major Subjects

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CS-601	Artificial Intelligence & Data Mining	3	0	0	3
2	CS-602	Management Information Systems & Knowledge Management	3	0	0	3
3	CS-603	Wireless Communication & Mobile Network Architecture	3	0	0	3
4	CS-604	Pattern Classification & Coding Theory	3	0	0	3
5	CS-605	Mobile Computing	3	0	0	3
6	CS-606	Game Design	3	0	0	3
7	CS-607	Neural Networks	3	0	0	3
8	CS-608	Distributed Systems	3	0	0	3
9	CS-609	Simulation & Modeling	3	0	0	3
10	CS-610	Advanced Knowledge Management	3	0	0	3
11	CS-611	Advanced Game Design	3	0	0	3
12	CS-612	Data Mining & Warehousing	3	0	0	3

## Minor Subject

S. No.	Course Code	Course Title	L	T	P	Credit (s)
1	BM-617	Research Methodology	3	0	0	3

**Detailed Syllabus for Ph.D. Degree Programme  
in  
Computer Science & Engineering**

**Semester - I**

**(Departmental Major Subject)**

CS-601	L-T-P-C
Artificial Intelligence & Data Mining	3-0-0-3

**Objective:** *The aim is to study the basics of artificial intelligence & data mining. The scope is to develop prenominal ideas of A.I. based search techniques with optimum time complexity & generating modern algorithms for data classification & clustering.*

**Course Content**

Artificial Intelligence (AI ), Representation of AI , Properties of internal representation, predicate calculus , other kinds of inference, Parsing Language , Expressing the rules of syntax , syntactic parsing , building an ATN Interpreter , Backtracking strategies, Graph strategies , uninformed graph-search procedures , heuristic graph-search procedures , measures of performance , Searching AND/OR graphs, Searching Game Trees, Rule based deduction systems , forward deduction system , backward deduction system , resolving within AND/OR Graphs , Control knowledge for rule based deduction systems, Planning decisions , Decision Theory, Robot Motion Planning, Game Playing. Data Mining , Classification , Regression , Time Series Analysis , Data Prediction, Sequence Discovery, Fuzzy Sets, Fuzzy Logic , Information Retrieval, Decision Support System , Dimension Modelling , Pattern Matching, Nearest Neighbor, Agglomerative clustering , K-Means Clustering , Clustering on the basis of trend analysis.

**Text/Reference Books**

1. Principles of Artificial Intelligence. Nilsson N.J. Narosa Publishing House. 2002.
2. Introduction to Artificial Intelligence. Charniak E. & McDermott D. Pearson Education. 2009.

3. Data Mining-Introductory & Advanced Topics. Dunham M. H. & Sridhar S. Pearson Education. 2008.

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in  
Computer Science & Engineering**

**Semester - I**

**(Departmental Major Subject)**

CS-602	L-T-P-C
Management Information Systems & Knowledge Management	3-0-0-3

**Objective:** *The aim is to study the fundamentals of Management Information System & Knowledge Management. The scope of study is to implement modern algorithms in decision support systems & e-security. The quantification of knowledge management is also another research challenge in this context.*

**Course Content**

Management Information System (MIS), Importance of MIS, Logical Foundations of MIS, Classification of Information Systems , Data & Information. Decision Support Systems (DSS), Characteristics of DSS, DSS Generators, Multicriteria. Modelling, Group Decisions, Expert Systems(ES), Components of ES, Expert System Applications, Benefits of ES , Limitations of ES , Knowledge Engineering , Fuzzy Logic in Business, Enhancing decision making. Security Information System , System Vulnerability , Internal & External Threats , Business Value of security & control. The Knowledge Management(KM) Landscape , Important dimensions of KM , KM Value Chain , Types of KM Systems , Structured Knowledge Systems , Quantification of KM.

**Text/Reference Books**

1. Management Information Systems. Laudon K.C. & Laudon J.P. Pearson Education. 2009.
2. Management Information Systems. Sadagopan S. PHI Learning Pvt. Ltd. 1997.
3. Management Information Systems. O'Brien J., Marakas G. & Behl R. Tata Mc-Graw Hill Education Pvt. Ltd. 2010.
4. Introduction to Knowledge Management. Bhunia C.T. Everest Publishing House. 2003.

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in  
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**Semester - I**

**(Departmental Major Subject)**

CS-603	L-T-P-C
Wireless Communication & Mobile Network Architecture	3-0-0-3

**Objective:** *The aim is to study the basics of wireless communication & mobile network architecture. The scope of study is to develop new algorithms towards realizing nodes & their area determination. Security enhancement of mobile & grid networks is also another important aspect in this perspective.*

**Course Content**

Principles of Cellular Networks, TDMA, CDMA, Wireless Link Improvement Techniques  
Satellite Communication, Satellite Parameters & Configuration, Capacity Allocation,  
Cordless Systems, Wireless Local Loop, Mobile IP , Wireless Application Protocol. Wi-  
Fi Protected Access , Overview of Bluetooth , Bluetooth Core Protocols , Bluetooth  
Usage Models , Mobility Management , Hand-off, Hand-off types , Roaming  
Management, Handoff detection , Strategies for hand-off detection , Channel  
assignment, Inter-system handoff, PACS Network Signaling , Cellular Digital Packet  
Data , GSM Systems , Paging Network Architecture , User Access Interface,  
Intersystem interface , Air Interface. Grid Computing – Issues & Challenges , Design of  
Grid Topologies , Grid Security Aspects , Mobile Computing- Issues & Challenges,  
Security Enhancement Techniques in Mobile Computing , Node Detection , Queueing  
Theory , System Dynamics Modeling, Investigation of Optimum Communication  
Techniques.

### **Text/Reference Books**

1. Wireless & Mobile Network Architectures. Lin Y. & Chlamtac I. Wiley India Pvt. Ltd. , 2001
2. Wireless Communications & Networks. Stallings W. Pearson Education, 2009.



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**Semester - I**

**(Departmental Major Subject)**

CS-604	L-T-P-C
Pattern Classification & Coding Theory	3-0-0-3

**Objective:** *The aim is to study various pattern classification & information coding schemes. The scope of study is to develop modern techniques of pattern classification with optimum search time & high accuracy level. Application of coding theory in cryptography & analysis of security enhancement with respect to existing attacks is to be investigated.*

**Course Content**

Maximum Likelihood Estimation, Bayesian Estimation, Hidden Markov Models, Stochastic Methods , Linear Discriminant Functions & Decision Surfaces , Number Theory , Boltzmann Learning, Multilayer Neural Networks. Information Theory, Uncertainty & Information, Average Mutual Information & Entropy, Shannon-Fano algorithm, Huffman coding , Arithmetic coding, Perfect Codes, Hamming Codes , Method for generating cyclic codes, Quasi-cyclic codes, Shortened cyclic codes Cyclic redundancy check codes, BCH Codes , Reed-Solomon Codes , Nested Codes, Convolution Codes , Turbo Codes.

**Text/Reference Books**

1. Pattern Classification. Duba R.O., Hart P. & stork D.G. Wiley India Pvt. Ltd., 2006.
2. Information Theory, Coding & Cryptography. Bose R. Tata Mc-Graw Hill Education Pvt. Ltd. 2010.

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**Semester - I**

**(Departmental Major Subject)**

CS-605	L-T-P-C
Mobile Computing	3-0-0-3

**Objective:** *Mobile technologies & applications will shape mobile computing & commerce into a new era of the 21<sup>st</sup> century whereby mobile devices are not only pervasive & ubiquitous, but also widely accepted as the main tool in commerce. Mobile Computing covers a broad range of aspects pertaining to mobile computing, mobile communication, mobile devices, & various mobile applications.*

**Course Content**

Introduction to mobile computing & Mobile Development Frameworks Architecture, Design & Technology, C/S architecture, n-tier architecture & WWW Mobile agent architecture, Wireless Transmission. Medium Access Control-Introduction, Near/Far Terminals, SDMA, FDMA, TDMA, CDMA. Wireless LANs & Ubiquitous Wireless Communications- Scenario of Mobile Communication, Mobile Communication Generations: 1G to 3G, 3rd Generation Mobile Communication Network, Universal Mobile Telecommunication System (UMTS). Mobile Computing-WWW architectures for mobile computing, Need of WAP, Benefits of WAP, Examples of WAP. Wireless Telecomm Networks, Generations of Mobile Networks, Evolution of GSM & GPRS. Developing Mobile Application with J2ME.

**Text/Reference Books**

1. Mobile Computing (Technologies & Applications). Jani N.N., Lakhtaria K.I., Jani A.N. & Kanabkar N. S.Chand & Company Ltd.. 2009.

2. Mobile computing. Talukder A.K. & Yavagal R.R. Tata McGraw-Hill Education. 2005.
3. Mobile Computing. Jeyasri A. V. Technical Publications. 2009.

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**Semester - I**

**(Departmental Major Subject)**

CS-606  
Game Design

L-T-P-C  
3-0-0-3

**Objective:** *Introduction to game concepts, mechanics in general & electronic game design in particular. The course will cover areas such as design elements, idea refinement, design documents, prototyping. By applying these concepts you will develop a playable demo at the end of the course.*

**Course Content**

Analysis & comparison of games. You will look at several games & study their game mechanics & narratives. Output: Report on conclusions. Idea refinement. How do we make a good idea great? What elements can be added to improve the game? Output: Challenges to be solved & evaluated. The game design team. How do we create a good design team? What are the roles in the team & how do we keep from interfering with other roles? Exercises in group dynamics, group roles & responsibilities. Output: Hand in exercises & group work results for evaluation & feedback. Social games. New ways of gaming with a social twist. We look at social games on the web & how they work as well as none computerized social games such as Geocaching. Alternate Reality Games as a cross technique for gaming. Output: Report on how social game elements can be used in new ways. How can existing ideas be developed further? Small project. Game prototyping. How to visualize & test ideas quickly. None computerized tools to try computerized ideas. Output: Small game prototype. Try out & evaluate another student's prototype. Final work. In a small team you will create a demo of an original

idea. Output: Presentation of demo game. Game design document & game demo will be handed in for evaluation & feedback.

### **Text/Reference Books**

1. Challenges for Game Designers. Brathwaite B. Schreiber I. 1<sup>st</sup> Ed. Charles River Media. 2008.
2. Theory of Fun for Game Design. Koster R. 1<sup>st</sup> Ed. Paraglyph Press. 2004.

**Detailed Syllabus for Ph.D. Degree Programme  
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**Semester - I**

**(Departmental Major Subject)**

CS-607  
Neural Networks

L-T-P-C  
3-0-0-3

**Objective:** *The aim is to understand the basics of neural network & design some new topologies & models for learning strategies. The application of data mining based learning theory can be investigated. Application of neural networks in speech & pattern recognition is another research issue in this scenario.*

**Course Content**

Neural Networks Characteristics, Neural Networks Principles, Artificial Neural Net terminology, Model of a neuron, topology, learning types of learning supervised unsupervised, re-inforcement learning. Basic Hopfield Model , the perceptron , linear separability , Basic learning laws : Hebb's rule, Delta rule , Widrow & Hoff LMS learning rule, correlation learning rule, instar & outstar learning rules. Unsupervised Learning, competitive learning, K-means clustering algorithm & Kohonen's feature maps. Radial Basis, Function neural networks, Learning Laws in RBF nets, Recurrent networks, recurrent back propagation, Real Time Recurrent learning algorithm. Counter Propagation networks, CMAC networks, ART networks. Applications of Neural Nets, optimization, associative memories, vector quantization, control, Applications in speech & decision making.

**Text/Reference Books**

1. Neuro fuzzy & soft computing. Jang, Sun & Mizutoni. Pearson Education. 2005.
2. Introduction to Artificial Intelligence & Expert Systems. Patterson D.W. Pearson Education. 2005.

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**Semester - I**

**(Departmental Major Subject)**

CS-608	L-T-P-C
Distributed Systems	3-0-0-3

**Objective:** *The aim is to study the concepts of distributed systems. Various approaches towards realizing optimum communication in distributed systems in the light of parallel computing is to be studied with relevant architecture & communication strategies.*

**Course Content**

Introduction & Architecture: Definitions & challenges. System models, Middleware, Client-Server models & its variants. Specifications of fundamental models: Interaction, Failure & Security models. Networking & Middleware Briefing: Networking & Internetworking, Internet protocols, APIs for internet protocols, External data representation & various marshaling environment. Distributed Objects & Remote Invocation: Communication between distributed objects, Remote procedure call, Sun RPC case study, Events & notifications. Synchronization: Introduction, Clocks, events & process states, Synchronizing physical clocks, Logical time & logical clocks, Global states, Distributed debugging. Transactions & Concurrency Control: Introduction, Transactions, Nested transactions, Locks, Optimistic concurrency control, Timestamp ordering, Comparison of methods for concurrency control. Overview of Distributed Transactions & Replication.

**Text/Reference Books**

1. Distributed Systems: concepts & Design. Coulouris G. 4th Ed. Pearson Education. 2006.

2. Distributed systems : principles & Paradigms. Tanenbaum A.S. & Steen M.V. Pearson Education. 2008.



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**Semester - I**

**(Departmental Major Subject)**

CS-609  
Simulation & Modeling

L-T-P-C  
3-0-0-3

**Objective:** *The aim is to study the simulation strategies & the mathematical models on system concepts. Modification in deterministic, probabilistic, continuous, discrete, static physical, dynamic physical, static mathematical & dynamic mathematical models of simulation is a great research challenge in this context. New models in the light of system dynamics can be proposed in the light of statistical means like variance, expectation, curve fitting, regression & correlation.*

**Course Content**

Introduction: System definition & components, stochastic activities, continuous & discrete System, system modeling, types of models, static & dynamic physical models, Static & dynamic mathematical models. System simulation: Basic nature of simulation, technique of simulation ,comparison of simulation & analytical methods, types of system simulation , real time simulation, hybrid simulation, simulation of pure pursuit problem single server queuing system & an inventory problem, Monte Carlo simulation, Distributed Lag methods. System dynamics: Exponential growth models, exponential decay models, modified exponential growth models, logistic curves, generalization of growth models, System dynamics diagrams. Simulation of PERT networks: Critical path computation, uncertainties in Activity duration, Resource allocation & consideration.

**Text/Reference Books**

1. System Simulation. Gordon G. PHI Learning Pvt. Ltd. 2005.
2. System Simulation with Digital Computer. Deo N. PHI Learning Pvt. Ltd. 2006.

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**Semester - I**

**(Departmental Major Subject)**

CS-610	L-T-P-C
Advanced Knowledge Management	3-0-0-3

**Objective:** The objective of the course is to develop some ideas regarding the knowledge types & modeling using UML.

**Course Content**

Knowledge Management - Knowledge Value, Knowledge Value Tree, Knowledge Acquisition. Declarative Knowledge – Subtypes, Declarative Knowledge Learning. Declarative Knowledge Representation. Procedural Knowledge – Definition, Capturing Procedural Knowledge. Tacit Knowledge - Definition, Varieties , Tacit Knowledge Capture. Explicit Knowledge - Definition, Explicit Knowledge Implicit , Capture for Knowledge Management. Process Knowledge & Concept Knowledge – Process Knowledge Workflow, Process Knowledge Applications, Concept Knowledge fundamentals. Knowledge Modeling using UML- Overview, UML applied to Knowledge Modeling , Knowledge Process , UML Decision Tree.

**Text/Reference Books**

1. UML for developing knowledge management systems. Rhem A.J. Auerbach Publications Taylor & Francis Group. 2006.
2. Knowledge Management in Modern Organizations. Jennex M. E. IGI Publishing. 2006.
3. Knowledge Management: Advanced Researches. Sanders M. 1<sup>st</sup> Ed. Clanrye International. 2015.

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**Semester - I**

**(Departmental Major Subject)**

CS-611	L-T-P-C
Advanced Game Design	3-0-0-3

**Objective:** This course will be held in the form of an intensive workshop for designing & producing meaningful games. This course serves as an intensive group workshop where the students will produce a fully functional game by the end of the semester. The course will cover all aspects of the design process in dept. It will be done in the work of a group task where the group works together to complete a full functional digital or non digital game.

**Course Content**

Pitch document. The group has to produce a pitch document & give a presentation of it.  
Design document. This document will be a living document throughout the course. Every week this document has to be submitted. The content of this document will be the main topics of the course. Game Concepts - Introduction, Description, Key Features, Minimum System Requirements, Supporting Technology. Story- Full Game Story & Setting, Game Mechanics - Sample Game Play , Core Game Play / Game Flow, Game Modes- Player Design /Characters, NPC-Description, Stats, AI, Location, & Player Interaction. Physics, Artificial Intelligence Design-Algorithms Used, Algorithms Applied On. User Interface - Overview, HUD, & Menus. Visual Art - Sound & Music, Technical Analysis-Experimental Features, Major Development Tasks, Risks, Estimated Schedule, Market Analysis- Target Platform, Target Market, Target ESRB Rating, Target Genre, Top Performers, Legal Analysis. Cost Analysis-Resource Costs, Revenue Projection.

### **Text/Reference Books**

1. The Game Design Reader: A Rules Of Play Anthology. Katie S. K. & Zimmerman E. MIT Press. 2005.
2. Game Mechanics: Advanced Game Design (Voices That Matter). Adams E. & Dormans J. New Riders. 2012.
3. Advanced Game Design with HTML5 & JavaScript. Spuy R. Apress, 2015.

**Detailed Syllabus for Ph.D. Degree Programme  
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Computer Science & Engineering**

**Semester - I**

**(Departmental Major Subject)**

CS-612	L-T-P-C
Data Mining & Warehousing	3-0-0-3

**Objective:** *In a knowledge-intensive economy, the ability of a company to compete effectively depends increasingly upon its ability to exploit its available knowledge resources. The focus of this course will be on understanding how some advanced information processing technologies can be used to raise organizational intelligence through exploratory data analysis methods such as data mining.*

**Course Content**

Introduction to Data Warehousing - Multi-dimensional Data Model & Schemas, OLAP Operations & Servers, Indexing OLAP Data Efficient Processing of OLAP Queries, Type of OLAP Servers: ROLAP vs. MOLAP vs. HOLAP, OLTP & Metadata Repository. Data Warehouse Architecture - The Design of A Data Warehouse, A Business Analysis Framework, The Process of Data, Warehouse Design, A 3-Tier Data Warehouse Architecture, Enterprise Warehouse, Data mart, Virtual Warehouse, Data Cleaning-Missing Values, Noisy Data, Data Cleaning as a Process, Data Integration & Transformation, Data Cube Aggregation Attribute Subset Selection, Dimensionality Reduction: Basic Concepts only. Data Mining - Introduction, Data Mining Functionalities, Characterization & Discrimination Mining Frequent Patterns, Associations, Correlations Classification & Prediction, Cluster Analysis, Outlier Analysis, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or Data Warehouse System, Major Issues in Data Mining. Attribute-Oriented Induction: An Alternate Method for Data Generalization & Concept Description

- Attribute-Oriented Induction for Data Characterization, & Its Efficient Implementation, Presentation of the Derived Generalization, Mining Class Comparisons: Discrimination between Different Classes, Class Descriptions: Presentation of both Characterization & Comparison. Mining Frequent Patterns, Associations, & Correlations - Basic Concepts: Market Basket Analysis Frequent Itemsets, Closed Itemsets. Association Rules, Frequent Pattern Mining, Apriori Algorithm, From Association Mining to Correlation Analysis. Classification & Prediction - Introduction to Classification & Prediction, Basics of Supervised & Unsupervised Learning, Preparing the Data for Classification & Prediction, Comparing Classification & Prediction Methods, Classification by Decision Tree Induction, Attribute Selection Measures, Tree Pruning Scalability & Decision Tree Induction. Cluster Analysis - Introduction to Cluster Analysis, Types of Data in Cluster Analysis, A Categorization of major Clustering Methods, Partitioning Methods Centroid-Based Technique: K-Means Method, An Overview of Other Clustering Methods, Outlier Analysis Statistical Distribution-based Outlier Detection Distance-based Outlier, Detection Density-based Outlier Detection Deviation-based Outlier Detection. Data Mining Applications-Financial Data Analysis, The Retail Industry, The Telecommunication Industry, Biological Data Analysis, Other Scientific Applications, Intrusion detection, Examples of Commercial Data Mining Systems.

### **Text/Reference Books**

1. Data Mining: Concepts & Techniques. Han J. & Kamber M. Morgan Kaufmann Publishers. 2000.
2. Advances in knowledge discovery & data mining. Fayyad U.M., Piatetsky-Shapiro G., Smyth P. & Uthurusanmy R. AAAI Press. 1996.
3. Business Intelligence: A Managerial Approach. Turban E., Sharda R., Aronson J.E. & King, D. Prentice Hall. 2010.
4. Data mining Explained - A manager's guide to customer-centric business intelligence. Delmater R. & Hancock M. Digital Press. 2001.

**Detailed Syllabus for Ph.D. Degree Programme  
in  
All Disciplines**

**Semester - I**

**(Minor Subject)**

BM-617  
Research Methodology

L-T-P-C  
3-0-0-3

**Objective:** *This course aims at helping students appreciate the importance of carrying out research in a planned and systematic manner. It discusses different research designs before providing students with an understanding of sampling for research purposes. It also provides students statistical tools to analyse and compare research data and test hypotheses for arriving at statistical valid results. Finally the course discusses ethical issues relating to sampling & research before providing inputs on development of synopsis that forms the basis of formal research.*

**Course Content**

Research & its Methodology: Definitions, Nature, Scope & Types of research, Stating the research problem and developing an approach, Importance of statement of research objectives.

Research Design and Research Instruments: Comparison on important research designs (Exploratory, Descriptive and Experimental); Methods of Data Collection - Observational and Survey Methods, Questionnaire Design.

Sampling Methods and Sampling Distributions: Statistics and Parameter, Sampling distributions - conceptual basis; standard error; sampling from normal populations; relationship between sample size and standard error; Finite Population Multiplier.

Measurement and Scaling: Discussion on primary scales of measurement, discussion on comparative scaling technique (paired comparison scaling, rank order scaling, constant sum scaling) and non-comparative scaling techniques (continuous rating

scale, itemized rating scale, Likert scale, Semantic differential scale, staple scale); Challenges of ensuring accuracy (reliability and validity of research).

Hypothesis Testing: Basic Concepts – Null and Alternative Hypotheses; Type I and Type II errors; the significance level. Chi-square and Analysis of Variance: Chi-square as a test of (a) independence and (b) goodness of fit; ANOVA, Non parametric tests & its applications.

Multivariate analysis using SPSS: Factor Analysis, Multiple Regression Analysis, Multiple Discriminant Analysis and Logistic Regression, Multivariate Analysis of Variance.

Presenting Research findings: Tabulation of Data, Synopsis & Report Writing, Ethical aspects of research.

Use of Analytical Tools for Research: Analysis of data through spreadsheets, Use of SPSS, Use of open source tools like R for research.

### **List of Exercises (Excel/SPSS/R)**

1. Estimating regression & correlation coefficients;
2. Estimating probability based on Binomial, Poisson & Normal distribution;
3. Estimating standard error using central limit theorem (small & large population);
4. Hypotheses testing for all three kinds of hypotheses;
5. Use of Chi-Squared value to estimate population variance & hypotheses testing;
6. Use of F-distribution for comparing multiple samples;
7. Non parametric testing as a tool for hypotheses tests;
8. Use of other open source software packages for research purposes.

### **Text/Reference Books**

1. Statistics for Management. Levin R.I. and Rubin D.S. 7<sup>th</sup> Ed. Dorling Kindersley Pvt Ltd. 2008.
2. Quantitative Techniques. Kothari C.R. Vikas Publishing House. 2009
3. Multivariate Data Analysis. Hair J.F.Jr., Black W.C. and Babin B.J. 7<sup>th</sup> Ed. Prentice Hall. 2009.
4. Statistical Methods. Gupta S.P. 30<sup>th</sup> Ed. Sultan Chand. 2012.
5. Statistical Methods. Das N.G. McGraw Hill Education (India) Pvt. Limited. 2008.