DEVI AHILYA VISHWAVIDYALAYA, INDORE

School of Data Science and Forecasting

1.1.1
Syllabus of all programs

M.Tech. in Future Studies and Planning

Specialization in Data Analytics

Programme Structure:

Batch: 2014-16

First Semester:

Code	Title	Credits (L T P)
CORE COURSES		
FS-711	Forecasting Methods	4 (2-1-2)
FS-712	Operations Research	4 (2-1-2)
FS-713	Statistical Research Methods	4 (2-1-2)
FS-714	RDBMS and NOSQL	4 (2-1-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two)		
FS-715	Supply Chain Management	4 (3-1-0)
FS-716	Technology Management	4 (3-1-0)
FS-717	Decision Analysis	4 (2-1-2)
FS-718	Statistical Programming in R	4 (2-1-2)
Choice Based Course (Any One): The students can choose any one course from the courses being offered in this semester in other M.Tech. programmes being run in this campus.		

Second Semester:

Code	Title	Credits (L T P)
CORE COURSES		
FS-721	Technology Forecasting	4 (3-1-0)
FS-722	Data Mining for Analytics	4 (2-1-2)
FS-723	Big Data Analytics	4 (2-1-2)
FS-724	Python for Analytics	4 (2-1-2)
ELECTIVE COURSES (Any Three) The students can choose any three courses from following elective courses of this programme and the courses being offered in this semester in M.Tech. (SM) programme.		
FS-725	Machine Learning	4 (3-1-0)
FS-726	Industrial Engineering and Systems	4 (3-1-0)
FS-727	System Dynamics	4 (2-1-2)
FS-728	Multivariate Analysis	4 (2-1-2)
Choice Based Course (Any One): The students can choose any one course from the courses being offered in this semester in other M.Tech. programmes being run in this campus.		

Third & Fourth Semesters:

Code	Title	Credits
FS-800	M.Tech. Thesis	40

Note: The above course contents can be modified as per requirement from time to time in accordance with University Ordinance No. 31.

DETAILED SYLLABUS

FIRST SEMESTER:

FS-711: Forecasting Methods Credits: 4 (2-1-2)

COURSE OBJECTIVE
This subject is designed in such a way to provide the basic concepts of forecasting models based on quantitative analysis. Risk and uncertainty in forecasting and it is generally considered good practice to indicate the degree of uncertainty attaching to forecasts.

COURSE DESCRIPTION:

Unit I: Introduction: Fo**re**casting perspective, an overview of forecasting methods, basic steps in forecasting. Basic forecasting tools: time series and cross-sectional data, graphical and numerical summaries, forecasting accuracy, prediction intervals, transformations and adjustments.

Unit II: Time series: Decomposition, principles of decomposition, moving averages, classical decomposition, census bureau methods, forecasting and decomposition.

Unit III: Exponential smoothing: averaging methods, Singleexponential smoothing methods, ARRSES, Double exponential soothing methodcomparison of methods, general aspects of smoothing methods.

Unit IV: Regression: Simple regression, forecasting with simple regression, non-linear relationships. Multiple regressions. Box-Jenkins methods: examining correlations in time series data, examining stationary, ARIMA models, forecasting with ARIMA models.

Text Book(s)—

1. Spyros Makridakis :Forecasting Method's and application Wiley
2. N.P. Nagpal :Forecasting Techniques ,RBSA
3. Stephen A. Delurgio: Forecasting Principals and Application,McGraw Hill

FS-712: Operations Research Credits: 4 (2-1-2)

COURSE OBJECTIVE
This course exposes the students in mathematical modelling, solving and analysing business and industrial problems using operations research methods.

COURSE DESCRIPTION:

Unit -I:
Introduction, History, Development of Operations Research, Characteristics of Operations Research, Models in Operations Research, Principles of Modelling. Pre-modelling-Need Recognition, Problem Formulation. Modelling-Model development, Data collection, Model solution, Model validation, and sensitivity analysis. Post-modelling-Interpretation of results and implications, Decision making, Implementation, and Control.

Unit-II:
Linear Programming, Formulation of Linear programming Problems. Solution Methods-Graphical, Simplex, M-Technique, Two-Phase. Special cases of LP problems. Duality, Primal-dual relationships, Dual simplex method. Sensitivity analysis. Solving LP problems using computer software.

Unit-III:
Transportation Model-Formulating the model, Initial Feasible Solution-North-West Method, Least Cost Method, Vogel's Approximation Method. Optimum Solution-MODI method, Stepping Stone Method. Special issues of transportation problems. Assignment Model: Formulating the model, Solving the assignment problem using Hungarian method. Special issues of assignment problems.

Integer programming: Types of integer programming problems, Formulating the model, Solution using Branch and bound method. Dynamic Programming.

Solving the problems using computer software.

Unit-IV:
Network models: Minimal spanning tree algorithm, Shortest-route problem, Maximal flow model, Minimum –cost capacitated flow problem. Project Scheduling: CPM and PERT.

Inventory models: Functions of inventory, information requirements for inventory management-demand, lead time, inventory costs, and quantity on hand. Objectives of inventory management. Economic Order Quantity Models-Economic order size, economic production run, quantity discounts. Determining the reorder point. Material Requirement Planning.

Queuing Models: Goals, elements and characteristics of queuing systems, Measures of system performance, Waiting line models-single channel, multiple channel. Cost considerations.

TEXT BOOKS
Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
William J. Stevenson: Introduction to Management Science, IRWIN.

FS-713: Statistical Research Methods Credits: 4 (2-1-2)

Objective:
This course will familiarize students with the rudiments of statistical theory and ready them for effective academic and professional practice in the field of research process of industrial, system and social Science.

COURSE DESCRIPTION:

Unit I: Introduction to Research Methods and Measures of central tendency
Meaning and Objectives of Research, Significance of Research, Arithmetic Mean, Geometric Mean, Harmonic Mean, Median, Mode. Mean deviation, Standard deviation, Variance, Co-efficient of variation.

Unit II: Probability and Statistical Distribution

Binomial distribution, Poison distribution and Normal distributions, Fitting of Normal Curve. Concept of Probability, Theorems of Probability, Conditional Probability, Baye's Theorem, Random Variable and Probability distribution.

Unit III: **Correlation and Regression Analysis**
Types of correlation, Methods of Correlation, Co-efficient of correlation, Properties of correlation, Rank Correlation. Difference between correlation and regression, Regression Lines, Regression Equations.

Unit IV: Testing of Hypothesis
Procedure of Testing Hypothesis, Standard Error and Sampling distribution, Estimation, Student's t-distribution, Chi-Square test and goodness of fit, F-test and analysis of variance.

Text Books:
S.P. Gupta: Statistical Method, S. Chand
C.K. Kothari: Research Methodology, New Age International

FS-714 RDBMS and NoSQL Credits: 4 (2-1-2)

Objective: The purpose of this course is to provide fundamental knowledge of relational database management system and SQL to students. Student will also learn new mechanism of storage and retrieval of data, NoSQL.

UNIT I

Overview of DBMS: Comparison between Database approach and Traditional file accessing approach, Advantages of database systems, Schemas and instances, Data Dependency, Data Dictionary, and Meta Data. Data models, Types of Data models (Object Oriented, Record Based and Physical data models), E-R Modelling;

UNIT II

Relational Data model: Domains, Tuples, Attributes, Keys, Relational database, Schemas, Integrity constraints, Relational algebra and relational calculus; Normalization: Normal forms (INF, 2NF, 3NF, BCNF), Functional dependency, Decomposition, Dependency preservation and lossless join;

UNIT III

Structured Query Language: DDL, DML, DCL, TCL, SQL Functions, integrity constraints, various joins, sub-query, index, View, Sequence, and Clusters.

UNIT IV

NoSQL: Nosql Basics, Storage Architecture, Operations, Query Model, Modifying Data Stores and Managing Evolution, Indexing and Ordering Data Sets, Managing Transactions and Data Integrity. Using Nosql in the Cloud, Scalable Parallel Processing with Mapreduce, Analyzing Big Data with Hive, Surveying Database Internals

Text Books:

1. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, fifth Edition McGraw-Hill.
2. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
3. Rob, Coronel, “Database Systems”, Seventh Edition, Cengage Learning.
4. Fred R.McFadden,Jeffrey A.Hoffer & Marry B.Prescott.?Modern Database Management, Fifth Edition,Pearson Education Asia,2001.
5. Bayross Ivan, "SQL, PL/SQL: The Programming Language Of Oracle", 4th Revised Edition, BPB Publications, 2010.
6. Tiwari Shashank , "Professional Nosql", Wiley India Pvt Ltd, 2011.

FS-715: Supply Chain Management Credits: 4 (3-1-0)

Objective: This course will familiarize students how Supply chain management is used in organization for effective outcomes by increasing productivity and efficient use of sources.

COURSE DESCRIPTION:

Unit I: Introduction to Supply Chain Management: Concept, Scope, Objectivesand importance of supply chain, Supply chain components, Drivers of supply chainmanagement. Achieving strategicPlanning Demand and Supply Chain.Aggregate Planning in a Supply Chain: Managing Supply and Demand, Models forSupply Chain.

Unit II: Managing Inventory - Role of Cycle Inventory, Estimating Cycle Inventory EOQ,Role of Safety Inventory, Determining Level of Safety Inventory. Estimating and ManagingSafety Inventory.

Unit III: Transportation and Facility Decisions: Factors Affecting Transportation and NetworkDesign Decisions. Modes of Transportation, Routing and Scheduling in Transportation.Models for Facility Location Capacity Allocation.

Unit IV: Third Party Logistic Retailer
Supplier’s relationships Types and Key issues: DistributionIntegration, Types and Key Issue in Procurement and Outsourcing Strategies. IT and e-businessin supply chain management.Importance and use of information in supply chainInfrastructure and Interface Devices. Case Studies

Text Book(s)—
Sunil Chopra, Peter Meindl :Supply Chain Management, Pearson
Sameer k Shrivastava: Business Logistic and Supply Chain Management, Pearson

FS-716: Technology Management Credits: 4 (3-1-0)

Objective: Technology Management is set of management disciplines that allow organizations to manage their technological fundamentals to create competitive advantage and profitability.

COURSE DESCRIPTION:

Unit I: Introduction
Basic concepts of Technology management, definition, role and importance of technology management. Constraint macro role of technology management

Unit II: Technological change
Technology life cycle, diffusion and growth of technologies, transformation, alternatives appropriate technology, policy and policy instrument.

Unit III: Technology development
Option and strategy. Technology and socio economic planning. Nature of technology change: revaluation on different Technology (product and services) Effect of Technology changes.

Unit IV: Generation and development of Technology
Technology strategy research and development. Technology Development and acquisition: Generation , Development and Transfer, Technology Transfer modes, Modes of Payment, Dimension of Technology Transfer, Routes of Technology Transfer, **Case study.**

Text Books:
Richard C. Dorf **:**The Technology Management Handbook
Edward p. Hawthorne: The Technology Management, McGraw Hill

FS-717: Decision Analysis Credits: 4 (2-1-2)

COURSE OBJECTIVE
This course introduces and applies advanced modelling techniques to decision problems with the objective of enhancing the decision-making skills as well as the spreadsheet knowledge base.

COURSE DESCRIPTION:

Unit-I: Probability
Basic Probability: Laws of probability-addition law, conditional law. Random variables and probability distributions. Expectation of a random variable-mean and variance of a random variable, mean and variance of joint random variables. Probability distributions-Binomial, Poisson, Normal, Exponential. Empirical distributions.

Unit-II: Game Theory
Introduction, definitions, two-person zero sum game. Game with pure strategies, saddle point, game value. Game with mixed strategies, solution methods-algebraic method, graphical method, dominance, linear programming method.

Unit-III: Decision Making
Structuring the decision problem-payoff tables, decision trees. Decision making under certainty. Decision making under risk: Expected value criterion, expected value of perfect information, sensitivity analysis, decision making with sample information, expected value of sample information, computing branch probabilities, utility and decision making. Decision making under uncertainty: Laplace, Minimax, Savage, Hurwicz.

Unit-IV: Multicriteria Decision Making
Multicriteria decision making: Goal programming, Scoring models, Analytical Hierarchy Process, TOPSIS. Markov Analysis.

TEXTBOOKS
Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
William J. Stevenson: Introduction to Management Science, IRWIN.

FS-718: Statistical Programming in R Credits: 4 (2-1-2)

Objective: This course is an introduction to R, a powerful and flexible statistical language and environment that also provides more flexible graphics capabilities than other popular statistical packages. After taking this course, students will be able to –

1. Use R for statistical programming, computation, graphics, and modeling,
2. Write functions and use R in an efficient way,
3. Fit some basic types of statistical models,
4. Use R in their own research,
5. Be able to expand their knowledge of R on their own

COURSE DESCRIPTION:

Unit I: Introduction to R programming language: Getting R, Managing R, Arithmetic and Matrix Operations, Introduction to Functions, Control Structures. Working with Objects and Data: Introduction to Objects, Manipulating Objects, Constructing Data Objects, types of Data items, Structure of Data items, Reading and Getting Data, Manipulating Data, Storing Data.

Unit II: Data Distribution and Statistical Testing: Types of Data distribution, Normal distribution, Poisson distribution, Random number generation, Chi-Square Testing, Student's t-test, F-test, Monte Carlo Simulation.

Unit III: Graphical Analysis using R: Basic Plotting, Manipulating the plotting window, Box-Whisker Plots, Scatter Plots, Pair Plots, Pie Charts, Bar Charts.

Unit IV: Advanced R: Statistical models in R, Correlation and regression analysis, Analysis of Variance (ANOVA), creating data for complex analysis, Summarizing data, and case studies.

Text Books:

1. Mark Gardener: Beginning R: The Statistical Programming Language, Willey publications
2. Norman Matloff: The Art of R Programming: A Tour of Statistical Software Design, OREILLY & Associates Inc.

SECOND SEMESTER:

FS 721: Technology Forecasting and Assessment Credits: 4 (3-1-0)

Objective: Primarily, a technological forecast deals with the characteristics of technology, such as levels of technical performance, the accuracy or precision of a technology. The forecast does not have to state how characteristics will be achieved. Secondly, technological forecasting usually deals with useful machines, procedures or techniques for society**.**

Unit I: Introduction Technology forecasting- it's meaning and need, alternatives to forecasting, stages of innovation. Delphi: advantages and disadvantages of committees, Delphi procedure, conducting a Delphi based study.

Unit II: Forecasting technology. Growth curves substitution curves, Pearl curve, Gompertz curve, Fisher-Pry curve, selection of proper growth curve, estimation of upper limit.

Unit III: Trend extrapolation- exponential trends, non-exponential growth, qualitative trends etc. Measures of technology-scoring models, constrained scoring models, planar tradeoff surfaces. Correlation models-lead lag correlation, technology progress function, maximum installation size etc.

Unit IV: Causal models-technology only models, techno economic model, simulation model. Forecasting breakthroughs. Combining forecasts-trend and growth curves, trend and analogy, components and aggregates, scenarios, cross impact models. Normative methods-relevance trees, morphological models, mission flow diagrams.

Text Book:
Technological Forecasting by Martino, Joseph Paul New York, American Elsevier Pub. Co. Publication

FS-722: Data Mining For Analytics Credits: 4 (2-1-2)

Objective:
The main objective of this course is to provide understanding of data mining techniques for business analytics services.

COURSE DESCRIPTION:

UNIT I:
Data Mining: Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining; Data Processing: Data Cleaning, Data Integration and Transformation; Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Data Discretization and Concept hierarchy generation for numerical and categorical data. Web Mining: Introduction, Web Content Mining, Web Structure Mining, Web Usage Mining; Spatial Mining, Text Mining.

UNIT II:

Data Warehousing: Introduction data warehousing, Data Mart, Data Warehouse Architecture; Star, Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning. OLAP technology, Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, Indexing data.

UNIT III:

Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, FP-Growth Algorithm, Time series mining association rules, latest trends in association rules mining.

UNIT IV:

Classification methods: Decision tree, Bayesian Classification, Association Rule based; Prediction: Linear and non-linear regression; Categories of clustering methods, Partitioning methods: K-Means, K-Mediods. Hierarchical Clustering: Agglomerative and Divisive Clustering, BIRCH and ROCK methods, DBSCAN, Outlier Analysis. Data Mining for Business Intelligence Applications

Text Books:

1. P.Ponnian, “Data Warehousing Fundamentals”, John Weliey.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.
3. P. N. Tan, M. Steinbach, Vipin Kumar, “Introduction to Data Mining”, Pearson Education.
4. G. Shmueli, N.R. Patel, P.C. Bruce, “Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner”, Wiley India.
5. Michael Berry and Gordon Linoff “Data Mining Techniques”, Wiley Publications.
6. M.H.Dunham, “Data Mining Introductory & Advanced Topics”, Pearson Education.

FS-723: Big Data Analytics Credits: 4 (2-1-2)

UNIT I

Introduction to BigData, Big Data Overview, Platform, Challenges of Conventional Systems, Intelligent data analysis, Analytic Processes and Tools, Analysis vs Reporting, Modern Data Analytic Tools. Introduction to Data Science: Data Science Process, Data Science for Business. Identifying problem and solving problem in data science. Data: Unstructured vs. Structured Data, Databases. Role of Data Scientist, Data Analyst, Business Analyst.

UNIT II

Introduction to Hadoop, Hadoop architecture, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases; Hadoop Distributed File system: Design of HDFS, HDFS Concepts, Command-Line Interface, Hadoop File systems Java Interface, Hadoop Archives;

UNIT III

Introduction to MapReduce: Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop, Hadoop Streaming, Hadoop Pipes, Functional programming with Mappers and Reducers. MapReduce Working, types and file formats, features; Setting up Hadoop Cluster;

UNIT IV

Pig: Installing and Running Pig, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators; Hive: Installing Hive, Running Hive, Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User-Defined Functions; HBase: HBasics, Concepts, Installation,Clients, HBase Versus RDBMS, Praxis; Fundamentals of Zookeeper and Sqoop.

Text Books:

1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, JohnWiley & sons, 2012
2. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons, 2007.
3. Pate Warden, “Big Data Glossary”, O’Reilly 2011.
4. Tom White,"Hadoop: The Definitive Guide", 3rd Edition, O'Reilly Media, 2012.
5. Donald Miner, Adam Shook, Eric Sammer, “Hadoop Operation”, O’Reilly 2012.
6. Donald Miner, Adam Shook “MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems”, O’Reilly 2012.
7. Chuck Lam, "Hadoop in Action", Manning Publications, 2010.

FS-724: Python for Analytics **Credits: 4 (2-1-2)**

Objective: The main objective is to help students to understand the fundamentals of python and student will learn how to analysis data using python.

UNIT I

Introduction to Python: Python versus Java, C, C++, Matlab, R, Python Interpreter and it’s Environment, Using the IPython notebook, Python basics: variables, conditionals, loops; Data structures: lists and dictionaries; using objects, classes, function;

UNIT II

Data Handling and Strings, Reading data into memory, Working with strings, Catching exceptions to deal with bad data, Writing the data back out again, Introduction to interfacing Python with other programming languages: C/C++, Fortran, R.

UNIT III

Python and Pandas: Manipulating data from CSV, Excel, HDF5, and SQL databases, Data analysis and modelling with Pandas, Time-series analysis with Pandas, Using Pandas, the Python data analysis library, Series and Data Frames, Grouping, aggregating and applying, Merging and joining, Managing huge hierarchical datasets with PyTables (HDF5) and NetCDF.

UNIT IV

Visualization: Visualization with matplotlib, Figures and subplots, Labeling and arranging figures, Outputting graphics, Introduction to building graphical UIs and web UIs for scientific applications.

Text Books:

1. McKinney Wes, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.
2. Hauck Trent, "Instant Data Intensive Apps with Pandas How-To", Packt Publishing Ltd, 2013.
3. Beazley David M.,"Advanced Python Programming", Pearson Education,2009.
4. Chun Wesley , Core Python Programming, 3rd Edition,Prentice Hall Professional, 2012.
5. Telles Matt "Python Power!: The Comprehensive Guide", Cengage Learning, 2008.
6. McKinney Wes & PyData Development Team, "pandas: powerful Python data analysis toolkit", Release 0.13.1, Feb 2014.

FS-725: Machine Learning Credits: 4 (3-1-0)

Objective: The main objective is to help students to understand the fundamental concepts of machine learning.

UNIT I Introduction

Introduction to Machine Learning, History and Overview of machine learning, Applications, Types of Machine Learning, Basic Concepts. Concept Learning and candidate elimination learning Algorithm.

UNIT II

Artificial Neural Network: biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervise & Unsupervised) and activation function. Supervised Learning: Perceptron learning, Single layer/multilayer, linear Separability, Adaline, Madaline, Back propagation network, RBFN.

UNIT III

Bayesian Learning, Bayes Theorem, Naïve Bayesian classifier, Bayesian belief, EM Algorithm. Dimensionality Reduction: Factor Analysis, Principal Component Analysis, Linear Discriminant Analysis.

UNIT IV

Markov and Hidden Markov Models, PAC Learning, Support Vector Machine, Evolutionary Learning: Genetic Algorithm, generating offspring, applications and genetic programming.

Text Books:

[1]. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
[2]. Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009.

[3]. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
[4]. Ethem Alpaydin, "Introduction to Machine Learning", Prentice Hall of India, 2005.
[5]. Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2006.
[6]. Sanjeev Kulkarni, Gilbert Harman, "An Elementary Introduction to Statistical Learning Theory", 2011.
[7]. N. Shivnandam, "Principle of soft computing", Wiley.

FS: 726 Industrial Engineering and Systems Credits: 4 (3-1-0)

Objective: Industrial engineering and systems deals with the optimization of complex processes or systems. It typically focuses on the development, improvement, implementation and evaluation of integrated systems for industrial practice in product design, process design, plant operation, production control, quality control, facilities planning, work system analysis and evaluation, and economic analysis of operational systems.

Unit I: Introduction – concepts of industrial engineering, history and development of industrial engineering, application. Facility: location factors and evaluation of alternate locations; types of plant layout and their evaluation; computer aided layout design techniques; assembly line balancing; materials handling systems. Productivity – concepts and measurements.

Unit II: Work System Design: Taylor's scientific management, Gilbreths's contributions; method study, micro-motion study, principles of motion economy; work measurement – stop watch time study, work sampling, standard data, PMTS; ergonomics; job evaluation, merit rating, incentive schemes, and wage administration.

Unit III: Product Design and Development: Principles of good product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, concurrent engineering.

Unit IV: Reliability and Maintenance: Reliability, availability and maintainability; distribution of failure and repair times; determination of MTBF and MTTR, reliability models; system reliability determination; preventive maintenance and replacement, total productive maintenance – concept and applications. Limits, fits, Tolerances, Gauges, Comparators, Surface Finish Measurements Wages payment plan: Introduction, classification of wage payment plan, incentive plan. Material purchase and store management: material management, purchasing and procurement, buying technique, store and material control and store record.

Text Books:
1. Industrial Engineering and Management, by O.P. Khanna
2. Operations Management, by William Stevensons, Tata McGraw Hills Publication

FS-727: System Dynamics Credits: 4 (2-1-2)

COURSE OBJECTIVES
To understand cause-effect relations in social and management systems.
To analyze complex, dynamic and nonlinear interactions in social systems.
To develop new structures and policies to improve the system behaviour.

COURSE DESCRIPTION:

Unit -I:
Introduction. System concepts, system theories, models. Classification of systems-continuous and discrete, stochastic and deterministic and open and closed systems. System studies: subsystems, types of system studies.

System dynamics paradigm-foundations, framework, viewpoints, philosophy, flexibility, strengths and weaknesses. Stages of problem solving with system dynamics. Examples of managerial and social problems.

Unit-II:
Elements of system dynamics modelling. Physical flows, Level and rate variables, Information flows, Diagramming aids, Delays, Smooth functions, equations, Table functions. Causal-loop diagramming, flow diagramming.

Unit-III:
Steps in system dynamics: Problem identification, Fixing model aggregates and boundary, Detailed model, Model validation, Model analysis. Principles of modelling. Model equations.

Unit-IV:
Development of system dynamics models. Behavior of linear systems, positive feedback, negative feedback systems. Simulation of low order systems. Validation. Applications in planning and policy design for industrial / social systems. System dynamics packages. Case studies.

TEXTBOOKS
Pratap K J Mohapatra, Purnendu Mandal, Madhab C Bora: Introduction to System Dynamics Modelling, Universities Press
Sushil: System Dynamics, Wiley Eastern

FS-728: Multivariate Analysis Credits: 4 (2-1-2)

Objective:
1. To understand the main features of multivariate data.
2. To be able to use exploratory and confirmatory multivariate statistical methods properly.
3. To be able to carry out multivariate statistical techniques and methods efficiently and effectively.

UNIT I: Analysis of categorical data. Loglinear models for two- and higher-dimensional contingency tables, Characterizing and Displaying Multivariate Data, Tests on one or two mean vectors.

UNIT II: Multivariate Analysis of Variance, Aspects of multivariate analysis, random vectors, sample geometry and random sampling, multivariate normal distribution, inferences about the mean vector, MANOVA.

UNIT III: Classification and grouping techniques: discrimination and classification, clustering. Logistic regression models.

UNIT IV: Analysis of covariance structures, Principal Component Analysis (PCA), Factor Analysis, Cluster Analysis. Use of statistical computer packages.

Text Books:

1. Applied Multivariate Statistical Analysis, by Richard A. Johnson and Dean W.Wichern (6th edition), Prentice Hall.
2. Characterizing and Displaying Multivariate Data, by A.C.Rencher, John Wiley and Sons.
3. Multivariate Data Analysis, by Joseph F.Hair, William, Babin and Anderson.
4. Cluster Analysis, by Brian S.Everitt, Sabine Landau, Morven Leese. Wiley

M.Tech. in Systems Management

Programme Structure:

Batch: 2014-16

First Semester:

Code	Title	Credits (L T P)
CORE COURSES		
SM-711	Introduction to Systems Engineering	4 (3-1-0)
SM-712	Operations Research	4 (2-1-2)
SM-713	Database Management Systems	4 (2-1-2)
SM-714	System Analysis and Design	4 (2-1-2)
ELECTIVE COURSES (Any Four) The students can choose any four courses from following elective courses of this programme and the courses being offered in this semester in M.Tech. (FSP) programme.		
SM-715	Computer Networks	4 (2-1-2)
SM-716	Information Security	4 (2-1-2)
SM-717	Cloud Computing	4 (2-1-2)
SM-718	Information Architecture	4 (3-1-0)

Second Semester:

Code	Title	Credits (L T P)
CORE COURSES		
SM-721	Mathematical Modelling	4 (3-1-0)
SM-722	System Simulation	4 (2-1-2)
SM-723	Enterprise Resource Planning	4 (3-1-0)
SM-724	Project Management	4 (2-1-2)
ELECTIVE COURSES (Any Three) The students can choose any three courses from following elective courses of this programme and the courses being offered in this semester in M.Tech. (FSP) programme.		
SM-725	Data Mining and Data Warehousing	4 (2-1-2)
SM-726	e-Business & e-Governance	4 (3-1-0)
SM-727	Big Data Analytics	4 (2-1-2)
SM-728	Artificial Intelligence & Neural Networks	4 (2-1-2)
Choice Based Course (Any One): The students can choose any one course from the courses being offered in this semester in other M.Tech. programmes being run in this campus.		

Third & Fourth Semesters:

Code	Title	Credits
SM-800	M.Tech. Thesis	40

Note: The above course contents can be modified as per requirement from time to time in accordance with University Ordinance No. 31.

DETAILED SYLLABUS

FIRST SEMESTER:

SM-711: Introduction to Systems Engineering Credits 4 (3-1-0)

COURSE OBJECTIVES

To provide an understanding of the concepts of systems engineering, including systems, life cycles, phases, and steps.

To develop and manage the systems (products and services) that that satisfy customer requirements, considering engineering, technology, environmental, management, risk, and economic factors by viewing the system as a whole, over its life cycle.

COURSE DESCRIPTION:

Unit -I:
Introduction to System Engineering
Systems point of view, definitions of systems engineering, systems engineering knowledge, challenges and pitfalls in system engineering.

Methodological Framework and Systems Engineering Processes
Methodological frameworks for systems acquisition or production: Logical steps of systems engineering, Life-cycle phases of systems engineering, two-dimensional framework for systems engineering, Life cycles or stage of systems engineering, Systems engineering processes. Other specific life-cycle methodologies for systems acquisition, production or procurement: A seven-phase life-cycle for system acquisition or product development, a twenty-two-phase life-cycle. Life cycles patterned after the waterfall model.

Unit-II:
Formulation of Issues
Situation assessment, Problem or issue identification: scoping and bounding the problem, system definition matrix, needs and constraints-identification and analysis, input-output matrix. Value system design: Objectives hierarchies or trees, objectives measures or design criteria. System synthesis. Relationship between issue formulation and design and development efforts: Functional decomposition and functional analysis, Functional analysis and business process reengineering, Quality function deployment. The system engineering requirements statements: User requirements, System requirements and specifications. Generation of alternatives or system synthesis: Brainstorming and brain writing, Groupware, Delphi methods, Morphological box approach. Feasibility studies: Feasibility screening, architecture and standards, feasibility criteria.

Unit-III:
Analysis of Alternatives
Analysis of systems with uncertain and imperfect information: Cross impact analysis models, hierarchical inference and extensions, logical reasoning models and inference, complications affecting inference and cross- impact analysis. Structural Modelling: Trees, casual loops and influence diagrams. Economic models and economic systems analysis: Present value analysis, Economic appraisal methods for benefits and cost overtime, systematic measurements of efforts and schedule, work breakdown structure and cost breakdown structure, cost- benefit and cost-effectiveness analysis. Reliability, Availability, Maintainability, and Supportability models. Evaluation of large-scale models.

Unit-IV:
Interpretation of Alternative Courses of Action and Decision Making: Types of decisions, Formal decisions, Group decision making, Voting.

Systems Engineering and Systems Engineering Management: Systems engineering organizational structures, Pragmatics of systems management, systems engineering methods for systems management, human and cognitive factors.

TEXTBOOKS

Andrew P. Sage, James E. Armstrong Jr.: Introduction to Systems Engineering, John Wiley & Sons
James N. Martin: Systems Engineering Guidebook, CRC Press
Benjamin S. Blanchard & Wolter J. Fabrycky: Systems Engineering & Analysis, Pearson International Edition

FS-712: Operations Research Credits: 4 (2-1-2)

COURSE OBJECTIVE

This course exposes the students in mathematical modelling, solving and analysing business and industrial problems using operations research methods.

COURSE DESCRIPTION:

Unit -I:

Introduction, History, Development of Operations Research, Characteristics of Operations Research, Models in Operations Research, Principles of Modelling. Pre-modelling-Need Recognition, Problem Formulation. Modelling-Model development, Data collection, Model solution, Model validation, and sensitivity analysis. Post-modelling-Interpretation of results and implications, Decision making, Implementation, and Control.

Unit-II:

Linear Programming, Formulation of Linear programming Problems. Solution Methods-Graphical, Simplex, M-Technique, Two-Phase. Special cases of LP problems. Duality, Primal-dual relationships, Dual simplex method. Sensitivity analysis. Solving LP problems using computer software.

Unit-III:

Transportation Model-Formulating the model, Initial Feasible Solution-North-West Method, Least Cost Method, Vogel’s Approximation Method. Optimum Solution-MODI method, Stepping Stone Method. Special issues of transportation problems. Assignment Model: Formulating the model, Solving the assignment problem using Hungarian method. Special issues of assignment problems.

Integer programming: Types of integer programming problems, Formulating the model, Solution using Branch and bound method. Dynamic Programming.

Solving the problems using computer software.

Unit-IV:

Network models: Minimal spanning tree algorithm, Shortest-route problem, Maximal flow model, Minimum –cost capacitated flow problem. Project Scheduling: CPM and PERT.

Inventory models: Functions of inventory, information requirements for inventory management-demand, lead time, inventory costs, and quantity on hand. Objectives of inventory management. Economic Order Quantity Models-Economic order size, economic production run, quantity discounts. Determining the reorder point. Material Requirement Planning.

Queuing Models: Goals, elements and characteristics of queuing systems, Measures of system performance, Waiting line models-single channel, multiple channel. Cost considerations.

TEXT BOOKS
Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
William J. Stevenson: Introduction to Management Science, IRWIN.

SM-713 Database Management Systems Credits: 4 (2-1-2)

Objective:
The purpose of this course is to provide fundamental knowledge of database management system and understanding of how to use and design a DBMS.

COURSE DESCRIPTION:

Unit I:
DBMS Concepts, Comparison between Database approach and Traditional file accessing approach, Advantages of database systems, Schemas and instances, Data Dependency, Data Dictionary, and Meta Data. Data models, Types of Data models (Object Oriented, Record Based and Physical data models), E-R diagram, Relational Data models: Domains, Tuples, Attributes, Keys, Relational database, Schemas, Integrity constraints, Relational algebra and relational calculus.

Unit II:
Database Design: Introduction to normalization, Normal forms (INF, 2NF, 3NF, BCNF), Functional dependency, Decomposition, Dependency preservation and lossless join, multi-valued dependencies. Structured Query Language: DDL, DML, DCL, TCL, SQL Functions, integrity constraints, various joins, sub-query, index, View, Sequence, and Clusters. PL/SQL: manipulating data using PL/SQL, Iteration, Exceptions, Cursors, Trigger. (Experiment on Oracle 11g)

Unit III:
Transaction Processing and Concurrency Control: Transaction System, Serializability of schedules, conflict & view serializable schedule, Recovery from transaction failures, Log based recovery. Checkpoints dead lock handling, Concurrency Control, locking Techniques for concurrency control, time stamping protocols for concurrency control, validation based protocol, multiple granularity.

Unit IV:
Advance Concepts: Introduction to Distributed databases, data mining, data warehousing, Basic Concepts of Object Oriented Database System, Comparative study of OODBMS V/s RDBMS. Introduction to Image and Multimedia databases and data structures, Web and mobile database, Spatial and Geographic Database, Accessing Database from front-end Application. Case Study: Oracle, MySql, DB2.

Text Books:
1. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, fifth Edition McGraw-Hill.
2. ElmasriRamez and NovatheShamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
3. Rob, Coronel, “Database Systems”, Seventh Edition, Cengage Learning.
4. Ramakrishnan: Database Management System , McGraw-Hill

5. Fred R.McFadden,JeffreyA.Hoffer& Marry B.Prescott.?Modern Database Management, Fifth Edition,Pearson Education Asia,2001
6. Gray Jim and Reuter Address, “Transaction Processing: Concepts and Techniques”, Moragan Kauffman Publishers.

SM-714 System Analysis and Design Credits: 4 (2-1-2)

Objective:
This course has been designed to provide a foundation of systems principles and an understanding of how analysts can analyze complex business system and develop solution.

COURSE DESCRIPTION:

Unit I: Introduction
System, Concepts, characteristics and components; Types of Systems: Physical System and abstract system, Open and closed system, Man-Made Information System and Formal Information System, Computer based Information System; System analysis and design, Role, task and attribute of the system analyst.

Unit II: System Development Life Cycle (SDLC)
Recognition of needs, Impetus for System Change, Feasibility Study, Analysis, Design, Implementation, Post implementation and Maintenance; Computer-Aided Software Engineering (CASE) Tools; Different models their advantages and disadvantages: Waterfall approach, Iterative approach, RAD model, Evolutionary software process model (Incremental model, Spiral model, Concurrent development model).

Unit III: System Analysis and System Design
Systems Planning and initial investigation, Information Gathering, Tools of structure Analysis (Data Flow Diagram, Data Dictionary, Decision Tree, Structured English and Decision Table), Feasibility Study. System Design: Process and Stages of Systems Design, Logical and Physical Design, Design Methodologies (Structured Design), Major Development Activities (Personnel Allocation, Audit Considerations, Processing Controls and Data Validation), Input/output and Form Design, File organization and database design. Modular and structured design: Module specifications, Module coupling and cohesion, Top-down and bottom-up design.

Unit IV: Object Oriented Analysis and Design
Introduction to Object Oriented Analysis and design, Association, Aggregation, Inheritance, encapsulation, Generalization and Specialization. Unified Modeling Language (UML): Class diagram, sequence diagram, Use case diagram, Collaboration diagram, state chart diagram, Activity diagram, component diagram, deployment diagram. System Implementation: System Testing and Quality Assurance, Implementation and Software Maintenance, Security and Disaster Recovery.

Text Books:

- System Analysis and Design Elias M. Award, Galgotia Publication.
- Essential of System Analysis and Design, Jeffrey A. Hofer Joey F. George Joseph .Valacich Addison Weseley.
- Systems Analysis and Design, Kenneth E. Kendall, Julie E Kendall, PHI
- Michael Blaha and J. Rumbugh, “Object oriented Modeling and design with UML”, Pearson Education

- O'Docherty, "Object Oriented Analysis and Design Understanding, System Development with UML2.0", Wiley India.

SM-715: Computer Networks Credits: 4 (2-1-2)

COURSE OBJECTIVES

The course is organized as an introduction into computer network, fundamental problems of computer networking and detailed understanding of widely-used networking technologies such as TCP/IP, HTTP, 802.11, Ethernet, and DNS.

COURSE DESCRIPTION:

Unit -I:

Introduction to Computer Network

Overview; Network topologies - LAN, MAN, WAN; Network Hardware – Repeater, Hub, Switches, Bridge, Router, Gateway, their difference; Network Software - Protocol Hierarchies, Design Issues for the Layers, Connection Oriented and Connection less Services, Service Primitives, Relationship between Services and Protocols; Reference models – OSI and TCP/IP, Comparison of OSI and TCP/IP Reference Models.

Unit-II:

Physical Layer and Data Link Layer

Type of Connections – Point-To-Point, Multipoint; Transmission media – Guided And Unguided Media; Switching Techniques – Circuit Switching and Packet Switching; Design issues – Services, Framing, Error Control and Flow Control; Error Detection Techniques - Parity Check and Cyclic Redundancy Check (CRC); Error Correction Technique - Hamming code; Elementary Data Link Protocols - Unrestricted Simplex Protocol, Simplex Stop-and-Wait Protocol, Sliding Window Protocols : One-Bit Sliding Window Protocol, protocol using Go Back N and Selective Repeat; HDLC protocol; Data link layer in the Internet - SLIP and PPP.

Medium Access Sublayer: Channel Allocation problem; Multiple access protocols: Pure Aloha, Slotted Aloha, CSMA Protocols, CSMA/CD, Collision-Free Protocols; IEEE MAC Sublayer protocols - 802.3, 802.4, 802.5 and their management; High speed LANs – Fast Ethernet, FDDI; Wireless LANs; Data Link Layer Switching – Bridges and Switches, their difference with Repeaters, Hubs, Routers and Gateways

Unit-III:

Network Layer

Design issues and functions; IP Addressing - The Anatomy of an IPv4 Address; Types of Addresses in an IPv4 Network - Network address, Broadcast address, Host addresses, Calculating Network, Hosts and Broadcast Addresses; Types of Communication - Unicast, Broadcast, Multicast; Legacy IPv4 Addressing – Classful Addressing, Classless Addressing, Calculating addresses; IPv4 Protocol – Datagram format, working, Fragmentation and Reassembling; Address Resolution Protocol and Reverse Address Resolution Protocol; Internet Control Message Protocol, IGMP Protocol; Routing algorithms – Optimality Principle, Intradomain and Interdomain Protocols; Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Broadcasting Routing, Multicast Routing; The Network Layer in the Internet - Internet Protocol, Internet addressing and Internet Control protocols.

Unit-IV:

Transport Layer and Application Layer

Transport Layer: Transport Service; Elements of transport protocols - Addressing, Connection establishment, Connection release, Flow control and Buffering, Multiplexing; The Internet Transport Protocols - UDP and TCP, The TCP Service Model, The TCP Protocol.

Application layer: Client Server Architecture, DNS, WWW and HTTP, E-mail Protocols (SMTP, POP3, IMAP, MIME), FTP, TELNET.

Practical: Socket Programming using Java/C/C++, Wireshark and Packet Tracer network simulation tools. Crating LAN, WAN, and implementing Routing using simulation tools. Client- Server Communication using Tomcat Server.

TEXTBOOKS

S.S. Shinde Computer Network
B.A. Frouzan, McGraw-Hill: Data Communications and Networking.
Andrew S. Tanenbaum, Addison-Wesley: Computer Networks
Douglas E. Comer: Computer Networks and Internets
Robert Shimonski : The Wireshark Field Guide. Analyzing and Troubleshooting Network Traffic.

SM-716 Information Security Credits: 4 (2-1-2)

Objective:

The purpose of this course is to provide fundamental knowledge of Information Security and introduction of some advance research topics.

COURSE DESCRIPTION:

Unit I:

Need for security, Security approaches, Principles of security, various security attacks. Basic of Cryptography, secret key cryptography, Types of attack, Substitution ciphers, Transposition ciphers, block ciphers and steam ciphers, Hill Cipher, Data encryption standard, Cryptanalysis, brute force attack; Public key cryptography, Principles of Public key Cryptosystems, Cryptographic Algorithms RSA, Diffie-Hellman key exchange; Digital Signature.

Unit II:

Authentication: One way Authentication, password based, certificate based, Mutual Authentication, shared secret based, Asymmetric based, Authentication and key agreement, centralized Authentication, eavesdropping, Kerberos, IP Security, Secure Socket Layer(SSL), Transport Layer Security (TLS).

Unit III:

Software vulnerabilities, Threats and Security Systems: Phishing Attacks, buffer overflow vulnerability, Format String attack, Cross Site Scripting, SQL injection Attacks, Denial-of-Service (DoS), Sniffing, Spoofing and Email security. Malware: Backdoors, Trojan horse, Viruses and it's Characteristics, Working, Infection Phases, Worms, Zombie. **Security Systems:** Intrusion Detection System, need and types of IDS, Intrusion Prevention Systems; Firewalls: functionality, Polices and

Access Control, Packet filters, Application level gateway; Anti-Intrusion Technique: Honey pot; Anti-virus.

Unit IV:

Advance Concepts of IS: Introduction to Identity based Cryptography, Data Hiding and It's applications, Data hiding techniques: Steganography, Watermarking; Cloud Security; Biometric Security; Introduction to Computer Forensic, Hacking, Cyber Crime.

Text Books:

1. Cryptography and Network Security – B. Forouzan, McGraw-Hill.
2. William Stalling, "Cryptography and Network security", Pearson.
3. Cryptography & Network Security: AtulKahate, TMH.
4. Matt Bishop, Computer Security- Arts and Science, Pearson Education, 2003.
5. Pieprzyk et.al, Fundamentals of Computer Securiry, Allied Publishers, 2004.
6. Rebecca Gurley Bace, Intrusion Detection, Technology Series MTP 2007.

SM-717: Cloud Computing Credits: 4 (2-1-2)

Objective:

The main objective of this subject is to help student to understand Cloud and It's Services, Architecture, Deployment, Core Issues, Strengths and limitations of cloud computing.

COURSE DESCRIPTION:

UNIT I: Introduction to Cloud Computing

Overview of Cloud Computing, History of Cloud Computing, Importance of Cloud Computing, advantages and disadvantages of Cloud Computing, Applications, Cloud computing vs. Cluster computing vs. Grid computing, Future of Cloud Computing; Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Cloud Service Models(XaaS), Deployment Models (Public cloud, Private cloud, Hybrid cloud).

Unit II: Cloud Service Models and Virtualization

Infrastructure as a Service (IaaS): Introduction, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Virtual Machine(VM), Resource Virtualization(Server, Storage, Network),VMware vSphere, Machine Image ,Porting Applications Case study on Amazon EC2;Platform as a Service(PaaS): Introduction to PaaS, advantages and disadvantages of PaaS, case study on Microsoft Azure; Software as a Service(SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS; Development Services and Tools : Amazon Ec2, Google App Engine, IBM Clouds.

UNIT III: Capacity Planning

Defining Baseline and Metrics, Baseline measurements, System metrics, Load testing, Resource ceilings, Server and instance types, Network Capacity, Scaling.Understanding Service Oriented Architecture, Moving Applications to the Cloud, Working with Cloud-Based Storage, Working with Productivity Software.

UNIT IV: Managing the Cloud

Administrating the Clouds, Cloud Management Products; Cloud Security: Security Overview, Cloud Security Challenges and Risks, Security Governance, Risk Management: Security Monitoring, Security Architecture Design, Data Security, Application Security, Virtual Machine Security, Identity Management and Access Control, Authentication in cloud computing, Client access in cloud, Cloud contracting Model. Using the Mobile Cloud: Working with Mobile Devices and Working with Mobile Web Services;

Case Studies on Various Clouds: Google Web Services, Amazon Web Services, Microsoft Cloud Services, IBM Clouds, Eucalyptus.

Text Books:

1. Kris A Jamsa: Cloud computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More 2013Jones & Bartlett Learning ISBN-13: 9781449647391.
2. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH, 2009.
4. Sosinsky B., "Cloud Computing Bible", Wiley India
5. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011.
6. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.

SM-718: Information Architecture Credits: 4 (3-1-0)

Objective: The main objective of this course is to help students in mapping, structuring and visualizing functions and applications of information architectures in a variety of complex systems.

COURSE DESCRIPTION:

UNIT I: Information Architecture: Definition, importance of IA, Challenges for Information Architects Information Architecture Specialists. The "Too-Simple" Information Model, Information Architecture and Related Disciplines. Web 2.0: Web 2.0 Applications and Products; Future of Information Architecture. The essential eight factors: Categories, Understanding, Presentation, Evolution, Knowledge, Responsibility, Process, Meta levels.

Unit II: Basic Principles of IA: Visualizing Information Architecture, Information Architecture Component, Organization Systems: Challenges of organizing Information, organizing website and Intranets, Organization scheme and structure, Social classification, creating Cohesive organization. Labeling Systems: Varieties of Labels, Designing Labels; Navigation Systems: Types of Navigation System, Building Context, Improving Flexibility, Embedded Navigation Systems, Supplemental Navigation Systems, Advanced Navigation Approaches.

UNIT III: Search Systems: Search System Anatomy, Choosing What to Search, Search Algorithms, Query Builders, Presenting Results, Designing the Search Interface. Process and Methodology:

Research, Process Overview, Research Framework, Context, Content and Users. Strategy: Developing the Strategy, Work Products and Deliverables, Strategy Report, Project Plan. Design and Documentation: Blueprint Wireframes, Content Mapping and Inventory, Content Models, Controlled Vocabularies, Design Collaboration.

UNIT IV: Information Architecture in Practice: Practicing Information Architecture in the Real World, Education, Ethics, Building Information, Architecture Team, Tools and Software; Information Architecture in the Organization: Business Strategy, Enterprise Information Architecture(EIA) strategy, Designing, and operations. Case Studies: MS Web: An Enterprise Intranet, evolt.org: An Online Community.

Text Books:

1. Peter Morville & Louis Rosenfeld Information Architecture for the World Wide Web, 3rd Edition, ISBN 978-0-596-52734-1.
2. Wei Ding, Xia Lin Information Architecture: The Design and Integration of Information Spaces, Morgan & Claypool Publishers.
3. Roger Evernden and Elaine Evernden, Information First: Integrating Knowledge and Information Architecture for Business Advantage, Elsevier Butterworth-Heinemann.
4. Donna Spencer, A Practical Guide to Information Architecture, Five Simple Steps.
5. Andrea Resmini& Luca Rosati"Pervasive Information Architecture" ISBN 978-0-12-382094-5.

SECOND SEMESTER:

SM-721: Mathematical Modelling Credits: 4 (3-1-0)

COURSE OBJECTIVE

This course exposes the students in mathematical tools for exploring and studying real world problems. The overall objective of this course is to provide an introduction to the process of mathematical modelling while giving students an opportunity to

- develop and construct appropriate models for various problem situations,
- analyze given models to uncover underlying assumptions, and
- investigate particular problems to find out what has already been done toward developing solutions.

COURSE DESCRIPTION:

Unit -I:

System modelling, classification of models, validation and verification. Systems, reservoirs, processes, converters, interrelationships. Uses of systems models. A systems approach: systems thinking, feedback-positive, negative.

Basic modelling concepts, building blocks, modelling of growth or decay-linear, exponential, logistic, overshoot or collapse, oscillation. Strategies for analysing and using systems models. Analysing a model, applying the strategy-problem definition, model validation, exploratory analysis, case analysis.

Unit-II:
Modelling predator-prey systems-problem definition, background information, difference equations, steady state solution. Modelling the dynamic deer-wolf system. Modelling surface water contamination-problem definition, background information, difference equations, steady state solution. Modelling the dynamic DO system.

Unit-III:
Modelling matter cycling in ecosystems-problem definition, background information, difference equations, steady state solution. Modelling the dynamic phosphorus system. Modelling mobile source air pollution inventories-problem definition, background information, difference equations, steady state solution. Modelling the dynamic mobile source emissions system.

Unit-IV:
Modelling greenhouse gases and global warming-problem definition, background information, difference equations, steady state solution. Modelling the dynamic greenhouse gas system. Modelling atmospheric chemistry and pollution transport-problem definition, background information, difference equations, steady state solution. Modelling the dynamic acid deposition system.

TEXTBOOKS
Deaton Michael L., Winebrake James J.: Dynamic Modelling of Environmental Systems. Springer.
Brian Albright: Mathematical Modelling with excel
Meerschaert, M., Mathematical Modeling, Academic Press, Fourth Edition

SM-722: System Simulation Credits: 4 (2-1-2)

COURSE OBJECTIVE
This course exposes the students in simulation modelling, solving and analysing business and industrial problems using simulation models.

COURSE DESCRIPTION:

Unit -I:
System simulation, simulation terminology, applications of simulation, Simulation steps, advantages and disadvantages of simulation. Monte Carlo (MC) simulation. An inventory simulation. A waiting line simulation.

Basic probability and statistics. Random variables and their properties, simulation output data and stochastic processes, estimation of means, variances, and correlations, confidence intervals, and hypothesis testing, Strong law of large numbers.

Unit-II:
Generation of Random Numbers: Pseudo random numbers: Pseudorandom numbers and algorithm for generating them-mid-square method, linear congruential method, additive congruential method, quadratic congruential method. Testing and validating of pseudo random sequences.

Generating random variants: inverse-transform method; generating continuous Random variates: uniform, exponential; generating discrete random variates: Binomial, Poisson.

Variance reduction techniques, Experimental design.

Unit-III:
Discrete-Event Simulation: Time advance mechanisms. Components and Organization of a discrete event simulation model. Simulation of a single-server queuing system. Simulation of an inventory system.

Simulation Languages: Comparison of simulation languages with general purpose languages. Classification of simulation software. Desirable software features. Simulation language – GPSS / SIMSCRIPT – II.5.

Unit-IV:
Building valid and credible simulation models, determining the level of model detailing, techniques for increasing model validity and credibility. Output data analysis.

TEXTBOOKS
Averill M. Law: Simulation Modeling & Analysis, Tata McGraw-Hill
Geoffrey Gordon: System Simulation, Prentice Hall of India
David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management

SM-723: Enterprise Resource Planning Credits: 4 (3-1-0)

Objective:
The main objective is to help student to understand strategic importance of ERP in business process and how to create competitive advantage from managerial point of view.

COURSE DESCRIPTION:

UNIT I:
Introduction to ERP, Need of ERP, Evolution of ERP, ERP and Related Technologies, Business Intelligence, E-Commerce and E-Business, Business Process Reengineering, Decision Support Systems (DSS), Executive Support Systems (ESS), Data Warehousing, Data Mining, OLTP, OLAP, Product life Cycle management, SCM, CRM, M-Commerce.

UNIT II:
ERP Business Modules: Finance, Manufacturing, Human Resources, Plant maintenance, Materials Management, Production Planning, Quality management, Marketing, Sales, Distribution andservice.

UNIT III:
ERP Implementation: Implementation Challenges, Strategies, Life Cycle, Pre-implementation Tasks,Requirements Definition, Methodologies, ERP Package selection, Project Planning, Project Teams, Process Definitions, role of Vendors and Consultants, Project management, End User Training, Testing, Post Evaluation and Maintenance.

UNIT IV:

ERP in Market place: Dynamics, SAP AG, Oracle, PeopleSoft, JD Edwards, QAD Inc, SSA Global, Lawson Software, Baan, Enterprise, Epicor, Intutive. Application Integration: ERP and E-Business, ERP II, Total qualitymanagement, Future Directions, Trends in ERP. Case studies of ERP Implementations.

Text Books:

1. Alexis Leon, “ERP DEMYSTIFIED”, Tata McGraw Hill, Second Edition, 2008.
2. V. K. Garg& N. K. Venkita Krishnan, “ERP Concepts & Planning”.
3. V. K. Garg& N. K. Venkita Krishnan, “ERP Ware: ERP Implementation Framework”.
4. Joseph A Brady, Ellen F Monk, Bret Wagner, “Concepts in Enterprise Resource Planning”, Thompson Course Technology, USA, 2001.
5. Mary Sumner, “Enterprise Resource Planning”, Pearson Education, 2007.

SM 724: Project Management Credits: 4 (2-1-2)

Course Objective: This course is aimed at providing both basic and some advanced exposure to Project Management, so as to enable the manager of tomorrow to successfully complete sophisticated projects within the constraints of capital, time, and other resources.

UNIT I: Introduction, Project Management Purpose, Project, Project Management, Relationships - Portfolio Management, Program Management, Project Management, Operations Management, Organizational Project Management and Organizational Strategy, Business Value, Project Manager Role. Organizational Influences on Project Management, Project Stakeholders & Governance, Project Team, Project Life Cycle, Project Management & Information Technology Context, System view of Project Management, Context of Information Technology Projects.

Project Management Process Groups (Initiating, Planning, Executing, Monitoring & Controlling, Closing), Project Management Processes & Knowledge Areas. Common Process Interactions. Project Integration Management, Processes -Develop Project Charter, Develop Project Management Plan, Direct and Manage Project Work, Monitor and Control Project Work, Perform Integrated Change Control, Close Project or Phase

UNIT II: Project Scope Management, Processes - Plan Scope Management, Collect Requirements, Define Scope, Create WBS, Validate Scope, Control Scope. Project Time Management, Processes - Plan Schedule Management, Define Activities, Sequence Activities, Estimate Activity Resources, Estimate Activity Durations, Develop Schedule, Control Schedule

Project Cost Management, Processes - Plan Cost Management, Estimate Costs, Determine Budget, Control Costs. Project Quality Management, Processes - Plan Quality Management, Perform Quality Assurance, Control Quality.

UNIT III: Project Human Resource Management, Processes - Plan Human Resource Management, Acquire Project Team, Develop Project Team, Manage Project Team. Project Communications Management, Processes - Plan Communications Management, Manage Communications, Control Communications.

Project Risk Management, Processes -Plan Risk Management, Identify Risks, Perform Qualitative Risk Analysis, Perform Quantitative Risk Analysis, Plan Risk Responses, Control Risks. Project Procurement Management, Processes - Plan Procurement Management, Conduct Procurements, Control Procurements, Close Procurements.

UNIT IV: Project Stakeholder Management, Processes - Identify Stakeholders, Plan Stakeholder Management, Manage Stakeholder Engagement, Control Stakeholder Engagement. Project Management Styles in Industry, Agile Methodology, Scrum, Lean, Extreme, Benefits Realization Model.

Text Books:

1. Information Technology Project Management, Kathy Schwalbe, 5th Edition, Thomson
2. Project Management Prassana Chandra
3. Project Management Mantle, Meredith
4. PMBOK 5th Edition, PMI
5. Head First Project Management
6. Project Management by Kim Heldman

SM-725: Data Mining and Data warehousing Credits: 4 (2-1-2)

Objective:
The main objective of this course is to provide understanding of data warehouse fundamentals and data mining techniques for business applications.

COURSE DESCRIPTION:

UNIT I:
Data Warehousing: Introduction data warehousing, Data Mart, Data Warehouse Architecture; Star, Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning. OLAP technology, Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, Indexing data.

UNIT II:
Data Mining: Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining; Data Processing: Data Cleaning, Data Integration and Transformation; Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Data Discretization and Concept hierarchy generation for numerical and categorical data. Web Mining: Introduction, Web Content Mining, Web Structure Mining, Web Usage Mining; Spatial Mining, Text Mining.

UNIT III:

Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, FP-Growth Algorithm, Time series mining association rules, latest trends in association rules mining.

UNIT IV:
Classification methods: Decision tree, Bayesian Classification, Association Rule based; Prediction: Linear and non-linear regression; Categories of clustering methods, Partitioning methods: K-Means, K-Mediods. Hierarchical Clustering: Agglomerative and Divisive Clustering, BIRCH and ROCK methods, DBSCAN, Outlier Analysis. Data Mining for Business Intelligence Applications

Text Books:

1. P.Ponnian, "Data Warehousing Fundamentals", John Weliey.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.
3. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education.
4. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", Wiley India.
5. Michael Berry and Gordon Linoff "Data Mining Techniques",Wiley Publications.
6. M.H.Dunham, "Data Mining Introductory & Advanced Topics", Pearson Education.

SM-726: E-Business and E-Governance Credits: 4 (3-1-0)

Objective:
The main objective of this course is to help students to understand underlying technologies infrastructure of e-business and e-governance.

COURSE DESCRIPTION:

UNIT I: introduction to e-Business, principles of e-Business Model and its elements
B2C, B2B, C2C, Storefront model, click and Mortar model, service provider model, prepaid access model. Porter's Value Chain Model. Competitive Strategy, Porter's Model; benefits and limitations of e-business.

UNIT II: Impact of e-Business on Different Fields
Internet Marketing and e-Tailing, e-Tourism, Employment and Job Market Online, Online Real Estate, e-Banking, On-Demand Delivery Systems and E-Grocers, Online Delivery of Digital Products, Entertainment, and Media; e-Learning and Online Education: benefits and drawbacks of e-Learning, technologies used in e-Learning; e-selling Process, e-buying Planning, e-Procurement.

UNIT III: E-Governance
Introduction to e-governance, issues in e-governance , evolution of e-governance, benefits and limitations of e-governance,e-governance models- broadcasting, critical flow, comparative analysis, mobilization and lobbying,interactive services / G2C2G. E-readiness, e-Framework, step & issues, applications of data warehousing and data mining in e-government, Challenges to e-government security.

UNIT IV: Case studies

NICNET-role of nationwide networking in e-governance, e-bhoomi, IT in Indian Judiciary, E-khazana for government Treasury Andhra Pradesh, PRAJA Rural e-Seva, E-Seva-new Paradigm in citizen Services, sachivalayavahini or E-governance in Secretariat, EkalSeva Kendra, computerization in Andhra Pradesh State Trading Corporation; Case study on E-Business.

Text Books:

1. Daniel Amor, The E-Business Revolution: Living and Working in an interconnected World, Prentice Hall.
2. H. M. Deitel, P. J. Deitel and T. R. Nieto, E-Business and E-Commerce: How to Programe, Prentice hall.
3. C.S.R. Prabhu, "E-governence: concept and case study", PHI Learning Private Limited.
4. J. Satyanarayan, "E-government: The science of the possible", PHI Learning Private Limited
5. Backus, Michiel, e-Governance in Developing Countries, IICD Research Brief, No. 1, March 2001.

SM-727: Big Data Analytics Credits: 4 (2-1-2)

UNIT I

Introduction to BigData, Big Data Overview, Platform, Challenges of Conventional Systems, Intelligent data analysis, Analytic Processes and Tools, Analysis vs Reporting, Modern Data Analytic Tools. Introduction to Data Science: Data Science Process, Data Science for Business. Identifying problem and solving problem in data science. Data: Unstructured vs. Structured Data, Databases. Role of Data Scientist, Data Analyst, Business Analyst.

UNIT II

Introduction to Hadoop, Hadoop architecture, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases; Hadoop Distributed File system: Design of HDFS, HDFS Concepts, Command-Line Interface, Hadoop File systems Java Interface, Hadoop Archives;

UNIT III

Introduction to MapReduce: Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop, Hadoop Streaming, Hadoop Pipes, Functional programming with Mappers and Reducers. MapReduce Working, types and file formats, features; Setting up Hadoop Cluster;

UNIT IV

Pig: Installing and Running Pig, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators; Hive: Installing Hive, Running Hive, Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User-Defined Functions; HBase: HBasics, Concepts, Installation,Clients, HBase Versus RDBMS, Praxis; Fundamentals of Zookeeper and Sqoop.

Text Books:

1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, JohnWiley & sons, 2012
2. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons, 2007.
3. Pate Warden, “Big Data Glossary”, O’Reilly 2011.
4. Tom White,"Hadoop: The Definitive Guide", 3rd Edition, O'Reilly Media, 2012.
5. Donald Miner, Adam Shook, Eric Sammer, “Hadoop Operation”, O’Reilly 2012.
6. Donald Miner, Adam Shook “MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems”, O’Reilly 2012.
7. Chuck Lam, "Hadoop in Action", Manning Publications, 2010.

SM-728: Artificial Intelligence and Neural Networks Credits: 4 (2-1-2)

Objective: The main objective is to help students to understand the fundamentals of Artificial Intelligence for design intelligent System.

COURSE DESCRIPTION:

UNIT I:
Introduction to artificial intelligence, History of AI, production system, Problem solving: Characteristics of production systems, Study and comparison of breadth first search and depth first search. Techniques, other Search Techniques like hill Climbing, Best first Search. A* algorithm, AO* algorithms. Knowledge and Reasoning: Knowledge Representation, Problems in representing knowledge, knowledge representation using propositional and predicate logic, comparison of propositional and predicate logic, Resolution, refutation, deduction, theorem proving, inferencing, monotonic and non-monotonic reasoning, Semantic networks, scripts, schemas, frames, conceptual dependency, forward and backward reasoning.

UNIT II:
Adversarial Search: Game playing techniques like minimax procedure, alpha-beta cut-offs; Introduction to learning, various techniques used in learning. Intelligent Agents: Agent Environments, Concept of Rational Agent, Structure of Intelligent agents, Types of Agents. Expert systems and its components, Decision Support System and integrating expert and decision support system, Introduction to Natural Language Processing.

UNIT III:
Neural Network: biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervise & Unsupervised) and activation function. Supervised Learning: Perceptron learning, Single layer/multilayer, linear Separability, Adaline, Madaline, Back propagation network, RBFN. Application of Neural networks in forecasting.

UNIT IV:
Unsupervised learning: Kohonen SOM, Counter Propagation, Full Counter Propagation NET and Forward only counter propagation net, ART, Applications of Neural network. Introduction to GA, Simple Genetic Algorithm, terminology and operators of GA, GA implementation using MATLAB. Introduction to Fuzzy Logic: Basic Definition and Terminology, Set-theoretic Operations, Member Functions.

Text Books:

1. S. Russel and P. Norvig, “Artificial Intelligence – A Modern Approach”, Second Edition, Pearson Education, 2003.
2. Rich E and Knight K, “Artificial Intelligence”, TMH, New Delhi.
3. Nelsson N.J., “Principles of Artificial Intelligence”, Springer Verlag, Berlin.
4. S.N. Shivnandam, “Principle of soft computing”, Wiley.
5. S. Rajshekaran and G.A.V. Pai, “Neural Network , Fuzzy logic And Genetic Algorithm”, PHI.
6. Simon Haykins, “Neural Network- A Comprehensive Foundation”.
7. Timothy J.Ross, “Fuzzy logic with Engineering Applications”, McGraw-Hills.

School of Future Studies and Planning
Syllabus for Ph.D. Course Work

RFS-801: Research Methodology (5 credits):

Unit I:

Foundation of Research: Motivation and objectives – Research methods *vs* Methodology. Types of research – Descriptive *vs*. Analytical, Applied *vs*. Fundamental, Quantitative *vs*. Qualitative, Conceptual *vs*. Empirical. Research Methodology: An Introduction, Research Design: defining and formulating the research problem - selecting the problem - necessity of defining the problem, Methods of Data Collection: Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review, Sampling, Measures of Central Tendencies and Dispersion, Correlation and Regression. Development of working hypothesis, Testing of Hypotheses: Meaning, Basic concepts, Null hypothesis – Alternate Hypothesis – Two types of errors levels of significance of a test – power of a Test. Limitations of Tests of hypothesis. t-test, F-test, Chi-Square test. Analysis and Presentation of Data. Cluster analysis. Factor analysis. Two-variable linear Regression model: Basics, Problem of Estimation, Classical linear Regression Model. Extensions of the Two variable linear model, Multiple Regression Model: Estimation and Inference.

Unit II:

Basic steps in forecasting. Basic forecasting tools: time series and cross sectional data, graphical and numerical summaries, forecasting accuracy, prediction intervals, transformations and adjustments. Time series-moving averages, exponential smoothing methods, ARIMA, comparison of methods. Brain storming and brain writing methods, Delphi method, Growth curves, substitution curves, Pearl curve, Gompertz curve, Fisher-Pry curve, selection of proper growth curve, estimation of upper limit. Trend extrapolation-exponential trends, non exponential growth, qualitative trends. Combining forecasts-trend and growth curves, trend and analogy, components and aggregates, scenarios, cross impact models. Normative methods-relevance trees, morphological models, mission flow diagrams.

Unit III:

Introduction to Linear Programming, Formulation of LP models, Solution of LP models-Graphical Method, Simplex Method. Transportation model, Assignment model, Goal programming, Integer programming.

Unit IV:

Systems approach: Systems thinking, feedback-positive & negative, steady state behaviour. System dynamics methodology: reservoirs, processes, converters, interrelationships. Modelling concepts. Applications to different systems.

Unit V:

The Structure of the Dissertation, Literature Review: Purpose, Finalising Dissertation Topics and Statement of the Problem, Formulating Hypotheses and Research Questions, Identifying the Methodology to be used, Preparing the Bibliography, Dissertation Titles and Draft Proposals, Dissertation Chapters and time-line, Proposal Presentation and Approval.

Essential Readings:

1. C.R.Kothari, Research Methodology: Methods and Techniques, New Age International Publishers
2. H.A.Taha, Operations Research: An Introduction, Pearson

3. Michael L Deaton, James J. Winebrake, Dynamic Modelling of Environmental Systems, Springer
4. Spyros Makridakis, Steven C Wheelright, Rob J Hyndman, Forecasting Methods and Applications, Wiley
5. Joseph P Martino, Technological Forecasting for Decision Making, Mc Graw Hill
6. Oliver, Paul, Writing Your Thesis, New Delhi: Sage.
7. Mauch, James E. and Jack Birch, Guide to the Successful Thesis and Dissertation: A Handbook for Students and Faculty, CRC Press, New York

RFS-802: Computer Applications (3 Credits):
MS Word, MS Excel, MS Power point, SPSS, MATLAB/ SCI Lab., TORA.

RFS-803: Literature Review (3 Credits)

RFS-804: Comprehensive Via Voce (4 credits)

M.Tech. in Future Studies and Planning

Specialization in Data Analytics

Programme Structure:

Batch: 2015-17

First Semester:

Code	Title	Credits (L-T-P)
CORE COURSES		
FS-701	Forecasting Methods	4 (2-1-2)
FS-703	Operations Research	4 (2-1-2)
FS-705	Statistical Research Methods	4 (2-1-2)
FS-707	RDBMS and NOSQL	4 (2-1-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two)		
FS-711	Supply Chain Management	4 (3-1-0)
FS-713	Information Architecture	4 (3-1-0)
FS-715	Statistical Programming in R	4 (2-1-2)
ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus.		
FS-721	Technical Communication	4 (3-1-0)

Second Semester:

Code	Title	Credits (L T P)
CORE COURSES		
FS-702	Technology Forecasting	4 (3-1-0)
FS-704	Data Mining for Analytics	4 (2-1-2)
FS-706	Big Data Analytics	4 (2-1-2)
FS-708	Python for Analytics	4 (2-1-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two)		
FS-712	Machine Learning	4 (3-1-0)
FS-714	Industrial Engineering and Systems	4 (3-1-0)
FS-716	System Dynamics	4 (2-1-2)
FS-718	Multivariate Analysis	4 (2-1-2)
ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus.		
FS-722	Decision Analysis	4 (2-1-2)

Third & Fourth Semesters:

Code	Title	Credits
FS-800	M.Tech. Thesis	40

Note: The above course contents can be modified as per requirement from time to time in accordance with University Ordinance No. 31.

DETAILED SYLLABUS

FIRST SEMESTER:

FS-701: Forecasting Methods Credits: 4 (2-1-2)

COURSE OBJECTIVE

This subject is designed in such a way to provide the basic concepts of forecasting models based on quantitative analysis. Risk and uncertainty in forecasting and it is generally considered good practice to indicate the degree of uncertainty attaching to forecasts.

COURSE DESCRIPTION:

Unit I: Introduction: Fo**re**casting perspective, an overview of forecasting methods, basic steps in forecasting. Basic forecasting tools: time series and cross-sectional data, graphical and numerical summaries, forecasting accuracy, prediction intervals, transformations and adjustments.

Unit II: Time series: Decomposition, principles of decomposition, moving averages, classical decomposition, census bureau methods, forecasting and decomposition.

Unit III: Exponential smoothing: averaging methods, Single exponential smoothing methods, ARRSES, Double exponential soothing method, comparison of methods, general aspects of smoothing methods.

Unit IV: Regression: Simple regression, forecasting with simple regression, non-linear relationships. Multiple regressions. Box-Jenkins methods: examining correlations in time series data, examining stationary, ARIMA models, forecasting with ARIMA models.

Text Book(s)—

1. Spyros Makridakis :Forecasting Method's and application Wiley
2. N.P. Nagpal :Forecasting Techniques ,RBSA
3. Stephen A. Delurgio: Forecasting Principals and Application,McGraw Hill

FS-703: Operations Research Credits: 4 (2-1-2)

COURSE OBJECTIVE

This course exposes the students in mathematical modelling, solving and analysing business and industrial problems using operations research methods.

COURSE DESCRIPTION:

Unit -I:

Introduction, History, Development of Operations Research, Characteristics of Operations Research, Models in Operations Research, Principles of Modelling. Pre-modelling-Need Recognition, Problem Formulation. Modelling-Model development, Data collection, Model solution, Model validation, and sensitivity analysis. Post-modelling-Interpretation of results and implications, Decision making, Implementation, and Control.

Unit-II:
Linear Programming, Formulation of Linear programming Problems. Solution Methods-Graphical, Simplex, M-Technique, Two-Phase. Special cases of LP problems. Duality, Primal-dual relationships, Dual simplex method. Sensitivity analysis. Solving LP problems using computer software.

Unit-III:
Transportation Model-Formulating the model, Initial Feasible Solution-North-West Method, Least Cost Method, Vogel's Approximation Method. Optimum Solution-MODI method, Stepping Stone Method. Special issues of transportation problems. Assignment Model: Formulating the model, Solving the assignment problem using Hungarian method. Special issues of assignment problems.

Integer programming: Types of integer programming problems, Formulating the model, Solution using Branch and bound method. Dynamic Programming.

Solving the problems using computer software.

Unit-IV:
Network models: Minimal spanning tree algorithm, Shortest-route problem, Maximal flow model, Minimum –cost capacitated flow problem. Project Scheduling: CPM and PERT.

Inventory models: Functions of inventory, information requirements for inventory management-demand, lead time, inventory costs, and quantity on hand. Objectives of inventory management. Economic Order Quantity Models-Economic order size, economic production run, quantity discounts. Determining the reorder point. Material Requirement Planning.

Queuing Models: Goals, elements and characteristics of queuing systems, Measures of system performance, Waiting line models-single channel, multiple channel. Cost considerations.

TEXT BOOKS
Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
William J. Stevenson: Introduction to Management Science, IRWIN.

FS-705: Statistical Research Methods Credits: 4 (2-1-2)

Objective:
This course will familiarize students with the rudiments of statistical theory and ready them for effective academic and professional practice in the field of research process of industrial, system and social Science.

COURSE DESCRIPTION:

Unit I: Introduction to Research Methods and Measures of central tendency
Meaning and Objectives of Research, Significance of Research, Arithmetic Mean, Geometric Mean, Harmonic Mean, Median, Mode. Mean deviation, Standard deviation, Variance, Co-efficient of variation.

Unit II: Probability and Statistical Distribution

Binomial distribution, Poison distribution and Normal distributions, Fitting of Normal Curve. Concept of Probability, Theorems of Probability, Conditional Probability, Baye's Theorem, Random Variable and Probability distribution.

Unit III: **Correlation and Regression Analysis**
Types of correlation, Methods of Correlation, Co-efficient of correlation, Properties of correlation, Rank Correlation. Difference between correlation and regression, Regression Lines, Regression Equations.

Unit IV: Testing of Hypothesis
Procedure of Testing Hypothesis, Standard Error and Sampling distribution, Estimation, Student's t-distribution, Chi-Square test and goodness of fit, F-test and analysis of variance.

Text Books:
S.P. Gupta: Statistical Method, S. Chand
C.K. Kothari: Research Methodology, New Age International

FS-707: RDBMS and NoSQL Credits: 4 (2-1-2)

Objective: The purpose of this course is to provide fundamental knowledge of relational database management system and SQL to students. Student will also learn new mechanism of storage and retrieval of data, NoSQL.

UNIT I

Overview of DBMS: Comparison between Database approach and Traditional file accessing approach, Advantages of database systems, Schemas and instances, Data Dependency, Data Dictionary, and Meta Data. Data models, Types of Data models (Object Oriented, Record Based and Physical data models), E-R Modelling;

UNIT II

Relational Data model: Domains, Tuples, Attributes, Keys, Relational database, Schemas, Integrity constraints, Relational algebra and relational calculus; Normalization: Normal forms (INF, 2NF, 3NF, BCNF), Functional dependency, Decomposition, Dependency preservation and lossless join;

UNIT III

Structured Query Language: DDL, DML, DCL, TCL, SQL Functions, integrity constraints, various joins, sub-query, index, View, Sequence, and Clusters.

UNIT IV

NoSQL: Nosql Basics, Storage Architecture, Operations, Query Model, Modifying Data Stores and Managing Evolution, Indexing and Ordering Data Sets, Managing Transactions and Data Integrity. Using Nosql in the Cloud, Scalable Parallel Processing with Mapreduce, Analyzing Big Data with Hive, Surveying Database Internals

Text Books:

1. A Silberschatz, H Korth, S Sudarshan, "Database System and Concepts", fifth Edition McGraw-Hill.
2. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing. Company.
3. Rob, Coronel, "Database Systems", Seventh Edition, Cengage Learning.
4. Fred R.McFadden,Jeffrey A.Hoffer & Marry B.Prescott.?Modern Database Management, Fifth Edition,Pearson Education Asia,2001.
5. Bayross Ivan, "SQL, PL/SQL: The Programming Language Of Oracle", 4th Revised Edition, BPB Publications, 2010.
6. Tiwari Shashank , "Professional Nosql", Wiley India Pvt Ltd, 2011.

FS-711: Supply Chain Management Credits: 4 (3-1-0)

Objective: This course will familiarize students how Supply chain management is used in organization for effective outcomes by increasing productivity and efficient use of sources.

COURSE DESCRIPTION:

Unit I: Introduction to Supply Chain Management: Concept, Scope, Objectivesand importance of supply chain, Supply chain components, Drivers of supply chainmanagement. Achieving strategicPlanning Demand and Supply Chain.Aggregate Planning in a Supply Chain: Managing Supply and Demand, Models forSupply Chain.

Unit II: Managing Inventory - Role of Cycle Inventory, Estimating Cycle Inventory EOQ,Role of Safety Inventory, Determining Level of Safety Inventory. Estimating and ManagingSafety Inventory.

Unit III: Transportation and Facility Decisions: Factors Affecting Transportation and NetworkDesign Decisions. Modes of Transportation, Routing and Scheduling in Transportation.Models for Facility Location Capacity Allocation.

Unit IV: Third Party Logistic Retailer
Supplier's relationships Types and Key issues: DistributionIntegration, Types and Key Issue in Procurement and Outsourcing Strategies. IT and e-businessin supply chain management.Importance and use of information in supply chainInfrastructure and Interface Devices. Case Studies

Text Book(s)—
Sunil Chopra, Peter Meindl :Supply Chain Management, Pearson
Sameer k Shrivastava: Business Logistic and Supply Chain Management, Pearson

FS-713: Information Architecture Credits: 4 (3-1-0)

Objective: The main objective of this course is to help students in mapping, structuring and visualizing functions and applications of information architectures in a variety of complex systems.

COURSE DESCRIPTION:

UNIT I: Information Architecture: Definition, importance of IA, Challenges for Information Architects Information Architecture Specialists. The "Too-Simple" Information Model, Information Architecture and Related Disciplines. Web 2.0: Web 2.0 Applications and Products; Future of Information Architecture. The essential eight factors: Categories, Understanding, Presentation, Evolution, Knowledge, Responsibility, Process, Meta levels.

Unit II: Basic Principles of IA: Visualizing Information Architecture, Information Architecture Component, Organization Systems: Challenges of organizing Information, organizing website and Intranets, Organization scheme and structure, Social classification, creating Cohesive organization. Labeling Systems: Varieties of Labels, Designing Labels; Navigation Systems: Types of Navigation System, Building Context, Improving Flexibility, Embedded Navigation Systems, Supplemental Navigation Systems, Advanced Navigation Approaches.

UNIT III: Search Systems: Search System Anatomy, Choosing What to Search, Search Algorithms, Query Builders, Presenting Results, Designing the Search Interface. Process and Methodology: Research, Process Overview, Research Framework, Context, Content and Users. Strategy: Developing the Strategy, Work Products and Deliverables, Strategy Report, Project Plan. Design and Documentation: Blueprint Wireframes, Content Mapping and Inventory, Content Models, Controlled Vocabularies, Design Collaboration.

UNIT IV: Information Architecture in Practice: Practicing Information Architecture in the Real World, Education, Ethics, Building Information, Architecture Team, Tools and Software; Information Architecture in the Organization: Business Strategy, Enterprise Information Architecture(EIA) strategy, Designing, and operations. Case Studies: MS Web: An Enterprise Intranet, evolt.org: An Online Community.

Text Books:

1. Peter Morville & Louis Rosenfeld Information Architecture for the World Wide Web, 3rd Edition, ISBN 978-0-596-52734-1.
2. Wei Ding, Xia Lin Information Architecture: The Design and Integration of Information Spaces, Morgan & Claypool Publishers.
3. Roger Evernden and Elaine Evernden, Information First: Integrating Knowledge and Information Architecture for Business Advantage, Elsevier Butterworth-Heinemann.
4. Donna Spencer, A Practical Guide to Information Architecture, Five Simple Steps.
5. Andrea Resmini& Luca Rosati"Pervasive Information Architecture" ISBN 978-0-12-382094-5.

FS-715: Statistical Programming in R Credits: 4 (2-1-2)

Objective: This course is an introduction to R, a powerful and flexible statistical language and environment that also provides more flexible graphics capabilities than other popular statistical packages. After taking this course, students will be able to –

1. Use R for statistical programming, computation, graphics, and modeling,
2. Write functions and use R in an efficient way,
3. Fit some basic types of statistical models,

4. Use R in their own research,
5. Be able to expand their knowledge of R on their own

COURSE DESCRIPTION:

Unit I: Introduction to R programming language: Getting R, Managing R, Arithmetic and Matrix Operations, Introduction to Functions, Control Structures. Working with Objects and Data: Introduction to Objects, Manipulating Objects, Constructing Data Objects, types of Data items, Structure of Data items, Reading and Getting Data, Manipulating Data, Storing Data.

Unit II: Data Distribution and Statistical Testing: Types of Data distribution, Normal distribution, Poisson distribution, Random number generation, Chi-Square Testing, Student's t-test, F-test, Monte Carlo Simulation.

Unit III: Graphical Analysis using R: Basic Plotting, Manipulating the plotting window, Box-Whisker Plots, Scatter Plots, Pair Plots, Pie Charts, Bar Charts.

Unit IV: Advanced R: Statistical models in R, Correlation and regression analysis, Analysis of Variance (ANOVA), creating data for complex analysis, Summarizing data, and case studies.

Text Books:

1. Mark Gardener: Beginning R: The Statistical Programming Language, Willey publications
2. Norman Matloff: The Art of R Programming: A Tour of Statistical Software Design, OREILLY & Associates Inc.

FS-721: Technical Communication Credits: 4 (3-1-0)

Objective:

This course is designed to help the students to develop skills that will enable them to produce clear and effective scientific and technical documents.

Unit I:

Technical writing: Definition, Similarities to other writings, Unique features, importance, technical writing as profession, qualifications for technical writing. Identifying audience. Problems involving content, words and phrases, punctuation, unity, coherence, logic, etc. Being concise.

Unit II:

Techniques of Technical Communication. Analysing-Division, Classification, Partition. Defining-Formal, informal, expanded. Describing-subjective versus objective, spatial description, description of mechanism, process, selected details. Illustrating-Tables, graphs, charts, pictorials. Researching-Basic types of research, original research, searching the literature. Abstracting of your own reports, the works of others, precautions. Oral communication-one to one reporting, participation in conferences, speaking to large audiences, organising the speech.

Unit III:

Basic forms of Technical Writings. The memorandum, The business letter, Formal report.

Unit IV:

Technical reports. Justification reports and proposals, the progress reports, periodic reports, status reports, trip reports. Laboratory reports, Feasibility reports, State-of-the-Art reports. Instructions and manuals.

Text Books:

1. James Sherlock: A Guide to Technical Communication

SECOND SEMESTER:

FS 702: Technology Forecasting Credits: 4 (3-1-0)

Objective: Primarily, a technological forecast deals with the characteristics of technology, such as levels of technical performance, the accuracy or precision of a technology. The forecast does not have to state how characteristics will be achieved. Secondly, technological forecasting usually deals with useful machines, procedures or techniques for society**.**

Unit I: Introduction Technology forecasting- it's meaning and need, alternatives to forecasting, stages of innovation. Delphi: advantages and disadvantages of committees, Delphi procedure, conducting a Delphi based study.

Unit II: Forecasting technology. Growth curves substitution curves, Pearl curve, Gompertz curve, Fisher-Pry curve, selection of proper growth curve, estimation of upper limit.

Unit III: Trend extrapolation- exponential trends, non-exponential growth, qualitative trends etc. Measures of technology-scoring models, constrained scoring models, planar tradeoff surfaces. Correlation models-lead lag correlation, technology progress function, maximum installation size etc.

Unit IV: Causal models-technology only models, techno economic model, simulation model. Forecasting breakthroughs. Combining forecasts-trend and growth curves, trend and analogy, components and aggregates, scenarios, cross impact models. Normative methods-relevance trees, morphological models, mission flow diagrams.

Text Book:

Technological Forecasting by Martino, Joseph Paul New York, American Elsevier Pub. Co. Publication

FS-704: Data Mining For Analytics Credits: 4 (2-1-2)

Objective:

The main objective of this course is to provide understanding of data mining techniques for business analytics services.

COURSE DESCRIPTION:

UNIT I:

Data Mining: Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining; Data Processing: Data Cleaning, Data Integration and Transformation; Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Data Discretization and Concept hierarchy generation for numerical and categorical data. Web Mining: Introduction, Web Content Mining, Web Structure Mining, Web Usage Mining; Spatial Mining, Text Mining.

UNIT II:

Data Warehousing: Introduction data warehousing, Data Mart, Data Warehouse Architecture; Star, Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning. OLAP technology, Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, Indexing data.

UNIT III:

Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, FP-Growth Algorithm, Time series mining association rules, latest trends in association rules mining.

UNIT IV:

Classification methods: Decision tree, Bayesian Classification, Association Rule based; Prediction: Linear and non-linear regression; Categories of clustering methods, Partitioning methods: K-Means, K-Mediods. Hierarchical Clustering: Agglomerative and Divisive Clustering, BIRCH and ROCK methods, DBSCAN, Outlier Analysis. Data Mining for Business Intelligence Applications

Text Books:

1. P.Ponnian, “Data Warehousing Fundamentals”, John Weliey.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.
3. P. N. Tan, M. Steinbach, Vipin Kumar, “Introduction to Data Mining”, Pearson Education.
4. G. Shmueli, N.R. Patel, P.C. Bruce, “Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner”, Wiley India.
5. Michael Berry and Gordon Linoff “Data Mining Techniques”, Wiley Publications.
6. M.H.Dunham, “Data Mining Introductory & Advanced Topics”, Pearson Education.

FS-706: Big Data Analytics Credits: 4 (2-1-2)

UNIT I

Introduction to BigData, Big Data Overview, Platform, Challenges of Conventional Systems, Intelligent data analysis, Analytic Processes and Tools, Analysis vs Reporting, Modern Data Analytic Tools. Introduction to Data Science: Data Science Process, Data Science for Business.

Identifying problem and solving problem in data science. Data: Unstructured vs. Structured Data, Databases. Role of Data Scientist, Data Analyst, Business Analyst.

UNIT II

Introduction to Hadoop, Hadoop architecture, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases; Hadoop Distributed File system: Design of HDFS, HDFS Concepts, Command-Line Interface, Hadoop File systems Java Interface, Hadoop Archives;

UNIT III

Introduction to MapReduce: Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop, Hadoop Streaming, Hadoop Pipes, Functional programming with Mappers and Reducers. MapReduce Working, types and file formats, features; Setting up Hadoop Cluster;

UNIT IV

Pig: Installing and Running Pig, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators; Hive: Installing Hive, Running Hive, Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User-Defined Functions; HBase: HBasics, Concepts, Installation,Clients, HBase Versus RDBMS, Praxis; Fundamentals of Zookeeper and Sqoop.

Text Books:

1. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", JohnWiley & sons, 2012
2. Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007.
3. Pate Warden, "Big Data Glossary", O'Reilly 2011.
4. Tom White,"Hadoop: The Definitive Guide", 3rd Edition, O'Reilly Media, 2012.
5. Donald Miner, Adam Shook, Eric Sammer, "Hadoop Operation", O'Reilly 2012.
6. Donald Miner, Adam Shook "MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems", O'Reilly 2012.
7. Chuck Lam, "Hadoop in Action", Manning Publications, 2010.

FS-708: Python for Analytics Credits: 4 (2-1-2)

Objective: The main objective is to help students to understand the fundamentals of python and student will learn how to analysis data using python.

UNIT I

Introduction to Python: Python versus Java, C, C++, Matlab, R, Python Interpreter and it's Environment, Using the IPython notebook, Python basics: variables, conditionals, loops; Data structures: lists and dictionaries; using objects, classes, function;

UNIT II

Data Handling and Strings, Reading data into memory, Working with strings, Catching exceptions to deal with bad data, Writing the data back out again, Introduction to interfacing Python with other programming languages: C/C++, Fortran, R.

UNIT III

Python and Pandas: Manipulating data from CSV, Excel, HDF5, and SQL databases, Data analysis and modelling with Pandas, Time-series analysis with Pandas, Using Pandas, the Python data analysis library, Series and Data Frames, Grouping, aggregating and applying, Merging and joining, Managing huge hierarchical datasets with PyTables (HDF5) and NetCDF.

UNIT IV

Visualization: Visualization with matplotlib, Figures and subplots, Labeling and arranging figures, Outputting graphics, Introduction to building graphical UIs and web UIs for scientific applications.

Text Books:

1. McKinney Wes, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.
2. Hauck Trent, "Instant Data Intensive Apps with Pandas How-To", Packt Publishing Ltd, 2013.
3. Beazley David M.,"Advanced Python Programming", Pearson Education,2009.
4. Chun Wesley , Core Python Programming, 3rd Edition,Prentice Hall Professional, 2012.
5. Telles Matt "Python Power!: The Comprehensive Guide", Cengage Learning, 2008.
6. McKinney Wes & PyData Development Team, "pandas: powerful Python data analysis toolkit", Release 0.13.1, Feb 2014.

FS-712: Machine Learning Credits: 4 (3-1-0)

Objective: The main objective is to help students to understand the fundamental concepts of machine learning.

UNIT I Introduction

Introduction to Machine Learning, History and Overview of machine learning, Applications, Types of Machine Learning, Basic Concepts. Concept Learning and candidate elimination learning Algorithm.

UNIT II

Artificial Neural Network: biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervise & Unsupervised) and activation function.

Supervised Learning: Perceptron learning, Single layer/multilayer, linear Separability, Adaline, Madaline, Back propagation network, RBFN.

UNIT III

Bayesian Learning, Bayes Theorem, Naïve Bayesian classifier, Bayesian belief, EM Algorithm. Dimensionality Reduction: Factor Analysis, Principal Component Analysis, Linear Discriminant Analysis.

UNIT IV

Markov and Hidden Markov Models, PAC Learning, Support Vector Machine, Evolutionary Learning: Genetic Algorithm, generating offspring, applications and genetic programming.

Text Books:

[1]. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
[2]. Stephen Marsland, "Machine Learning –An Algorithmic Perspective", CRC Press, 2009.
[3]. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
[4]. Ethem Alpaydin, "Introduction to Machine Learning", Prentice Hall of India, 2005.
[5]. Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2006.
[6]. Sanjeev Kulkarni, Gilbert Harman, "An Elementary Introduction to Statistical Learning Theory", 2011.
[7]. N. Shivnandam, "Principle of soft computing", Wiley.

FS- 714: Industrial Engineering and Systems Credits: 4 (3-1-0)

Objective: Industrial engineering and systems deals with the optimization of complex processes or systems. It typically focuses on the development, improvement, implementation and evaluation of integrated systems for industrial practice in product design, process design, plant operation, production control, quality control, facilities planning, work system analysis and evaluation, and economic analysis of operational systems.

Unit I: Introduction – concepts of industrial engineering, history and development of industrial engineering, application. Facility: location factors and evaluation of alternate locations; types of plant layout and their evaluation; computer aided layout design techniques; assembly line balancing; materials handling systems. Productivity – concepts and measurements.

Unit II: Work System Design: Taylor's scientific management, Gilbreths's contributions; method study, micro-motion study, principles of motion economy; work measurement – stop watch time study, work sampling, standard data, PMTS; ergonomics; job evaluation, merit rating, incentive schemes, and wage administration.

Unit III: Product Design and Development: Principles of good product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, concurrent engineering.

Unit IV: Reliability and Maintenance: Reliability, availability and maintainability; distribution of failure and repair times; determination of MTBF and MTTR, reliability models; system reliability determination; preventive maintenance and replacement, total productive maintenance – concept and applications. Limits, fits, Tolerances, Gauges, Comparators, Surface Finish Measurements Wages payment plan: Introduction, classification of wage payment plan, incentive plan. Material purchase and store management: material management, purchasing and procurement, buying technique, store and material control and store record.

Text Books:

1. Industrial Engineering and Management, by O.P. Khanna
2. Operations Management, by William Stevensons, Tata McGraw Hills Publication

FS-716: System Dynamics Credits: 4 (2-1-2)

COURSE OBJECTIVES

To understand cause-effect relations in social and management systems.
To analyze complex, dynamic and nonlinear interactions in social systems.
To develop new structures and policies to improve the system behaviour.

COURSE DESCRIPTION:

Unit -I:

Introduction. System concepts, system theories, models. Classification of systems-continuous and discrete, stochastic and deterministic and open and closed systems. System studies: subsystems, types of system studies.

System dynamics paradigm-foundations, framework, viewpoints, philosophy, flexibility, strengths and weaknesses. Stages of problem solving with system dynamics. Examples of managerial and social problems.

Unit-II:

Elements of system dynamics modelling. Physical flows, Level and rate variables, Information flows, Diagramming aids, Delays, Smooth functions, equations, Table functions. Causal-loop diagramming, flow diagramming.

Unit-III:

Steps in system dynamics: Problem identification, Fixing model aggregates and boundary, Detailed model, Model validation, Model analysis. Principles of modelling. Model equations.

Unit-IV:

Development of system dynamics models. Behavior of linear systems, positive feedback, negative feedback systems. Simulation of low order systems. Validation. Applications in planning and policy design for industrial / social systems. System dynamics packages. Case studies.

TEXTBOOKS

Pratap K J Mohapatra, Purnendu Mandal, Madhab C Bora: Introduction to System Dynamics Modelling, Universities Press
Sushil: System Dynamics, Wiley Eastern

FS-718: Multivariate Analysis Credits: 4 (2-1-2)

Objective:

1. To understand the main features of multivariate data.
2. To be able to use exploratory and confirmatory multivariate statistical methods properly.
3. To be able to carry out multivariate statistical techniques and methods efficiently and effectively.

UNIT I: Analysis of categorical data. Loglinear models for two- and higher-dimensional contingency tables, Characterizing and Displaying Multivariate Data, Tests on one or two mean vectors.

UNIT II: Multivariate Analysis of Variance, Aspects of multivariate analysis, random vectors, sample geometry and random sampling, multivariate normal distribution, inferences about the mean vector, MANOVA.

UNIT III: Classification and grouping techniques: discrimination and classification, clustering. Logistic regression models.

UNIT IV: Analysis of covariance structures, Principal Component Analysis (PCA), Factor Analysis, Cluster Analysis. Use of statistical computer packages.

Text Books:

1. Applied Multivariate Statistical Analysis, by Richard A. Johnson and Dean W.Wichern (6th edition), Prentice Hall.
2. Characterizing and Displaying Multivariate Data, by A.C.Rencher, John Wiley and Sons.
3. Multivariate Data Analysis, by Joseph F.Hair, William, Babin and Anderson.
4. Cluster Analysis, by Brian S.Everitt, Sabine Landau, Morven Leese. Wiley

SM-722: Decision Analysis Credits: 4 (2-1-2)

COURSE OBJECTIVE

This course introduces and applies advanced modelling techniques to decision problems with the objective of enhancing the decision-making skills as well as the spreadsheet knowledge base.

COURSE DESCRIPTION:

Unit-I: Probability

Basic Probability: Laws of probability-addition law, conditional law. Random variables and probability distributions. Expectation of a random variable-mean and variance of a random variable, mean and variance of joint random variables. Probability distributions-Binomial, Poisson, Normal, Exponential. Empirical distributions.

Unit-II: Game Theory

Introduction, definitions, two-person zero sum game. Game with pure strategies, saddle point, game value. Game with mixed strategies, solution methods-algebraic method, graphical method, dominance, linear programming method.

Unit-III: Decision Making

Structuring the decision problem-payoff tables, decision trees. Decision making under certainty. Decision making under risk: Expected value criterion, expected value of perfect information, sensitivity analysis, decision making with sample information, expected value of sample information, computing branch probabilities, utility and decision making. Decision making under uncertainty: Laplace, Minimax, Savage, Hurwicz.

Unit-IV: Multicriteria Decision Making

Multicriteria decision making: Goal programming, Scoring models, Analytical Hierarchy Process, TOPSIS. Markov Analysis.

TEXTBOOKS

Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
William J. Stevenson: Introduction to Management Science, IRWIN.

M.Tech. in Systems Management

Programme Structure:

Batch: 2015-17

First Semester:

Code	Title	Credits (L T P)
CORE COURSES		
SM-701	Introduction to Systems Engineering	4 (3-1-0)
SM-703	Operations Research	4 (2-1-2)
SM-705	Database Management Systems	4 (2-1-2)
SM-707	Statistical Research Methods	4 (2-1-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two):		
SM-711	Information Security	4 (2-1-2)
SM-713	Cloud Computing	4 (2-1-2)
SM-715	System Analysis and Design	4 (2-1-2)
ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus.		
SM-721	Technical Communication	4 (3-1-0)

Second Semester:

Code	Title	Credits (L T P)
CORE COURSES		
SM-702	Modelling and Simulation	4 (3-1-0)
SM-704	Industrial Engineering and Systems	4 (3-1-0)
SM-706	Enterprise Resource Planning	4 (3-1-0)
SM-708	Project Management	4 (2-1-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two):		
SM-712	Data Mining and Data Warehousing	4 (2-1-2)
SM-714	e-Business & e-Governance	4 (3-1-0)
SM-716	Big Data Analytics	4 (2-1-2)
SM-718	Artificial Intelligence & Neural Networks	4 (2-1-2)
ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus.		
SM-722	Dynamic Modelling	4 (3-1-0)

Third & Fourth Semesters:

Code	Title	Credits
SM-800	M.Tech. Thesis	24

Note: The above course contents can be modified as per requirement from time to time in accordance with University Ordinance No. 31.

DETAILED SYLLABUS

FIRST SEMESTER:

SM-701: Introduction to Systems Engineering Credits 4 (3-1-0)

COURSE OBJECTIVES

To provide an understanding of the concepts of systems engineering, including systems, life cycles, phases, and steps.

To develop and manage the systems (products and services) that that satisfy customer requirements, considering engineering, technology, environmental, management, risk, and economic factors by viewing the system as a whole, over its life cycle.

COURSE DESCRIPTION:

Unit -I:

Introduction to System Engineering

Systems point of view, definitions of systems engineering, systems engineering knowledge, challenges and pitfalls in system engineering.

Methodological Framework and Systems Engineering Processes

Methodological frameworks for systems acquisition or production: Logical steps of systems engineering, Life-cycle phases of systems engineering, two-dimensional framework for systems engineering, Life cycles or stage of systems engineering, Systems engineering processes. Other specific life-cycle methodologies for systems acquisition, production or procurement: A seven-phase life-cycle for system acquisition or product development, a twenty-two-phase life-cycle. Life cycles patterned after the waterfall model.

Unit-II:

Formulation of Issues

Situation assessment, Problem or issue identification: scoping and bounding the problem, system definition matrix, needs and constraints-identification and analysis, input-output matrix. Value system design: Objectives hierarchies or trees, objectives measures or design criteria. System synthesis. Relationship between issue formulation and design and development efforts: Functional decomposition and functional analysis, Functional analysis and business process reengineering, Quality function deployment. The system engineering requirements statements: User requirements, System requirements and specifications. Generation of alternatives or system synthesis: Brainstorming and brain writing, Groupware, Delphi methods, Morphological box approach. Feasibility studies: Feasibility screening, architecture and standards, feasibility criteria.

Unit-III:

Analysis of Alternatives

Analysis of systems with uncertain and imperfect information: Cross impact analysis models, hierarchical inference and extensions, logical reasoning models and inference, complications affecting inference and cross- impact analysis. Structural Modelling: Trees, casual loops and influence diagrams. Economic models and economic systems analysis: Present value analysis, Economic appraisal methods for benefits and cost overtime, systematic measurements of efforts and schedule, work breakdown structure and cost breakdown structure, cost- benefit and cost-effectiveness analysis. Reliability, Availability, Maintainability, and Supportability models. Evaluation of large-scale models.

Unit-IV:
Interpretation of Alternative Courses of Action and Decision Making: Types of decisions, Formal decisions, Group decision making, Voting.

Systems Engineering and Systems Engineering Management: Systems engineering organizational structures, Pragmatics of systems management, systems engineering methods for systems management, human and cognitive factors.

TEXTBOOKS

Andrew P. Sage, James E. Armstrong Jr.: Introduction to Systems Engineering, John Wiley & Sons
James N. Martin: Systems Engineering Guidebook, CRC Press
Benjamin S. Blanchard & Wolter J. Fabrycky: Systems Engineering & Analysis, Pearson International Edition

SM-703: Operations Research Credits: 4 (2-1-2)

COURSE OBJECTIVE
This course exposes the students in mathematical modelling, solving and analysing business and industrial problems using operations research methods.

COURSE DESCRIPTION:

Unit -I:
Introduction, History, Development of Operations Research, Characteristics of Operations Research, Models in Operations Research, Principles of Modelling. Pre-modelling-Need Recognition, Problem Formulation. Modelling-Model development, Data collection, Model solution, Model validation, and sensitivity analysis. Post-modelling-Interpretation of results and implications, Decision making, Implementation, and Control.

Unit-II:
Linear Programming, Formulation of Linear programming Problems. Solution Methods-Graphical, Simplex, M-Technique, Two-Phase. Special cases of LP problems. Duality, Primal-dual relationships, Dual simplex method. Sensitivity analysis. Solving LP problems using computer software.

Unit-III:
Transportation Model-Formulating the model, Initial Feasible Solution-North-West Method, Least Cost Method, Vogel's Approximation Method. Optimum Solution-MODI method, Stepping Stone Method. Special issues of transportation problems. Assignment Model: Formulating the model, Solving the assignment problem using Hungarian method. Special issues of assignment problems.

Integer programming: Types of integer programming problems, Formulating the model, Solution using Branch and bound method. Dynamic Programming.

Solving the problems using computer software.

Unit-IV:
Network models: Minimal spanning tree algorithm, Shortest-route problem, Maximal flow model, Minimum –cost capacitated flow problem. Project Scheduling: CPM and PERT.

Inventory models: Functions of inventory, information requirements for inventory management-demand, lead time, inventory costs, and quantity on hand. Objectives of inventory management. Economic Order Quantity Models-Economic order size, economic production run, quantity discounts. Determining the reorder point. Material Requirement Planning.

Queuing Models: Goals, elements and characteristics of queuing systems, Measures of system performance, Waiting line models-single channel, multiple channel. Cost considerations.

TEXT BOOKS

Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall

David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.

William J. Stevenson: Introduction to Management Science, IRWIN.

SM-705: Database Management Systems Credits: 4 (2-1-2)

Objective:

The purpose of this course is to provide fundamental knowledge of database management system and understanding of how to use and design a DBMS.

COURSE DESCRIPTION:

Unit I:

DBMS Concepts, Comparison between Database approach and Traditional file accessing approach, Advantages of database systems, Schemas and instances, Data Dependency, Data Dictionary, and Meta Data. Data models, Types of Data models (Object Oriented, Record Based and Physical data models), E-R diagram, Relational Data models: Domains, Tuples, Attributes, Keys, Relational database, Schemas, Integrity constraints, Relational algebra and relational calculus.

Unit II:

Database Design: Introduction to normalization, Normal forms (INF, 2NF, 3NF, BCNF), Functional dependency, Decomposition, Dependency preservation and lossless join, multi-valued dependencies. Structured Query Language: DDL, DML, DCL, TCL, SQL Functions, integrity constraints, various joins, sub-query, index, View, Sequence, and Clusters. PL/SQL: manipulating data using PL/SQL, Iteration, Exceptions, Cursors, Trigger. (Experiment on Oracle 11g)

Unit III:

Transaction Processing and Concurrency Control: Transaction System, Serializability of schedules, conflict & view serializable schedule, Recovery from transaction failures, Log based recovery. Checkpoints dead lock handling, Concurrency Control, locking Techniques for concurrency control, time stamping protocols for concurrency control, validation based protocol, multiple granularity.

Unit IV:

Advance Concepts: Introduction to Distributed databases, data mining, data warehousing, Basic Concepts of Object Oriented Database System, Comparative study of OODBMS V/s RDBMS. Introduction to Image and Multimedia databases and data structures, Web and mobile database, Spatial and Geographic Database, Accessing Database from front-end Application. Case Study: Oracle, MySql, DB2.

Text Books:

1. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, fifth Edition McGraw-Hill.
2. ElmasriRamez and NovatheShamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
3. Rob, Coronel, “Database Systems”, Seventh Edition, Cengage Learning.
4. Ramakrishnan: Database Management System , McGraw-Hill
5. Fred R.McFadden,JeffreyA.Hoffer& Marry B.Prescott.?Modern Database Management, Fifth Edition,Pearson Education Asia,2001
6. Gray Jim and Reuter Address, “Transaction Processing: Concepts and Techniques”, Moragan Kauffman Publishers.

SM-707: System Analysis and Design Credits: 4 (2-1-2)

Objective:
This course has been designed to provide a foundation of systems principles and an understanding of how analysts can analyze complex business system and develop solution.

COURSE DESCRIPTION:

Unit I: Introduction
System, Concepts, characteristics and components; Types of Systems: Physical System and abstract system, Open and closed system, Man-Made Information System and Formal Information System, Computer based Information System; System analysis and design, Role, task and attribute of the system analyst.

Unit II: System Development Life Cycle (SDLC)
Recognition of needs, Impetus for System Change, Feasibility Study, Analysis, Design, Implementation, Post implementation and Maintenance; Computer-Aided Software Engineering (CASE) Tools; Different models their advantages and disadvantages: Waterfall approach, Iterative approach, RAD model, Evolutionary software process model (Incremental model, Spiral model, Concurrent development model).

Unit III: System Analysis and System Design
Systems Planning and initial investigation, Information Gathering, Tools of structure Analysis (Data Flow Diagram, Data Dictionary, Decision Tree, Structured English and Decision Table), Feasibility Study. System Design: Process and Stages of Systems Design, Logical and Physical Design, Design Methodologies (Structured Design), Major Development Activities (Personnel Allocation, Audit Considerations, Processing Controls and Data Validation), Input/output and Form Design, File organization and database design. Modular and structured design: Module specifications, Module coupling and cohesion, Top-down and bottom-up design.

Unit IV: Object Oriented Analysis and Design
Introduction to Object Oriented Analysis and design, Association, Aggregation, Inheritance, encapsulation, Generalization and Specialization. Unified Modeling Language (UML): Class diagram, sequence diagram, Use case diagram, Collaboration diagram, state chart diagram, Activity diagram, component diagram, deployment diagram. System Implementation: System Testing and Quality Assurance, Implementation and Software Maintenance, Security and Disaster Recovery.

Text Books:
- System Analysis and Design Elias M. Award, Galgotia Publication.

- Essential of System Analysis and Design, Jeffrey A. Hofer Joey F. George Joseph .Valacich Addison Weseley.
- Systems Analysis and Design, Kenneth E. Kendall, Julie E Kendall, PHI
- Michael Blaha and J. Rumbugh, "Object oriented Modeling and design with UML", Pearson Education
- O'Docherty, "Object Oriented Analysis and Design Understanding, System Development with UML2.0", Wiley India.

SM-711 Information Security Credits: 4 (2-1-2)

Objective:
The purpose of this course is to provide fundamental knowledge of Information Security and introduction of some advance research topics.

COURSE DESCRIPTION:

Unit I:
Need for security, Security approaches, Principles of security, various security attacks. Basic of Cryptography, secret key cryptography, Types of attack, Substitution ciphers, Transposition ciphers, block ciphers and steam ciphers, Hill Cipher, Data encryption standard, Cryptanalysis, brute force attack; Public key cryptography, Principles of Public key Cryptosystems, Cryptographic Algorithms RSA, Diffie-Hellman key exchange; Digital Signature.

Unit II:
Authentication: One way Authentication, password based, certificate based, Mutual Authentication, shared secret based, Asymmetric based, Authentication and key agreement, centralized Authentication, eavesdropping, Kerberos, IP Security, Secure Socket Layer(SSL), Transport Layer Security (TLS).

Unit III:
Software vulnerabilities, Threats and Security Systems: Phishing Attacks, buffer overflow vulnerability, Format String attack, Cross Site Scripting, SQL injection Attacks, Denial-of-Service (DoS), Sniffing, Spoofing and Email security. Malware: Backdoors, Trojan horse, Viruses and it's Characteristics, Working, Infection Phases, Worms, Zombie. **Security Systems:** Intrusion Detection System, need and types of IDS, Intrusion Prevention Systems; Firewalls: functionality, Polices and Access Control, Packet filters, Application level gateway; Anti-Intrusion Technique: Honey pot; Anti-virus.

Unit IV:
Advance Concepts of IS: Introduction to Identity based Cryptography, Data Hiding and It's applications, Data hiding techniques: Steganography, Watermarking; Cloud Security; Biometric Security; Introduction to Computer Forensic, Hacking, Cyber Crime.

Text Books:
1. Cryptography and Network Security – B. Forouzan, McGraw-Hill.

2. William Stalling, “Cryptography and Network security”, Pearson.
3. Cryptography & Network Security: AtulKahate, TMH.
4. Matt Bishop, Computer Security- Arts and Science, Pearson Education, 2003.
5. Pieprzyk et.al, Fundamentals of Computer Securiry, Allied Publishers, 2004.
6. Rebecca Gurley Bace, Intrusion Detection, Technology Series MTP 2007.

SM-713: Cloud Computing Credits: 4 (2-1-2)

Objective:
The main objective of this subject is to help student to understand Cloud and It’s Services, Architecture, Deployment, Core Issues, Strengths and limitations of cloud computing.

COURSE DESCRIPTION:

UNIT I: Introduction to Cloud Computing
Overview of Cloud Computing, History of Cloud Computing, Importance of Cloud Computing, advantages and disadvantages of Cloud Computing, Applications, Cloud computing vs. Cluster computing vs. Grid computing, Future of Cloud Computing; Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Cloud Service Models(XaaS), Deployment Models (Public cloud, Private cloud, Hybrid cloud).

Unit II: Cloud Service Models and Virtualization
Infrastructure as a Service (IaaS): Introduction, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Virtual Machine(VM), Resource Virtualization(Server, Storage, Network),VMware vSphere, Machine Image ,Porting Applications Case study on Amazon EC2;Platform as a Service(PaaS): Introduction to PaaS, advantages and disadvantages of PaaS, case study on Microsoft Azure; Software as a Service(SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS; Development Services and Tools : Amazon Ec2, Google App Engine, IBM Clouds.

UNIT III: Capacity Planning
Defining Baseline and Metrics, Baseline measurements, System metrics, Load testing, Resource ceilings, Server and instance types, Network Capacity, Scaling.Understanding Service Oriented Architecture, Moving Applications to the Cloud, Working with Cloud-Based Storage, Working with Productivity Software.

UNIT IV: Managing the Cloud
Administrating the Clouds, Cloud Management Products; Cloud Security: Security Overview, Cloud Security Challenges and Risks, Security Governance, Risk Management: Security Monitoring, Security Architecture Design, Data Security, Application Security, Virtual Machine Security, Identity Management and Access Control, Authentication in cloud computing, Client access in cloud, Cloud contracting Model. Using the Mobile Cloud: Working with Mobile Devices and Working with Mobile Web Services;
Case Studies on Various Clouds: Google Web Services, Amazon Web Services, Microsoft Cloud Services, IBM Clouds, Eucalyptus.

Text Books:

1. Kris A Jamsa: Cloud computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More 2013Jones & Bartlett Learning ISBN-13: 9781449647391.
2. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH, 2009.
4. Sosinsky B., "Cloud Computing Bible", Wiley India
5. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011.
6. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.

SM-715 System Analysis and Design Credits: 4 (2-1-2)

Objective:
This course has been designed to provide a foundation of systems principles and an understanding of how analysts can analyze complex business system and develop solution.

COURSE DESCRIPTION:

Unit I: Introduction
System, Concepts, characteristics and components; Types of Systems: Physical System and abstract system, Open and closed system, Man-Made Information System and Formal Information System, Computer based Information System; System analysis and design, Role, task and attribute of the system analyst.

Unit II: System Development Life Cycle (SDLC)
Recognition of needs, Impetus for System Change, Feasibility Study, Analysis, Design, Implementation, Post implementation and Maintenance; Computer-Aided Software Engineering (CASE) Tools; Different models their advantages and disadvantages: Waterfall approach, Iterative approach, RAD model, Evolutionary software process model (Incremental model, Spiral model, Concurrent development model).

Unit III: System Analysis and System Design
Systems Planning and initial investigation, Information Gathering, Tools of structure Analysis (Data Flow Diagram, Data Dictionary, Decision Tree, Structured English and Decision Table), Feasibility Study. System Design: Process and Stages of Systems Design, Logical and Physical Design, Design Methodologies (Structured Design), Major Development Activities (Personnel Allocation, Audit Considerations, Processing Controls and Data Validation), Input/output and Form Design, File organization and database design. Modular and structured design: Module specifications, Module coupling and cohesion, Top-down and bottom-up design.

Unit IV: Object Oriented Analysis and Design
Introduction to Object Oriented Analysis and design, Association, Aggregation, Inheritance, encapsulation, Generalization and Specialization. Unified Modeling Language (UML): Class diagram, sequence diagram, Use case diagram, Collaboration diagram, state chart diagram, Activity diagram, component diagram, deployment diagram. System Implementation: System Testing and Quality Assurance, Implementation and Software Maintenance, Security and Disaster Recovery.

Text Books:

- System Analysis and Design Elias M. Award, Galgotia Publication.
- Essential of System Analysis and Design, Jeffrey A. Hofer Joey F. George Joseph .Valacich Addison Weseley.
- Systems Analysis and Design, Kenneth E. Kendall, Julie E Kendall, PHI
- Michael Blaha and J. Rumbugh, "Object oriented Modeling and design with UML", Pearson Education
- O'Docherty, "Object Oriented Analysis and Design Understanding, System Development with UML2.0", Wiley India.

SM-721: Technical Communication Credits: 4 (3-1-0)

Objective:
This course is designed to help the students to develop skills that will enable them to produce clear and effective scientific and technical documents.

Unit I:
Technical writing: Definition, Similarities to other writings, Unique features, importance, technical writing as profession, qualifications for technical writing. Identifying audience. Problems involving content, words and phrases, punctuation, unity, coherence, logic, etc. Being concise.

Unit II:
Techniques of Technical Communication. Analysing-Division, Classification, Partition. Defining-Formal, informal, expanded. Describing-subjective versus objective, spatial description, description of mechanism, process, selected details. Illustrating-Tables, graphs, charts, pictorials. Researching-Basic types of research, original research, searching the literature. Abstracting of your own reports, the works of others, precautions. Oral communication-one to one reporting, participation in conferences, speaking to large audiences, organising the speech.

Unit III:
Basic forms of Technical Writings. The memorandum, The business letter, Formal report.

Unit IV:
Technical reports. Justification reports and proposals, the progress reports, periodic reports, status reports, trip reports. Laboratory reports, Feasibility reports, State-of-the-Art reports. Instructions and manuals.

Text Books:

1. James Sherlock: A Guide to Technical Communication

SECOND SEMESTER:

SM-702: Modelling and Simulation Credits: 4 (3-1-0)

COURSE OBJECTIVE

This course exposes the students in simulation modelling, solving and analysing business and industrial problems using simulation models.

COURSE DESCRIPTION:

Unit -I:

System modelling, classification of models, validation and verification. System simulation, simulation terminology, applications of simulation, Simulation steps, advantages and disadvantages of simulation. Monte Carlo (MC) simulation. An inventory simulation. A waiting line simulation.

Basic probability and statistics. Random variables and their properties, simulation output data and stochastic processes, estimation of means, variances, and correlations, confidence intervals, and hypothesis testing, Strong law of large numbers.

Unit-II:

Generation of Random Numbers: Pseudo random numbers: Pseudorandom numbers and algorithm for generating them-mid-square method, linear congruential method, additive congruential method, quadratic congruential method. Testing and validating of pseudo random sequences.

Generating random variants: inverse-transform method; generating continuous Random variates: uniform, exponential; generating discrete random variates: Binomial, Poisson.

Variance reduction techniques, Experimental design.

Unit-III:

Discrete-Event Simulation: Time advance mechanisms. Components and Organization of a discrete event simulation model. Simulation of a single-server queuing system. Simulation of an inventory system.

Simulation Languages: Comparison of simulation languages with general purpose languages. Classification of simulation software. Desirable software features. Simulation language – GPSS / SIMSCRIPT – II.5.

Unit-IV:

Building valid and credible simulation models, determining the level of model detailing, techniques for increasing model validity and credibility. Output data analysis.

TEXTBOOKS

Averill M. Law: Simulation Modeling & Analysis, Tata McGraw-Hill
Geoffrey Gordon: System Simulation, Prentice Hall of India
David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management

SM: 704 Industrial Engineering and Systems Credits: 4 (3-1-0)

Objective: Industrial engineering and systems deals with the optimization of complex processes or systems. It typically focuses on the development, improvement, implementation and evaluation of integrated systems for industrial practice in product design, process design, plant operation, production control, quality control, facilities planning, work system analysis and evaluation, and economic analysis of operational systems.

Unit I: Introduction – concepts of industrial engineering, history and development of industrial engineering, application. Facility: location factors and evaluation of alternate locations; types of plant layout and their evaluation; computer aided layout design techniques; assembly line balancing; materials handling systems. Productivity – concepts and measurements.

Unit II: Work System Design: Taylor's scientific management, Gilbreths's contributions; method study, micro-motion study, principles of motion economy; work measurement – stop watch time study, work sampling, standard data, PMTS; ergonomics; job evaluation, merit rating, incentive schemes, and wage administration.

Unit III: Product Design and Development: Principles of good product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, concurrent engineering.

Unit IV: Reliability and Maintenance: Reliability, availability and maintainability; distribution of failure and repair times; determination of MTBF and MTTR, reliability models; system reliability determination; preventive maintenance and replacement, total productive maintenance – concept and applications. Limits, fits, Tolerances, Gauges, Comparators, Surface Finish Measurements Wages payment plan: Introduction, classification of wage payment plan, incentive plan. Material purchase and store management: material management, purchasing and procurement, buying technique, store and material control and store record.

Text Books:

1. Industrial Engineering and Management, by O.P. Khanna
2. Operations Management, by William Stevensons, Tata McGraw Hills Publication

SM-706: Enterprise Resource Planning Credits: 4 (3-1-0)

Objective:

The main objective is to help student to understand strategic importance of ERP in business process and how to create competitive advantage from managerial point of view.

COURSE DESCRIPTION:

UNIT I:

Introduction to ERP, Need of ERP, Evolution of ERP, ERP and Related Technologies, Business Intelligence, E-Commerce and E-Business, Business Process Reengineering, Decision Support Systems (DSS), Executive Support Systems (ESS), Data Warehousing, Data Mining, OLTP, OLAP, Product life Cycle management, SCM, CRM, M-Commerce.

UNIT II:

ERP Business Modules: Finance, Manufacturing, Human Resources, Plant maintenance, Materials Management, Production Planning, Quality management, Marketing, Sales, Distribution andservice.

UNIT III:

ERP Implementation: Implementation Challenges, Strategies, Life Cycle, Pre-implementation Tasks,Requirements Definition, Methodologies, ERP Package selection, Project Planning, Project Teams, Process Definitions, role of Vendors and Consultants, Project management, End User Training, Testing, Post Evaluation and Maintenance.

UNIT IV:

ERP in Market place: Dynamics, SAP AG, Oracle, PeopleSoft, JD Edwards, QAD Inc, SSA Global, Lawson Software, Baan, Enterprise, Epicor, Intutive. Application Integration: ERP and E-Business, ERP II, Total qualitymanagement, Future Directions, Trends in ERP. Case studies of ERP Implementations.

Text Books:

1. Alexis Leon, "ERP DEMYSTIFIED", Tata McGraw Hill, Second Edition, 2008.
2. V. K. Garg& N. K. Venkita Krishnan, "ERP Concepts & Planning".
3. V. K. Garg& N. K. Venkita Krishnan, "ERP Ware: ERP Implementation Framework".
4. Joseph A Brady, Ellen F Monk, Bret Wagner, "Concepts in Enterprise Resource Planning", Thompson Course Technology, USA, 2001.
5. Mary Sumner, "Enterprise Resource Planning", Pearson Education, 2007.

SM 708: Project Management Credits: 4 (2-1-2)

Course Objective: This course is aimed at providing both basic and some advanced exposure to Project Management, so as to enable the manager of tomorrow to successfully complete sophisticated projects within the constraints of capital, time, and other resource**s.**

UNIT I: Introduction, Project Management Purpose, Project, Project Management, Relationships - Portfolio Management, Program Management, Project Management, Operations Management, Organizational Project Management and Organizational Strategy, Business Value, Project Manager Role. Organizational Influences on Project Management, Project Stakeholders & Governance, Project Team, Project Life Cycle, Project Management & Information Technology Context, System view of Project Management, Context of Information Technology Projects.

Project Management Process Groups (Initiating, Planning, Executing, Monitoring & Controlling, Closing), Project Management Processes & Knowledge Areas. Common Process Interactions. Project Integration Management, Processes -Develop Project Charter, Develop Project Management Plan, Direct and Manage Project Work, Monitor and Control Project Work, Perform Integrated Change Control, Close Project or Phase

UNIT II: Project Scope Management, Processes - Plan Scope Management, Collect Requirements, Define Scope, Create WBS, Validate Scope, Control Scope. Project Time Management, Processes - Plan Schedule Management, Define Activities, Sequence Activities, Estimate Activity Resources, Estimate Activity Durations, Develop Schedule, Control Schedule

Project Cost Management, Processes - Plan Cost Management, Estimate Costs, Determine Budget, Control Costs. Project Quality Management, Processes - Plan Quality Management, Perform Quality Assurance, Control Quality.

UNIT III: Project Human Resource Management, Processes - Plan Human Resource Management, Acquire Project Team, Develop Project Team, Manage Project Team. Project Communications Management, Processes - Plan Communications Management, Manage Communications, Control Communications.

Project Risk Management, Processes -Plan Risk Management, Identify Risks, Perform Qualitative Risk Analysis, Perform Quantitative Risk Analysis, Plan Risk Responses, Control Risks. Project Procurement Management, Processes - Plan Procurement Management, Conduct Procurements, Control Procurements, Close Procurements.

UNIT IV: Project Stakeholder Management, Processes - Identify Stakeholders, Plan Stakeholder Management, Manage Stakeholder Engagement, Control Stakeholder Engagement. Project Management Styles in Industry, Agile Methodology, Scrum, Lean, Extreme, Benefits Realization Model.

Text Books:

1. Information Technology Project Management, Kathy Schwalbe, 5th Edition, Thomson
2. Project Management Prassana Chandra
3. Project Management Mantle, Meredith
4. PMBOK 5th Edition, PMI
5. Head First Project Management
6. Project Management by Kim Heldman

SM-712: Data Mining and Data warehousing Credits: 4 (2-1-2)

Objective:
The main objective of this course is to provide understanding of data warehouse fundamentals and data mining techniques for business applications.

COURSE DESCRIPTION:

UNIT I:
Data Warehousing: Introduction data warehousing, Data Mart, Data Warehouse Architecture; Star, Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning. OLAP technology, Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, Indexing data.

UNIT II:
Data Mining: Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining; Data Processing: Data Cleaning, Data Integration and Transformation; Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Data Discretization and Concept hierarchy generation for

numerical and categorical data. Web Mining: Introduction, Web Content Mining, Web Structure Mining, Web Usage Mining; Spatial Mining, Text Mining.

UNIT III:

Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, FP-Growth Algorithm, Time series mining association rules, latest trends in association rules mining.

UNIT IV:

Classification methods: Decision tree, Bayesian Classification, Association Rule based; Prediction: Linear and non-linear regression; Categories of clustering methods, Partitioning methods: K-Means, K-Mediods. Hierarchical Clustering: Agglomerative and Divisive Clustering, BIRCH and ROCK methods, DBSCAN, Outlier Analysis. Data Mining for Business Intelligence Applications

Text Books:

1. P.Ponnian, "Data Warehousing Fundamentals", John Weliey.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.
3. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education.
4. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", Wiley India.
5. Michael Berry and Gordon Linoff "Data Mining Techniques",Wiley Publications.
6. M.H.Dunham, "Data Mining Introductory & Advanced Topics", Pearson Education.

SM-714: E-Business and E-Governance Credits: 4 (3-1-0)

Objective:

The main objective of this course is to help students to understand underlying technologies infrastructure of e-business and e-governance.

COURSE DESCRIPTION:

UNIT I: introduction to e-Business, principles of e-Business Model and its elements

B2C, B2B, C2C, Storefront model, click and Mortar model, service provider model, prepaid access model. Porter's Value Chain Model. Competitive Strategy, Porter's Model; benefits and limitations of e-business.

UNIT II: Impact of e-Business on Different Fields

Internet Marketing and e-Tailing, e-Tourism, Employment and Job Market Online, Online Real Estate, e-Banking, On-Demand Delivery Systems and E-Grocers, Online Delivery of Digital Products, Entertainment, and Media; e-Learning and Online Education: benefits and drawbacks of e-Learning, technologies used in e-Learning; e-selling Process, e-buying Planning, e-Procurement.

UNIT III: E-Governance

Introduction to e-governance, issues in e-governance , evolution of e-governance, benefits and limitations of e-governance,e-governance models- broadcasting, critical flow, comparative analysis, mobilization and lobbying,interactive services / G2C2G. E-readiness, e-Framework, step & issues, applications of data warehousing and data mining in e-government, Challenges to e-government security.

UNIT IV: Case studies

NICNET-role of nationwide networking in e-governance, e-bhoomi, IT in Indian Judiciary, E-khazana for government Treasury Andhra Pradesh, PRAJA Rural e-Seva, E-Seva-new Paradigm in citizen Services, sachivalayavahini or E-governance in Secretariat, EkalSeva Kendra, computerization in Andhra Pradesh State Trading Corporation; Case study on E-Business.

Text Books:

1. Daniel Amor, The E-Business Revolution: Living and Working in an interconnected World, Prentice Hall.
2. H. M. Deitel, P. J. Deitel and T. R. Nieto, E-Business and E-Commerce: How to Programe, Prentice hall.
3. C.S.R. Prabhu, “E-governence: concept and case study”, PHI Learning Private Limited.
4. J. Satyanarayan, “E-government: The science of the possible”, PHI Learning Private Limited
5. Backus, Michiel, e-Governance in Developing Countries, IICD Research Brief, No. 1, March 2001.

SM-716: Big Data Analytics Credits: 4 (2-1-2)

UNIT I

Introduction to BigData, Big Data Overview, Platform, Challenges of Conventional Systems, Intelligent data analysis, Analytic Processes and Tools, Analysis vs Reporting, Modern Data Analytic Tools. Introduction to Data Science: Data Science Process, Data Science for Business. Identifying problem and solving problem in data science. Data: Unstructured vs. Structured Data, Databases. Role of Data Scientist, Data Analyst, Business Analyst.

UNIT II

Introduction to Hadoop, Hadoop architecture, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases; Hadoop Distributed File system: Design of HDFS, HDFS Concepts, Command-Line Interface, Hadoop File systems Java Interface, Hadoop Archives;

UNIT III

Introduction to MapReduce: Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop, Hadoop Streaming, Hadoop Pipes, Functional programming with Mappers and Reducers. MapReduce Working, types and file formats, features; Setting up Hadoop Cluster;

UNIT IV

Pig: Installing and Running Pig, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators; Hive: Installing Hive, Running Hive, Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User-Defined Functions; HBase:

HBasics, Concepts, Installation,Clients, HBase Versus RDBMS, Praxis; Fundamentals of Zookeeper and Sqoop.

Text Books:

1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, JohnWiley & sons, 2012
2. Glenn J. Myatt, “Making Sense of Data”, John Wiley & Sons, 2007.
3. Pate Warden, “Big Data Glossary”, O’Reilly 2011.
4. Tom White,"Hadoop: The Definitive Guide", 3rd Edition, O'Reilly Media, 2012.
5. Donald Miner, Adam Shook, Eric Sammer, “Hadoop Operation”, O’Reilly 2012.
6. Donald Miner, Adam Shook “MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems”, O’Reilly 2012.
7. Chuck Lam, "Hadoop in Action", Manning Publications, 2010.

SM-718: Artificial Intelligence and Neural Networks Credits: 4 (2-1-2)

Objective: The main objective is to help students to understand the fundamentals of Artificial Intelligence for design intelligent System.

COURSE DESCRIPTION:

UNIT I:
Introduction to artificial intelligence, History of AI, production system, Problem solving: Characteristics of production systems, Study and comparison of breadth first search and depth first search. Techniques, other Search Techniques like hill Climbing, Best first Search. A* algorithm, AO* algorithms. Knowledge and Reasoning: Knowledge Representation, Problems in representing knowledge, knowledge representation using propositional and predicate logic, comparison of propositional and predicate logic, Resolution, refutation, deduction, theorem proving, inferencing, monotonic and non-monotonic reasoning, Semantic networks, scripts, schemas, frames, conceptual dependency, forward and backward reasoning.

UNIT II:
Adversarial Search: Game playing techniques like minimax procedure, alpha-beta cut-offs; Introduction to learning, various techniques used in learning. Intelligent Agents: Agent Environments, Concept of Rational Agent, Structure of Intelligent agents, Types of Agents. Expert systems and its components, Decision Support System and integrating expert and decision support system, Introduction to Natural Language Processing.

UNIT III:
Neural Network: biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervise & Unsupervised) and activation function. Supervised Learning: Perceptron learning, Single layer/multilayer, linear Separability, Adaline, Madaline, Back propagation network, RBFN. Application of Neural networks in forecasting.

UNIT IV:

Unsupervised learning: Kohonen SOM, Counter Propagation, Full Counter Propagation NET and Forward only counter propagation net, ART, Applications of Neural network. Introduction to GA, Simple Genetic Algorithm, terminology and operators of GA, GA implementation using MATLAB. Introduction to Fuzzy Logic: Basic Definition and Terminology, Set-theoretic Operations, Member Functions.

Text Books:

1. S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, Pearson Education, 2003.
2. Rich E and Knight K, "Artificial Intelligence", TMH, New Delhi.
3. Nelsson N.J., "Principles of Artificial Intelligence", Springer Verlag, Berlin.
4. S.N. Shivnandam, "Principle of soft computing", Wiley.
5. S. Rajshekaran and G.A.V. Pai, "Neural Network , Fuzzy logic And Genetic Algorithm", PHI.
6. Simon Haykins, "Neural Network- A Comprehensive Foundation".
7. Timothy J.Ross, "Fuzzy logic with Engineering Applications", McGraw-Hills.

SM-722: Dynamic Modelling Credits: 4 (3-1-0)

COURSE OBJECTIVE

This course exposes the students in mathematical tools for exploring and studying real world problems. The overall objective of this course is to provide an introduction to the process of mathematical modelling while giving students an opportunity to

- develop and construct appropriate models for various problem situations,
- analyze given models to uncover underlying assumptions, and
- investigate particular problems to find out what has already been done toward developing solutions.

COURSE DESCRIPTION:

Unit -I:

System modelling, classification of models, validation and verification. Systems, reservoirs, processes, converters, interrelationships. Uses of systems models. A systems approach: systems thinking, feedback-positive, negative.

Basic modelling concepts, building blocks, modelling of growth or decay-linear, exponential, logistic, overshoot or collapse, oscillation. Strategies for analysing and using systems models. Analysing a model, applying the strategy-problem definition, model validation, exploratory analysis, case analysis.

Unit-II:

Modelling predator-prey systems-problem definition, background information, difference equations, steady state solution. Modelling the dynamic deer-wolf system. Modelling surface water contamination-problem definition, background information, difference equations, steady state solution. Modelling the dynamic DO system.

Unit-III:

Modelling matter cycling in ecosystems-problem definition, background information, difference equations, steady state solution. Modelling the dynamic phosphorus system. Modelling mobile source air pollution inventories-problem definition, background information, difference equations, steady state solution. Modelling the dynamic mobile source emissions system.

Unit-IV:
Modelling greenhouse gases and global warming-problem definition, background information, difference equations, steady state solution. Modelling the dynamic greenhouse gas system. Modelling atmospheric chemistry and pollution transport-problem definition, background information, difference equations, steady state solution. Modelling the dynamic acid deposition system.

TEXTBOOKS

Deaton Michael L., Winebrake James J.: Dynamic Modelling of Environmental Systems. Springer.
Brian Albright: Mathematical Modelling with excel
Meerschaert, M., Mathematical Modeling, Academic Press, Fourth Edition

M.Tech. in Future Studies and Planning

Specialization in Data Science

Batch 2016-18

Programme Structure

First Semester:

Code	Title	Credits (L-T-P)
CORE COURSES		
FS-701	Operations Research	4
FS-703	Statistical Research Methods	4
FS-705	Data Science and Visualization	4
FS-707	RDBMS and NOSQL	4
FS-709	Python for Analytics	4
FS-711	Laboratory-Advanced Excel	2
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two)		
FS-721	Data Mining and Warehousing	3
FS-723	Statistical Programming in R	3
FS-725	Information Architecture	3
FS-727	Multivariate Analysis	3

Second Semester:

Code	Title	Credits (L T P)
CORE COURSES		
FS-702	Forecasting Methods	4
FS-704	Hadoop	4
FS-706	Linear Algebra and Advanced Calculus	3
FS-708	Introduction to System Dynamics	3
FS-710	Machine Learning	3
FS-712	Laboratory-Statistical Software Packages (Systat/ SPSS)	2
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two)		
FS-722	Technology Forecasting	3
FS-724	Big Data and Cloud Computing	3
FS-726	Natural Language Processing	3
FS-728	Web Mining	3
ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus.		
FS-752	Technical Communication	3

Third & Fourth Semesters:

Code	Title	Credits
FS-800	M.Tech. Thesis	24

Note: The above course contents can be modified as per requirement from time to time in accordance with University Ordinance No. 31.

DETAILED SYLLABUS

SEMESTER-I:

FS-701: Operation Research Credits: 4 (2-1-2)

COURSE OBJECTIVE:

This course exposes the students in mathematical modelling, solving and analysing business and industrial problems using operations research methods.

COURSE DESCRIPTION:

Unit -I:

Introduction, History, Development of Operations Research, Characteristics of Operations Research, Models in Operations Research, Principles of Modelling. Pre-modelling-Need Recognition, Problem Formulation. Modelling-Model development, Data collection, Model solution, Model validation, and sensitivity analysis. Post-modelling-Interpretation of results and implications, Decision making, Implementation, and Control.

Unit-II:

Linear Programming, Formulation of Linear programming Problems. Solution Methods-Graphical, Simplex, M-Technique, Two-Phase. Special cases of LP problems. Duality, Primal-dual relationships, Dual simplex method. Sensitivity analysis. Solving LP problems using computer software.

Unit-III:

Transportation Model-Formulating the model, Initial Feasible Solution-North-West Method, Least Cost Method, Vogel's Approximation Method. Optimum Solution-MODI method, Stepping Stone Method. Special issues of transportation problems. Assignment Model: Formulating the model, Solving the assignment problem using Hungarian method. Special issues of assignment problems.

Integer programming: Types of integer programming problems, Formulating the model, Solution using Branch and bound method. Dynamic Programming.

Solving the problems using computer software.

Unit-IV:

Network models: Minimal spanning tree algorithm, Shortest-route problem, Maximal flow model, Minimum –cost capacitated flow problem. Project Scheduling: CPM and PERT.

Inventory models: Functions of inventory, information requirements for inventory management-demand, lead time, inventory costs, and quantity on hand. Objectives of inventory management. Economic Order Quantity Models-Economic order size, economic production run, quantity discounts. Determining the reorder point. Material Requirement Planning.

Queuing Models: Goals, elements and characteristics of queuing systems, Measures of system performance, Waiting line models-single channel, multiple channel. Cost considerations.

TEXT BOOKS

Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall

David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.

William J. Stevenson: Introduction to Management Science, IRWIN.

FS-703: Statistical Research Methods Credits: 4 (2-1-2)

Objective:

This course will familiarize students with the rudiments of statistical theory and ready them for effective academic and professional practice in the field of research process of industrial, system and social science.

COURSE DESCRIPTION:

Unit I: Introduction to Research Methods and Measures of central tendency

Meaning and Objectives of Research, Significance of Research, Arithmetic Mean, Geometric Mean, Harmonic Mean, Median, Mode. Mean deviation, Standard deviation, Variance, Co-efficient of variation.

Unit II: Probability and Statistical Distribution

Binomial distribution, Poison distribution and Normaldistributions, Fitting of Normal Curve. Concept of Probability, Theorems of Probability, Conditional Probability, Baye's Theorem, Random Variable and Probability distribution.

Unit III: **Correlation and Regression Analysis**

Types of correlation, Methods of Correlation, Co-efficient of correlation, Properties of correlation, Rank Correlation.Difference between correlation and regression, Regression Lines, Regression Equations.

Unit IV: Testing of Hypothesis

Procedure of Testing Hypothesis, Standard Error and Sampling distribution, Estimation, Student's t-distribution, Chi-Square test and goodness of fit, F-test and analysis of variance.

Text Books:

S.P. Gupta: Statistical Method, S. Chand

C.K. Kothari: Research Methodology, New Age International

FS-705: Data Science & Visualization Credits: 4 (2-1-2)

Objective: This course will help the student to understand data science and role of data scientist. Students will also get fundamental knowledge of data visualization techniques.

COURSE DESCRIPTION:

UNIT I: Introduction: What is Data Science, Data Science Process, Data Science for Business and Competition. Identifying problem and solving problem in data science. Introduction to algorithms. Data: Unstructured vs. Structured Data, Databases, Big Data. Role of Data Scientist, Data Analyst, and Business Analyst.

UNIT II: Introduction to Data Wrangling, Data Analysis, and Data Visuslization. Introduciton to Various Data Analysis Techniques. Introduction to Data Visualization, characteristics, need of data visualization, comparison of data science and data visuslaization. Data types, Intro to Tableas, Perception.

UNIT III: Intro to Processing, Views, Tabular data, Trees and graphs Text & Sets, Scalar field, scalar data.

UNIT IV: 3D graphics, Transfer function design, Vector fields, Visualization models, Design Study.

Text Books:

1. Mike Loukides, "What Is Data Science?", O'Reilly Media, Inc., 10-Apr-2011.
2. Lars Nielsen, Noreen Burlingame, "A Simple Introduction to Data Science", New Street Communications, LLC, 02-Nov-2012.
3. William Cleveland,”The Elements of Graphing Data”,AT&T Bell Laboratories, 1994
4. Nathan Yau, “Visualize This: The FlowingData Guide to Design, Visualization, and Statistics”, “Visual Thinking for Design”, Colin Ware, Morgan Kaufman, 2008.
5. Daniel Shiffman,“Learning Processing”, Morgan Kaufmann, 2008.
6. Casey Reas and Ben Fry, :Getting Started with Processing”, O'Reilly Media, 2010.
7. Tamara Munzner,"Visualization Analysis and Design", AK Peters, 2014.

FS-707: RDBMS and NOSQL Credits: 4 (2-1-2)

Objective: The purpose of this course is to provide fundamental knowledge of relational database management system and SQL to students. Student will also learn new mechanism of storage and retrieval of data, NoSQL.

COURSE DESCRIPTION:

UNIT I: Overview of DBMS: Comparison between Database approach and Traditional file accessing approach, Advantages of database systems, Schemas and instances, Data Dependency, Data Dictionary, and Meta Data. Data models, Types of Data models (Object Oriented, Record Based and Physical data models), E-R Modelling.

UNIT II: Relational Data model: Domains, Tuples, Attributes, Keys, Relational database, Schemas, Integrity constraints, Relational algebra and relational calculus; Normalization: Normal forms (INF, 2NF, 3NF, BCNF), Functional dependency, Decomposition, Dependency preservation and lossless join.

UNIT III: Structured Query Language: DDL, DML, DCL, TCL, SQL Functions, integrity constraints, various joins, sub-query, index, View, Sequence, and Clusters.

UNIT IV: NoSQL: Nosql Basics, Storage Architecture, Operations, Query Model, Modifying Data Stores and Managing Evolution, Indexing and Ordering Data Sets, Managing Transactions and Data Integrity.Using Nosql in the Cloud, Scalable Parallel Processing with Mapreduce, Analyzing Big Data with Hive, Surveying Database Internals

Text Books:

1. A Silberschatz, H Korth, S Sudarshan, "Database System and Concepts", fifth Edition McGraw-Hill.
2. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing. Company.
3. Rob, Coronel, "Database Systems", Seventh Edition, Cengage Learning.
4. Fred R.McFadden,Jeffrey A.Hoffer & Marry B.Prescott.?Modern Database Management, Fifth Edition,Pearson Education Asia,2001.
5. Bayross Ivan, "SQL, PL/SQL: The Programming Language Of Oracle", 4th Revised Edition, BPB Publications, 2010.
6. Tiwari Shashank, "Professional Nosql", Wiley India Pvt Ltd, 2011.

FS-709: Python for Analytics Credits: 4 (2-1-2)

Objective: The main objective is to help students to understand the fundamentals of python. Student will learn how to analysis data using Python.

COURSE DESCRIPTION:

UNIT I: Introduction to Python: Python versus Java, Python Interpreter and it's Environment, Python installation, Python basics: variables, operators, Strings, Conditional and Control Statements, loops; Data structures: lists and dictionaries; functions: global functions, local functions, lambda functions and methods.

UNIT II: Object Oriented Programming Concepts: Class, object, constructor, destructor and inheritance; Modules & Packages, File Input and Output, Catching exceptions to deal with bad data, Multithreading, Database Connectivity.

UNIT III: Numpy: Creating Arrays, Arrays Operations, Multidimensional ArraysArrays transformation, Array Concatenation, Array Math Operations, Multidimensional Array and its Operations, Vector and Matrix. **Visualization:** Visualization with matplotlib, Figures and subplots, Labeling and arranging figures, Outputting graphics.

UNIT IV: Pandas: Manipulating data from CSV, Excel, HDF5, and SQL databases, Data analysis and modelling with Pandas, Time-series analysis with Pandas, Using Pandas, the Python data analysis library, Series and Data Frames, Grouping, aggregating and applying, Merging and joining.

Text Books:

1. McKinney Wes, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.
2. Hauck Trent, "Instant Data Intensive Apps with Pandas How-To", Packt Publishing Ltd, 2013.
3. Beazley David M.,"Advanced Python Programming", Pearson Education,2009.
4. Chun Wesley , Core Python Programming, 3rd Edition,Prentice Hall Professional, 2012.
5. Telles Matt "Python Power!: The Comprehensive Guide", Cengage Learning, 2008.
6. McKinney Wes & PyData Development Team, "pandas: powerful Python data analysis toolkit", Release 0.13.1, Feb 2014.
7. https://docs.python.org/3.4/tutorial/
8. http://www.tutorialspoint.com/python/python_quick_guide.htm

FS-711: Laboratory-Advanced Excel Credits: 2 (0-0-4)

Objective: The main objective of this course is to learn analysis of data using MS Excel, resulting in less time and better understands what the data means.

COURSE DESCRIPTION:

Unit I: Introduction to Excel User Interface**,** Application, Workbook, Worksheets & its Components, Named Ranges; Formatting: Cell Color, Font Color, Indents, Alignments, Number Formats, Custom Formats, Editing commands; Data Sorting: Built-in Sort, Sorting Levels, Custom Sort; Data Filtering: Auto Filter – Filter By Color, Filter by Icono Advanced Filter, Remove Duplicates; Data Subtotal – Built-In Subtotal (Nested Subtotal).

Unit II: Data Validation: Based on cell values (text length, whole no Based on Formulas, List Dropdown, Circle Invalid Data, Input & Error Messages; Data Grouping: Grouping Rows, Grouping Columns. Data Tables: Conditional Formatting, Formatting based on Cell values, Formatting based on Formulas, Icon Sets (bars, scales, icons), Freezing Panes, Text-to-Columns, Delimited, Fixed Length; Data Consolidation (from multiple files), Getting External Data into Excel, From MS Access, From Text files, From Web, Other Data Sources.

Unit III: Formulas, TEXT Functions, IF, ERROR Functions, LOGICAL Functions, VLOOKUP, HLOOKUP, COUNTIF, SUMIF, SUMPRODUCT, DATE & TIME FUNCTIONS, FORMULA TEXT, Information Functions (ISNA, ISEVEN, ISERR…).

Unit IV: Charts: Chart Types, Chart Components, Primary Vs Secondary Axis, Chart Formatting, Sparkline (2010 and above); Pivot Tables: Introduction & Creation, Slicer, TimeLine, Pivot Charts, Calculated Fields, Calculated Items, Grouping, Formatting – Number/Conditional, PowerPivot, PowerView.

Text Books:

1. John Walkenbac, "Excel 2016 Bible", John Willey & sons.
2. Jordan Goldmeier , "Advanced Excel Essentials", Apress Publisher.
3. Conrad George Carlberg , "Business Analysis with Microsoft Excel", Que Publishers.
4. Bernd Held, "Microsoft Excel Functions & Formulas", Wordware publishing, Inc.
5. Steven Roman ,"Writing Excel Macros with VBA" O'Reilly Media.

FS-721: Data Mining and Warehousing Credits: 3 (2-1-0)

Course Objective The main objective of this course is to provide understanding of data warehouse fundamentals and data mining techniques for business applications.

COURSE DESCRIPTION:

UNIT I: Data Warehousing: Introduction data warehousing, Data Mart, Data Warehouse Architecture; Star, Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning. ETL Concepts. OLAP technology: Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, indexing data.

UNIT II: Data Mining: Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining; Introduction to Web Mining, Text Mining. Data Processing: Data Cleaning, Data Integration and Transformation; Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Data Discretization and Concept hierarchy generation for numerical and categorical data.

UNIT III: Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, FP-Growth Algorithm, latest trends in association rules mining.

UNIT IV: Classification methods: Decision tree, Bayesian Classification, Rule based; clustering methods: Partitioning methods(K-Means, K-Mediods) and Hierarchical Clustering (Agglomerative and Divisive Clustering, Multi-phase method) Prediction: Linear and non-linear regression.

Text Books:

1. P.Ponnian, “Data Warehousing Fundamentals”, John Weliey.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.
3. P. N. Tan, M. Steinbach, Vipin Kumar, “Introduction to Data Mining”, Pearson Education.
4. G. Shmueli, N.R. Patel, P.C. Bruce, “Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner”, Wiley India.
5. Michael Berry and Gordon Linoff “Data Mining Techniques”,Wiley Publications.
6. M.H.Dunham, “Data Mining Introductory & Advanced Topics”, Pearson Education.

FS-723: Statistical Programming in R Credits: 3 (2-0-2)

Objective: This course is an introduction to R, a powerful and flexible statistical language and environment that also provides more flexible graphics capabilities than other popular statistical packages. After taking this course, students will be able to –

1. Use R for statistical programming, computation, graphics, and modeling,
2. Write functions and use R in an efficient way,
3. Fit some basic types of statistical models,
4. Use R in their own research,
5. Be able to expand their knowledge of R on their own

COURSE DESCRIPTION:

Unit I: Introduction to R programming language: Getting R, Managing R, Arithmetic and Matrix Operations, Introduction to Functions, Control Structures. Working with Objects and Data: Introduction to Objects, Manipulating Objects, Constructing Data Objects, types of Data items, Structure of Data items, Reading and Getting Data, Manipulating Data, Storing Data.

Unit II: Data Distribution and Statistical Testing: Types of Data distribution, Normal distribution, Poisson distribution, Random number generation, Chi-Square Testing, Student’s t-test, F-test, Monte Carlo Simulation.

Unit III: Graphical Analysis using R: Basic Plotting, Manipulating the plotting window, Box-Whisker Plots, Scatter Plots, Pair Plots, Pie Charts, Bar Charts.

Unit IV: Advanced R: Statistical models in R, Correlation and regression analysis, Analysis of Variance (ANOVA), creating data for complex analysis, Summarizing data, and case studies.

Text Books:

1. Mark Gardener: Beginning R: The Statistical Programming Language, Willey publications
2. Norman Matloff: The Art of R Programming: A Tour of Statistical Software Design, OREILLY & Associates Inc.

FS-725: Information Architecture Credits: 3 (2-1-0)

Objective: The main objective of this course is to help students in mapping, structuring and visualizing functions and applications of information architectures in a variety of complex systems.

UNIT I: Information Architecture: Definition, importance of IA, Challenges for Information Architects Information Architecture Specialists, The "Too-Simple" Information Model, Information Architecture and Related Disciplines. Web 2.0: Web 2.0 Applications and Products; Future of Information Architecture. The essential eight factors: Categories, Understanding, Presentation, Evolution, Knowledge, Responsibility, Process, Meta levels.

Unit II: Basic Principles of IA: Visualizing Information Architecture, Information Architecture Component, Organization Systems: Challenges of organizing Information, organizing website and Intranets, Organization scheme and structure, Social classification, creating Cohesive organization. Labeling Systems: Varieties of Labels, Designing Labels; Navigation Systems: Types of Navigation System, Building Context, Improving Flexibility, Embedded Navigation Systems, Supplemental Navigation Systems, Advanced Navigation Approaches.

UNIT III: Search Systems: Search System Anatomy, Choosing What to Search, Search Algorithms, Query Builders, Presenting Results, Designing the Search Interface. Process and Methodology: Research, Process Overview, Research Framework, Context, Content and Users. Strategy: Developing the Strategy, Work Products and Deliverables, Strategy Report, Project Plan. Design and Documentation: Blueprint Wireframes, Content Mapping and Inventory, Content Models, Controlled Vocabularies, Design Collaboration.

UNIT IV: Information Architecture in Practice: Practicing Information Architecture in the Real World, Education, Ethics, Building Information, Architecture Team, Tools and Software; Information Architecture in the Organization: Business Strategy, Enterprise Information Architecture(EIA) strategy, Designing, and operations.

Case Studies: MSWeb: An Enterprise Intranet, evolt.org: An Online Community

Reference Books:

1. Peter Morville & Louis Rosenfeld Information Architecture for the World Wide Web, 3rd Edition,ISBN 978-0-596-52734-1.
2. Wei Ding, Xia Lin Information Architecture: The Design and Integration of Information Spaces, Morgan & Claypool Publishers.

3. Roger Evernden and Elaine Evernden, Information First: Integrating Knowledge and Information Architecture for Business Advantage, Elsevier Butterworth-Heinemann.
4. Donna Spencer, A Practical Guide to Information Architecture, Five Simple Steps.
5. Andrea Resmini & Luca Rosati "Pervasive Information Architecture" ISBN 978-0-12-382094-5.

FS-727: Multivariate Analysis Credits: 3 (2-1-0)

Objective:

1. To understand the main features of multivariate data.
2. To be able to use exploratory and confirmatory multivariate statistical methods properly.
3. To be able to carry out multivariate statistical techniques and methods efficiently and effectively.

COURSE DESCRIPTION:

UNIT I: Analysis of categorical data. Loglinear models for two- and higher-dimensional contingency tables, Characterizing and Displaying Multivariate Data, Tests on one or two mean vectors.

UNIT II: Multivariate Analysis of Variance, Aspects of multivariate analysis, random vectors, sample geometry and random sampling, multivariate normal distribution, inferences about the mean vector, MANOVA.

UNIT III: Classification and grouping techniques: discrimination and classification, clustering. Logistic regression models.

UNIT IV: Analysis of covariance structures, Principal Component Analysis (PCA), Factor Analysis, Cluster Analysis. Use of statistical computer packages.

Text Books:

1. Applied Multivariate Statistical Analysis, by Richard A. Johnson and Dean W.Wichern (6th edition), Prentice Hall.
2. Characterizing and Displaying Multivariate Data, by A.C.Rencher, John Wiley and Sons.
3. Multivariate Data Analysis, by Joseph F.Hair, William, Babin and Anderson.
4. Cluster Analysis, by Brian S.Everitt, Sabine Landau, Morven Leese. Wiley

SEMESTER-II:

FS-702: Forecasting Methods Credits: 4 (2-1-2)

COURSE OBJECTIVE

This subject is designed in such a way to provide the basic concepts of forecasting models based on quantitative analysis. Risk and uncertainty in forecasting and it is generally considered good practice to indicate the degree of uncertainty attaching to forecasts.

COURSE DESCRIPTION:

Unit I: Introduction: Fo**re**casting perspective, an overview of forecasting methods, basic steps in forecasting. Basic forecasting tools: time series and cross-sectional data, graphical and numerical summaries, forecasting accuracy, prediction intervals, transformations and adjustments.

Unit II: Time series: Decomposition, principles of decomposition, moving averages, classical decomposition, census bureau methods, forecasting and decomposition.

Unit III: Exponential smoothing: averaging methods, Singleexponential smoothing methods, ARRSES, Double exponential soothing methodcomparison of methods, general aspects of smoothing methods.

Unit IV: Regression: Simple regression, forecasting with simple regression, non-linear relationships. Multiple regressions. Box-Jenkins methods: examining correlations in time series data, examining stationary, ARIMA models, forecasting with ARIMA models.

Text Book(s):

1. Spyros Makridakis :Forecasting Method’s and application Wiley
2. N.P. Nagpal :Forecasting Techniques ,RBSA
3. Stephen A. Delurgio: Forecasting Principals and Application,McGraw Hill

FS-704: Hadoop Credits: 4 (2-0-4)

Objective: The main objective of this course is to introduce Hadoop and how to use Hadoop for analysis purpose.

COURSE DESCRIPTION:

UNIT I: Introduction to Hadoop, Hadoop architecture, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases; Hadoop Distributed File system: Design of HDFS, HDFS Concepts, Command-Line Interface, Hadoop File systems Java Interface, Hadoop Archives.

UNIT II: Introduction to MapReduce: Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop, Hadoop Streaming, Hadoop Pipes, Functional programming with Mappers and Reducers. MapReduce Working, types and file formats, features;Setting up Hadoop Cluster.

UNIT III: Pig: Installing and Running Pig, Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators; Hive: Installing Hive, Running Hive, Comparison with Traditional Databases, HiveQL, Tables, Querying Data, User-Defined Functions; HBase: HBasics, Concepts, Installation,Clients, HBase Versus RDBMS, Praxis.

UNIT IV: ZooKeeper: Installing and Running ZooKeeper, The ZooKeeper Service, Building Applications with ZooKeeper, ZooKeeper in Production; Sqoop: Introduction, Sqoop Connectors, Generated Code, Working with Imported Data, Importing Large Objects, Performing an Export; Utilizing your programming environment with Hadoop Streaming, Filtering, Aggregating and Searching; Case Study: Mining data at China Mobile.

Text Books:

1. Tom White,"Hadoop: The Definitive Guide", 3rd Edition, O'Reilly Media, 2012.
2. Donald Miner, Adam Shook, Eric Sammer, “Hadoop Operation”, O’Reilly 2012.
3. Donald Miner, Adam Shook “MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems”, O’Reilly 2012.
4. Chuck Lam, "Hadoop in Action", Manning Publications, 2010.

FS-706: Linear Algebra and Advanced Calculus Credits: 3 (2-1-0)

Objective: The main objective is to students will learn to solve many types of data science problems using Linear Algebra and Calculus.

Course Description:

Unit I: Vector spaces over fields, subspaces, bases and dimension. Systems of linear equations, matrices, rank, Gaussian elimination. Linear transformations, representation of linear transformations by matrices, rank-nullity theorem, duality and transpose.

Unit II: Determinants, cofactors, adjoint, Cramer's Rule. Eigenvalues and eigenvectors, characteristic polynomials, minimal polynomials, Cayley-Hamilton Theorem, triangulation, diagonal-lization, rational canonical form, Jordan canonical form.

Unit III: Inner product spaces, Gram-Schmidt orthonormalization, orthogonal projections, linear functionals and adjoints, Hermitian, self-adjoint, unitary and normal operators, Spectral Theorem for normal operators, Rayleigh quotient, Min-Max Principle.

Unit IV: Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor’s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange’s method of undetermined multipliers. Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

Text Books:

1. K. Hoffman and R. Kunze, Linear Algebra, Pearson Education (India), 2003. Prentice-Hall of India, 1991.
2. S. Lang, Linear Algebra, Undergraduate Texts in Mathematics, Springer-Verlag, New York, 1989.
3. P. Lax, Linear Algebra, John Wiley & Sons, New York,. Indian Ed. 1997
4. H.E. Rose, Linear Algebra, Birkhauser, 2002.
5. Hildebrand, Francis. Advanced Calculus for Applications. 2nd ed. Englewood Cliffs: Prentice Hall, March 31, 1976.
6. Kaplan W., "Advanced Calculus", Addison Wesley (Pearson Education, Inc.), 5 th Edition, 2003
7. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, (2011).

FS-708: Introduction to System Dynamics **Credits: 3 (2-1-0)**

COURSE OBJECTIVES

To understand cause-effect relations in social and management systems.
To analyze complex, dynamic and nonlinear interactions in social systems.
To develop new structures and policies to improve the system behaviour.

COURSE DESCRIPTION:

Unit -I:

Introduction. System concepts, system theories, models. Classification of systems-continuous and discrete, stochastic and deterministic and open and closed systems. System studies: subsystems, types of system studies.

System dynamics paradigm-foundations, framework, viewpoints, philosophy, flexibility, strengths and weaknesses. Stages of problem solving with system dynamics. Examples of managerial and social problems.

Unit-II:

Elements of system dynamics modelling. Physical flows, Level and rate variables, Information flows, Diagramming aids, Delays, Smooth functions, equations, Table functions. Causal-loop diagramming, flow diagramming.

Unit-III:

Steps in system dynamics: Problem identification, Fixing model aggregates and boundary, Detailed model, Model validation, Model analysis. Principles of modelling. Model equations.

Unit-IV:

Development of system dynamics models. Behavior of linear systems, positive feedback, negative feedback systems. Simulation of low order systems. Validation. Applications in planning and policy design for industrial / social systems. System dynamics packages. Case studies.

TEXTBOOKS

Pratap K J Mohapatra, Purnendu Mandal, Madhab C Bora: Introduction to System Dynamics Modelling, Universities Press
Sushil: System Dynamics, Wiley Eastern

FS-710: Machine Learning Credits: 3 (2-1-0)

Objective: The main objective is to help students to understand the fundamental concepts of machine learning.

COURSE DESCRIPTION:

UNIT I: Introduction to Machine Learning, History and Overview of machine learning, Applications, Types of Machine Learning, Basic Concepts. Concept Learning and candidate elimination learning Algorithm.

UNIT II: Artificial Neural Network: biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervise & Unsupervised) and activation function. Supervised Learning: Perceptron learning, Single layer/multilayer, linear Separability, Adaline, Madaline, Back propagation network, RBFN.

UNIT III: Bayesian Learning, Bayes Theorem, Naïve Bayesian classifier, Bayesian belief, EM Algorithm. Dimensionality Reduction: Factor Analysis, Principal Component Analysis, Linear Discriminant Analysis.

UNIT IV: Markov and Hidden Markov Models, PAC Learning, Support Vector Machine, Evolutionary Learning: Genetic Algorithm, generating offspring, applications and genetic programming.

Text Books:

1. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
2. Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
4. Ethem Alpaydin, “Introduction to Machine Learning”, Prentice Hall of India, 2005.
5. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2006.
6. Sanjeev Kulkarni, Gilbert Harman, “An Elementary Introduction to Statistical Learning Theory”, 2011.
7. N. Shivnandam, “Principle of soft computing”, Wiley.

FS-712: Laboratory-Statistical Software Packages (Systat/ SPSS) Credits: 2 (0-0-4)

FS-722: Technology Forecasting Credits: 3 (2-1-0)

Objective: Primarily, a technological forecast deals with the characteristics of technology, such as levels of technical performance, the accuracy or precision of a technology. The forecast does not have to state how characteristics will be achieved. Secondly, technological forecasting usually deals with useful machines, procedures or techniques for society.

Unit I: Introduction Technology forecasting- it's meaning and need, alternatives to forecasting, stages of innovation. Delphi: advantages and disadvantages of committees, Delphi procedure, conducting a Delphi based study.

Unit II: Forecasting technology. Growth curves substitution curves, Pearl curve, Gompertz curve, Fisher-Pry curve, selection of proper growth curve, estimation of upper limit.

Unit III: Trend extrapolation- exponential trends, non-exponential growth, qualitative trends etc. Measures of technology-scoring models, constrained scoring models, planar tradeoff surfaces. Correlation models-lead lag correlation, technology progress function, maximum installation size etc.

Unit IV: Causal models-technology only models, techno economic model, simulation model. Forecasting breakthroughs. Combining forecasts-trend and growth curves, trend and analogy, components and aggregates, scenarios, cross impact models. Normative methods-relevance trees, morphological models, mission flow diagrams.

Text Book:
Technological Forecasting by Martino, Joseph Paul New York, American Elsevier Pub. Co. Publication

FS-724: Big Data and Cloud Computing Credits: 3 (2-1-0)

Objective: The main objective of this subject is to help student to understand basic concepts and technologies of Big data and Cloud.

COURSE DESCRIPTION:

Unit I: Basics of Big Data and Cloud Computing: Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting – Modern Data Analytic Tools. Overview of Cloud Computing, Evolution of Cloud Computing, advantages and disadvantages of Cloud Computing, Applications, Cloud computing vs. Cluster computing vs. Grid computing, NIST

Definition of Cloud computing, features of cloud computing, Cloud Service Models, Deployment Models.

Unit II: Cloud Service Models and Virtualization: Infrastructure as a Service (IaaS): Introduction, Introduction to virtualization, Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, advantages and disadvantages of Cloud Computing, Technologies of virtualization.

UNIT III: Managing the Cloud, Security and Privacy issues in Cloud Computing: Administrating the Clouds, Cloud Management Products; Emerging Cloud Management Products, Managing Cloud Security, Cloud Security Challenges and Risks, Data Security, Virtual Machine Security, Identity Management and Access Control, Authentication in cloud computing

Unit IV: Emerging trends and applications of Cloud Computing: Cloud Databases, Mobile Cloud, Energy Efficient and Green Cloud Computing, Federated Clouds or Inter Cloud, Various Commercial and Scientific Applications of Cloud Computing e.g. Healthcare, Biology and Geoscience applications, CRM, Social networking and online gaming.
Various Cloud Computing and Big Data Toolkits/ Technologies: Google Cloud Services, Amazon Cloud Services, Microsoft Azure, Oracle Public Cloud, Aneka toolkit , Eucalyptus, OpenStack, CloudStack, Hadoop and its components.

Text Books:

1. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India) Private Limited, 2013.
2. Kris A Jamsa: Cloud computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More, 2013, Jones & Bartlett Learning ISBN-13: 9781449647391.
3. Sosinsky B., "Cloud Computing Bible", Wiley India
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.
5. Web Reference: csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf.

FS-726: Natural Language Processing Credits: 3 (2-1-0)

Objective: The main object of this course is to provide an introduction to the field of computational linguistics, and natural language processing (NLP).

COURSE DESCRIPTION:

UNIT I: Introduction to NLP, NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field.

UNIT II: The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Lexical syntax. Hidden Markov Models. Maximum Entropy Models. Conditional Random Fields.

UNIT III: Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing.

UNIT IV: Named entity recognition and relation extraction. IE using sequence labeling. Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars. Web 2.0 Applications : Sentiment Analysis; Text Entailment.

Text Books:

1. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
2. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
3. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
4. Steven Bird, Ewan Klein, and Edward Loper,"Natural Language Processing with Python - Analyzing Text with the Natural Language Toolkit", O'Reilly Media, 2009.
5. Ian H. Witten and Eibe Frank. "Data Mining: Practical Machine Learning Tools and Techniques" , 3rd edition, Morgan Kaufmann, 2005.
6. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

FS-728: Web Mining Credits: 3 (2-1-0)

Objective: The main objective of this course s to student will learn how to apply web mining to derive data driven results.

COURSE DESCRIPTION:

UNIT I: Introduction to Web Mining: Web content, web usage mining and web structure mining. Web crawling: Crawling Basics; Indexing, Text analysis and classification.

UNIT II: Similarity and Clustering/community algorithms: Partitioning Approaches, Geometric Embedding Approaches, and Probabilistic Approaches; Topical locality,

UNIT III: Supervised Text Learining: Evaluating Text Classifiers, Nearest Neighbor Learners, Greedy Inclusion Algorithms, Truncation Algorithms, Exploiting Hierarchy among Topics, Discriminative Classification, Regression, Support Vector Machines, Hypertext Classification. SEMISUPERVISED LEARNING: Expectation Maximization, Labeling Hypertext Graphs.

UNIT IV: Link analysis: PageRank and HITS ranking methods, Ranking algorithms; Web search and retrieval, Web growth models, Web traffic models;Social tagging, Social networks and social media, Information diffusion.Applications of Web mining in Recommendtion system.

Text Books:

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008.
2. Michael Berry and Gordon Linoff, “Data Mining Techniques for Marketing, Sales, and Customer Relationship Management”, Third Edition, John Wiley, 2011.
3. Soumen Chakrabarti,"Mining the Web: Discovering Knowledge from Hypertext Data",Morgan Kaufmann, 2003.
4. Bing Liu “Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data”,2011 edition, Springer.
5. Anthony Scime,"Web Mining: Applications and Techniques", Idea Group Inc (IGI), 2005.

DS-752: Technical Communication Credits: 3 (2-1-0)

Objective:

This course is designed to help the students to develop skills that will enable them to produce clear and effective scientific and technical documents.

Unit I:

Technical writing: Definition, Similarities to other writings, Unique features, importance, technical writing as profession, qualifications for technical writing. Identifying audience. Problems involving content, words and phrases, punctuation, unity, coherence, logic, etc. Being concise.

Unit II:

Techniques of Technical Communication. Analysing-Division, Classification, Partition. Defining-Formal, informal, expanded. Describing-subjective versus objective, spatial description, description of mechanism, process, selected details. Illustrating-Tables, graphs, charts, pictorials. Researching-Basic types of research, original research, searching the literature. Abstracting of your own reports, the works of others, precautions. Oral communication-one to one reporting, participation in conferences, speaking to large audiences, organising the speech.

Unit III:

Basic forms of Technical Writings. The memorandum, The business letter, Formal report.

Unit IV:

Technical reports. Justification reports and proposals, the progress reports, periodic reports, status reports, trip reports. Laboratory reports, Feasibility reports, State-of-the-Art reports. Instructions and manuals.

Text Books:

1. James Sherlock: A Guide to Technical Communication

M.Tech. in Systems Management

Specialization in Information Systems

Batch: 2016-18

Programme Structure

First Semester:

Code	Title	Credits
CORE COURSES		
IS-701	Database Management Systems	4
IS-703	Object Oriented Programming in Java	4
IS-705	Distributed Systems	3
IS-707	Modelling and Simulation	3
IS-709	Probability and Statistics	3
IS-711	System Analysis and Design	3
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
IS-721	Electronic Commerce	4
IS-723	Business Intelligence	4
ELECTIVE GENERIC: The students can choose following course or any other PG level generic course being run in this campus.		
IS-751	Communication Skills	4

Second Semester:

Code	Title	Credits
CORE COURSES		
IS-702	Enterprise Resource Planning	4
IS-704	IT Project Management	4
IS-706	Data Mining and Warehousing	3
IS-708	Big Data and Cloud Computing	3
IS-710	Decision Analysis	3
IS-712	IT Strategy & Management	3
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
IS-722	Information Security Management	4
IS-724	Software Quality Assurance	4
ELECTIVE GENERIC: The students can choose following course or any other PG level generic course being run in this campus.		
IS-752	Technical Communication	4

Third & Fourth Semesters:

Code	Title	Credits
IS-800	M.Tech. Thesis	24

Note: The above course contents can be modified as per requirement from time to time in accordance with University Ordinance No. 31.

DETAILED SYLLABUS

SEMESTER-I:

IS-701: Database Management Systems Credits: 4 (3-1-0)

Objective: The purpose of this course is to provide fundamental knowledge of database management system and understanding of how to use and design a DBMS.

Unit I: DBMS Concepts, Comparison between Database approach and Traditional file accessing approach, Advantages of database systems, Schemas and instances, Data Dependency, Data Dictionary, and Meta Data. Data models, Types of Data models (Object Oriented, Record Based and Physical data models), E-R diagram, Relational Data models: Domains, Tuples, Attributes, Keys, Relational database, Schemas, Integrity constraints, Relational algebra and relational calculus.

Unit II: Database Design: Introduction to normalization, Normal forms (INF, 2NF, 3NF, BCNF), Functional dependency, Decomposition, Dependency preservation and lossless join, multi-valued dependencies. **Structured Query Language**: DDL, DML, DCL, TCL, SQL Functions, integrity constraints, various joins, sub-query, index, View, Sequence, and Clusters. PL/SQL: manipulating data using PL/SQL, Iteration, Exceptions, Cursors, Trigger. (Experiment on Oracle 11g)

Unit III: Transaction Processing and Concurrency Control: Transaction System, Serializability of schedules, conflict & view serializable schedule, Recovery from transaction failures, Log based recovery. Checkpoints dead lock handling, Concurrency Control, locking Techniques for concurrency control, time stamping protocols for concurrency control, validation based protocol, multiple granularity.

Unit IV: Advance Concepts: Introduction to Distributed databases, data mining, data warehousing, Basic Concepts of Object Oriented Database System, Comparative study of OODBMS V/s RDBMS. Introduction to Image and Multimedia databases and data structures, Web and mobile database, Spatial and Geographic Database, Accessing Database from front-end Application. Case Study: Oracle, MySql, DB2.

Reference Books:

1. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, fifth Edition McGraw-Hill.
2. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
3. Rob, Coronel, “Database Systems”, Seventh Edition, Cengage Learning.
4. Ramakrishnan: Database Management System , McGraw-Hill
5. Fred R.McFadden,Jeffrey A.Hoffer & Marry B.Prescott.?Modern Database Management, Fifth Edition,Pearson Education Asia,2001
6. Gray Jim and Reuter Address, “Transaction Processing: Concepts and Techniques”, Moragan Kauffman Publishers.

IS-703: Object Oriented Programming in Java   Credits: 4 (3-1-0)

Objective: The main objective is to help students to understand the fundamentals object oriented programming, concurrent programming using java.

UNIT I: Introduction to Object Oriented Programming paradigm, classes and instances, Abstraction, encapsulation Association, Aggregation, Inheritance, Generalization and Specialization; Introduction to Java: History, Byte Code and Java Virtual Machine, JDK, Data types, variables, scope and life time of variables, arrays, expressions, control statements, type conversion, classes, objects, constructors, methods, access control, this keyword, garbage collection, method overloading, string class, final keyword.

UNIT II: Inheritance: Inheritance, Inheriting Data members and Methods, constructor in inheritance, Multilevel Inheritance, method overriding, super keyword. Packages and Interfaces: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, differences between abstract classes and interfaces, interface, implementing interface. Explore java.io.

UNIT III: Exception handling: introduction to exception handling, benefits of exception handling, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception sub classes; Multithreading: Introduction to multi-threading, multitasking, thread life cycle, creating threads, thread priorities, synchronizing thread, daemon threads.

UNIT IV: Java IO: IO Streams and the new IO Capabilities, Working with File Object, File I/O Basics, Reading and Writing to Files, Buffer and Buffer Management, Read/Write Operations with File Channel, Serializing Objects. Introduction to Collection classes & Interfaces, Core Collections Interfaces: List, Set & Map, Collection Classes – Lists, Sets, Maps & Using an Iterator.

Text Books:

1. Cay S. Horstmann and Gary Cornell, “Core Java: Volume I – Fundamentals”, Eighth Edition, Sun Microsystems Press, 2008.
2. K. Arnold and J. Gosling, “The JAVA programming language”, Third edition, Pearson Education, 2000.
3. Timothy Budd, “Understanding Object-oriented programming with Java”, Updated Edition, Pearson Education, 2000.
4. C. Thomas Wu, “An introduction to Object-oriented programming with Java”, Fourth Edition, Tata McGraw-Hill Publishing company Ltd., 2006.

IS-705: Distributed Systems   Credits: 3 (2-1-0)

Objective: The main objective of this course is to provide students detail understanding of distributed systems.

Unit I: Distributed Systems, Communication in distributed systems, processes and processors in distributed systems. Threads, systems Models, Process allocation, scheduling in distributed systems, fault tolerance, real-time distributed systems.

Unit II: Theoretical issues in distributed systems: Logical clock, mutual exclusion, deadlock detection, agreement protocols, resource security and protection, concurrency control.

Unit III: Distributed File System: Design and implementation, trends.

Unit IV: Distributed shared Memory, consistency models, page-based distributed shared memory, shared variable distributed shared memory, object-based distributed shared memory.

Text Books:

1. Andrew S Tannebaum , Distributed Operating Systems, Pearson
2. Pradeep K. Sinha, Distributed Operating Systems Concepts and Design, PHI
3. Nancy A. Lynch, "Distributed Algorithms", The Morgan Kaufmann Series in Data Management System, Morgan Kaufmann Publishers.
4. George Coulouris, Jean Dollimore,Tim Kindberg,, Distributed Systems: Concepts and Design Pearson.

IS-707: Modelling and Simulation Credits: 3 (2-1-0)

COURSE OBJECTIVE

This course exposes the students in simulation modelling, solving and analysing business and industrial problems using simulation models.

Unit -I: System modelling, classification of models, validation and verification. System simulation, simulation terminology, applications of simulation, Simulation steps, advantages and disadvantages of simulation. Monte Carlo (MC) simulation. An inventory simulation. A waiting line simulation.

Basic probability and statistics. Random variables and their properties, simulation output data and stochastic processes, estimation of means, variances, and correlations, confidence intervals, and hypothesis testing, Strong law of large numbers.

Unit-II: Generation of Random Numbers: Pseudo random numbers: Pseudorandom numbers and algorithm for generating them-mid-square method, linear congruential method, additive congruential method, quadratic congruential method. Testing and validating of pseudo random sequences. Generating random variants: inverse-transform method; generating continuous Random variates: uniform, exponential; generating discrete random variates: Binomial, Poisson. Variance reduction techniques, Experimental design.

Unit-III: Discrete-Event Simulation: Time advance mechanisms. Components and Organization of a discrete event simulation model. Simulation of a single-server queuing system. Simulation of an inventory system. Simulation Languages: Comparison of simulation languages with general purpose languages. Classification of simulation software. Desirable software features. Simulation language – GPSS / SIMSCRIPT – II.5.

Unit-IV: Building valid and credible simulation models, determining the level of model detailing, techniques for increasing model validity and credibility. Output data analysis.

TEXTBOOKS:

1. Averill M. Law: Simulation Modeling & Analysis, Tata McGraw-Hill
2. Geoffrey Gordon: System Simulation, Prentice Hall of India
3. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management

IS-709: Probability and Statistics Credits: 3 (2-1-0)

Objective: The main objective of this course is to provide students fundamental knowledge of probability and statistics.

UNIT I: Probability Theory: Set Theory, Random Experiments and Outcomes, Measure of Probability of Events, Independence Events, Conditional Probability, Some Basic Rules/Theorems of Probability; Counting Techniques and Application to Problems; Random Variables and Probability Distributions: Discrete distributions: degenerate, Bernoulli, Binomial, Poisson, Geometric, Negative binomial, hyper-geometric, uniform, Multinomial distribution and its marginal and conditional distributions. Continuous distributions: Uniform, Normal, Lognormal, Exponential, Laplace, Pareto, Beta, Gamma, Cauchy.

UNIT II: General Introduction, including the Uses and Applications of Statistics, Types of Data and their Collection Methods, Stages of Statistical Investigation; Descriptive Analysis of Data including Exploratory Data Analysis; Central Tendency: mean, mode, median, percentile, moments, kurtosis, and skewness, measures of dispersion: mean deviation, standard deviation, variance.

UNIT III: Correlation: correlation coefficient and its properties, Correlation ratio, Correlation Index, Intra class correlation; Rank correlation: Spearman's and Kendall's measures; Concept of Regression: Principles of least squares, Fitting of polynomial and exponential curves; ANOVA, Design of Experiment.

UNIT IV: Introduction to Sampling Techniques and Sampling Distributions of Sample Means, Hypothesis Testing: Basic Concepts, Significance Tests for Parameters including Analysis of Variance; Non-Parametric Tests: Chi-square Tests, Tests for Independent and Paired Samples; Type I and Type II Errors and Power Function, Neyman-Pearson Lemma and Likelihood Ratio Test for Most Powerful Critical Region.

Text Books:

1. Chung K.L. "Elementary Probability Theory with Stochastic Process", Springer / Narosa
2. Feller W. "An Introduction to Probability Theory & its Applications", John Wiley
3. Goon A.M., Gupta M. K., Dasgupta B., "Fundamentals of Statistics (V-1)",World Press
4. Yule G.U & Kendall M.G., "An Introduction to the Theory of Statistics", C.Griffin
5. Snedecor & Cochran "Statistical Methods" 6th edition, Iowa State Univ. Press.

IS-711: System Analysis and Design Credits: 3 (2-1-0)

Objective:
This course has been designed to provide a foundation of systems principles and an understanding of how analysts can analyze complex business system and develop solution.

Unit I Introduction: System, Concepts, characteristics and components; Types of Systems: Physical System and abstract system, Open and closed system, Man-Made Information System and Formal Information System, Computer based Information System; System analysis and design, Role, task and attribute of the system analyst.

Unit II System Development Life Cycle (SDLC): Recognition of needs, Impetus for System Change, Feasibility Study, Analysis, Design, Implementation, Post implementation and Maintenance; Computer-Aided Software Engineering (CASE) Tools; Different models their advantages and disadvantages: Waterfall approach, Iterative approach, RAD model, Evolutionary software process model (Incremental model, Spiral model, Concurrent development model).

Unit III System Analysis and System Design: Systems Planning and initial investigation, Information Gathering, Tools of structure Analysis (Data Flow Diagram, Data Dictionary, Decision Tree, Structured English and Decision Table), Feasibility Study. **System Design:** Process and Stages of Systems Design, Logical and Physical Design, Design Methodologies (Structured Design), Major Development Activities (Personnel Allocation, Audit Considerations, Processing Controls and Data Validation), Input/output and Form Design, File organization and database design. **Modular and structured design:** Module specifications, Module coupling and cohesion, Top-down and bottom-up design.

Unit IV Object Oriented Analysis and design: Introduction to Object Oriented Analysis and design, Association, Aggregation, Inheritance, encapsulation, Generalization and Specialization. **Unified Modeling Language (UML)**: Class diagram, sequence diagram, Use case diagram, Collaboration diagram, state chart diagram, Activity diagram, component diagram, deployment diagram. **System Implementation:** System Testing and Quality Assurance, Implementation and Software Maintenance, Security and Disaster Recovery.

Text Books:
1. System Analysis and Design Elias M. Award, Galgotia Publication.
2. Essential of System Analysis and Design, Jeffrey A. Hofer Joey F. George Joseph . Valacich Addison Weseley.
3. Systems Analysis and Design, Kenneth E. Kendall, Julie E Kendall, PHI
4. Michael Blaha and J. Rumbugh, "Object oriented Modeling and design with UML", Pearson Education
5. O'Docherty, "Object Oriented Analysis and Design Understanding, System Development with UML2.0", Wiley India.

IS-721: Electronic Commerce Credits: 4 (3-1-0)

OBJECTIVES:
- To understand the concepts of e-commerce

- To know and understand the e-advertising and e-payments systems and marketing strategies.
- To understand the e-security, e-CRM.

Unit I: Framework, Architecture, Benefits and Impact of e-Commerce, The Anatomy of e-Commerce applications, e-Commerce Consumer applications, e-Commerce Organisation Applications, e-commerce in India, Prospects of e-commerce.

Unit II: Network Infrastructure for e-commerce: Intranet, Extranet, & Internet, Internet Backbone in India, ISP and services in India, OSI Model, Standards & Overview of TCP/IP, Internet Security, e-commerce & Internet. E-commerce Models: Business-to-Business-Hubs, Market Places, Business-to-Business Exchange, Business-to-Consumer, Consumer-to-consumer, Business-to-Government, Government-to-Government.

Unit III: e-Advertising & Marketing: The new age of information-based Marketing, Emergence of internet as a competitive advertising media, Market Research, Weakness in Internet Advertising, e-Advertising & Marketing in India. Electronic Payment Systems: Introduction to Payment Systems, On-Line Payment Systems, Pre-Paid e-Payment System, Post-Paid e-Payment System, Requirements Metrics of a Payment System.

Unit IV: Electronic Data Exchange: EDI- Definitions & Applications, Standardisation and EDI, EDI-Legal Security and Privacy Issues, Advantages & Limitations of EDI. E-Security: Securing the Business on Internet- Security Policy, Procedures and Practices, Transaction Security, Cryptology, Digital Signatures, Security Protocols for Web Commerce. e-CRM: CRM, what is e-CRM, it's Applications, The e-CRM Marketing in India, Major Trends, Global Scenario for e-CRM, CRM utility in India.

References:

1. Jeffrey F.Rayport & Bernard J.Jaworski: Introduction to E-commerce, TMH, 2003.
2. Kalakota & Winston: Frontiers of E-commerce, Pearson Education, Mumbai, 2002.
3. David Whiteley: E-Commerce- Strategy technologies and Applications, Tata Mac-Graw Hill, New Delhi, 2000.
4. C.S.V.Murthy: E-Commerce-Concepts, Models & Strategies, Himalaya Publishing house, Mumbai, 2003.
5. Kamalesh K Bajaj & Debjani Nag: E-Commerce, the Cutting Edge of Business- Tata McGraw-Hill, New Delhi, 2002.
6. Bharat Bhaskar: Electronic Commerce,Tata Mc-Graw-Hill, New Delhi, 2003.
7. Perry: E-Commerce, Thomson Publications, New Delhi,2003.
8. Elias M.Awad: Electronic Commerce,Prentice-Hall India, New Delhi,.2002.

IS-723: Business Intelligence Credits: 4 (3-1-0)

Objective: The main objective of the course is to prepare to lead, build and manage effective Business Intelligence systems in today's dynamic and challenging business environment.

Unit I: Introduction, Creating Business Intelligence Environment, Business Intelligence Landscape, Types of Business Intelligence, Business Intelligence Platform, Dynamic roles in Business Intelligence, Roles of Business Intelligence in Modern Business- Challenges of BI.

Unit II: Business Intelligence Life Cycle: Introduction, Business Intelligence Lifecycle, Enterprise Performance Life Cycle Framework Elements, Life Cycle Phases, Human Factors in BI Implementation, BI Strategy, Objectives and Deliverables, Transformation Roadmap, Building a transformation roadmap, BI Development Stages and Steps, Parallel Development Tracks, BI Framework.

Unit III: Business Intelligence User Model: Introduction, Evolution of Business Intelligence, Business Intelligence Opportunity Analysis Overview, Content Management System, End User Segmentation, Basic Reporting and Querying, Online Analytical Processing, OLAP Techniques, OLAP Applications, Applying the OLAP to Data Warehousing, Benefits of using OLAP, Dashboard, Advanced/Emerging BI Technologies, Future of Business Intelligence.

Unit IV: Business Intelligence Issues and Challenges: Introduction, Critical Challenges for Business Intelligence success, Cross-Organizational Partnership, Business Sponsors, Dedicated Business Representation, Availability of Skilled Team Members, Business Intelligence Application Development methodology, Planning the BI Projects, Business Analysis and Data Standardization, effect of Dirty Data on Business profitability, Importance of Meta-Data, Silver Bullet Syndrome, Customer Pain Points, Creating Cost Effective Enterprise friendly BI solution.

Text Books:

1. Larissa T. Moss and Shaku Atre, "Business Intelligence Roadmap, the complete project lifecycle for decision support applications", Addison-Wesley Professional.
2. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", Wiley India.
3. Michael Berry and Gordon Linoff "Data Mining Techniques",Wiley Publications.

IS-751: Communication Skills Credits: 4 (3-1-0)

OBJECTIVE: To make use of the opportunities and meet the challenges of the modern world, students need to develop effective communication skills. This is a skill that is most often quoted as lacking in engineers and IT professionals. Proper communication skills are also extremely important in interpersonal relationships. This course will help students in becoming confident and effective communicators, who can project themselves positively to others.

Unit I: Introduction to Communication: Need for Effective Communication. The Process of Communication: Levels of communication; Flow of communication; Use of language in communication; Communication networks; Significance of technical communication. Barriers to Communication: Types of barriers; miscommunication; noise; overcoming measures.

Unit II: Listening Skills: Listening as an active skill; Types of Listeners; Listening for general content; Listening to fill up information; Intensive Listening; Listening for specific information; Developing effective listening skills; Barriers to effective listening skills.

Reading Skills: Previewing techniques; Skimming; Scanning; Understanding the gist of an argument; Identifying the topic sentence; Inferring lexical and contextual meaning; recognizing coherence and sequencing of sentences; Improving comprehension skills.

Writing Skills: Sentence formation; Use of appropriate diction; Paragraph and Essay Writing; Coherence and Cohesion.

Unit III: Letter Writing: Formal, informal and demi-official letters; business letters. Job Application: Cover letter, Differences between bio-data, CV and Resume. Report Writing: Basics of Report Writing; Structure of a report; Types of reports. Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language.

Unit IV: Interview Skills: Types of Interviews; Ensuring success in job interviews; Appropriate use of non-verbal communication. Group Discussion: Differences between group discussion and debate; Ensuring success in group discussions. Presentation Skills: Oral presentation and public speaking skills; business presentations. Technology-based Communication: Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software.

Text Books:

1. Spoken English & Effective Communication (With 2 CDs): Mind Power Spoken English Institute by by Prof. Sharad Srivastava and Dr Amita Singhvi; Franklin International; New edition (2015)
2. Communication Skills by Sanjay Kumar and Pushp Lata; Oxford University Press India; (2015)
3. El Dorado: A Textbook of Communication Skills by R. Pushkala and P.A.Sarada; Orient Blackswan; (2013)

SEMESTER-II:

IS-702: Enterprise Resource Planning Credits: 4 (3-1-0)

Objective: The main objective is to help student to understand strategic importance of ERP in business process and how to create competitive advantage from managerial point of view.

UNIT I: Introduction to ERP, Need of ERP, Evolution of ERP, ERP and Related Technologies: Business Intelligence, E-Commerce and E-Business, Business Process Reengineering, Decision Support Systems (DSS), Executive Support Systems (ESS), Data Warehousing, Data Mining, OLTP, OLAP, Product life Cycle management, SCM, CRM, M-Commerce.

UNIT II: ERP Business Modules: Finance, Manufacturing, Human Resources, Plant maintenance, Materials Management, Production Planning, Quality management, Marketing, Sales, Distribution and service.

UNIT III: ERP Implementation: Implementation Challenges, Strategies, Life Cycle, Pre-implementation Tasks, Requirements Definition, Methodologies, ERP Package selection, Project Planning, Project Teams, Process Definitions, role of Vendors and Consultants, Project management, End User Training, Testing, Post Evaluation and Maintenance.

UNIT IV: ERP in Market place: Dynamics, SAP AG, Oracle, PeopleSoft, JD Edwards, QAD Inc, SSA Global, Lawson Software, Baan Enterprise, Epicor. Application Integration: ERP and E-Business, ERP II, ERP III, Total quality management, Future Directions, Trends in ERP. Cloud ERP, Open Source ERP and its vendors, Case studies of ERP Implementations.

Reference Books:

1. Alexis Leon, “ERP DEMYSTIFIED”, Tata McGraw Hill, Second Edition, 2008.
2. V. K. Garg & N. K. Venkita Krishnan, “ERP Concepts & Planning”.
3. V. K. Garg & N. K. Venkita Krishnan, “ERP Ware: ERP Implementation Framework”.
4. Joseph A Brady, Ellen F Monk, Bret Wagner, “Concepts in Enterprise Resource Planning”, Thompson Course Technology, USA, 2001.
5. Mary Sumner, “Enterprise Resource Planning”, Pearson Education, 2007.

IS-704: IT Project Management Credits: 4 (3-1-0)

Course Objective: This course is aimed at providing both basic and some advanced exposure to Project Management, so as to enable the manager of tomorrow to successfully complete sophisticated projects within the constraints of capital, time, and other resources.

UNIT I: Introduction, Project Management Purpose, Project, Project Management, Relationships - Portfolio Management, Program Management, Project Management, Operations Management, Organizational Project Management and Organizational Strategy, Business Value, Project Manager Role. Organizational Influences on Project Management, Project Stakeholders & Governance, Project Team, Project Life Cycle, Project Management & Information Technology Context, System view of Project Management, Context of Information Technology Projects.

Project Management Process Groups (Initiating, Planning, Executing, Monitoring & Controlling, Closing), Project Management Processes & Knowledge Areas. Common Process Interactions. Project Integration Management, Processes -Develop Project Charter, Develop Project Management Plan, Direct and Manage Project Work, Monitor and Control Project Work, Perform Integrated Change Control, Close Project or Phase

UNIT II: Project Scope Management, Processes - Plan Scope Management, Collect Requirements, Define Scope, Create WBS, Validate Scope, Control Scope. Project Time Management, Processes - Plan Schedule Management, Define Activities, Sequence Activities, Estimate Activity Resources, Estimate Activity Durations, Develop Schedule, Control Schedule

Project Cost Management, Processes - Plan Cost Management, Estimate Costs, Determine Budget, Control Costs. Project Quality Management, Processes - Plan Quality Management, Perform Quality Assurance, Control Quality.

UNIT III: Project Human Resource Management, Processes - Plan Human Resource Management, Acquire Project Team, Develop Project Team, Manage Project Team. Project Communications Management, Processes - Plan Communications Management, Manage Communications, Control Communications.

Project Risk Management, Processes -Plan Risk Management, Identify Risks, Perform Qualitative Risk Analysis, Perform Quantitative Risk Analysis, Plan Risk Responses, Control Risks. Project Procurement Management, Processes - Plan Procurement Management, Conduct Procurements, Control Procurements, Close Procurements.

UNIT IV: Project Stakeholder Management, Processes - Identify Stakeholders, Plan Stakeholder Management, Manage Stakeholder Engagement, Control Stakeholder Engagement. Project Management Styles in Industry, Agile Methodology, Scrum, Lean, Extreme, Benefits Realization Model.

Text Books:

1. Information Technology Project Management, Kathy Schwalbe, 5th Edition, Thomson
2. Project Management Prassana Chandra
3. Project Management Mantle, Meredith
4. PMBOK 5th Edition, PMI
5. Head First Project Management
6. Project Management by Kim Heldman

IS-706: Data Mining and Warehousing Credits: 3 (2-1-0)

Course Objective The main objective of this course is to provide understanding of data warehouse fundamentals and data mining techniques for business applications.

UNIT I: Data Warehousing: Introduction data warehousing, Data Mart, Data Warehouse Architecture; Star, Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning. ETL Concepts.
OLAP technology: Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, indexing data.

UNIT II: Data Mining: Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining; Introduction to Web Mining, Text Mining.
Data Processing: Data Cleaning, Data Integration and Transformation; Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Data Discretization and Concept hierarchy generation for numerical and categorical data.

UNIT III: Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, FP-Growth Algorithm, latest trends in association rules mining.

UNIT IV: Classification methods: Decision tree, Bayesian Classification, Rule based; clustering methods: Partitioning methods(K-Means, K-Mediods) and Hierarchical Clustering(Agglomerative and Divisive Clustering, Multi-phase method) Prediction: Linear and non-linear regression;

Text Books:

1. P.Ponnian, "Data Warehousing Fundamentals", John Weliey.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.
3. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education.
4. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", Wiley India.
5. Michael Berry and Gordon Linoff "Data Mining Techniques",Wiley Publications.
6. M.H.Dunham, "Data Mining Introductory & Advanced Topics", Pearson Education.

IS-708: Big Data and Cloud Computing Credits: 3 (2-1-0)

Objective: The main objective of this subject is to help student to understand basic concepts and technologies of Big data and Cloud.

Unit I: Basics of Big Data and Cloud Computing: Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting – Modern Data Analytic Tools. Overview of Cloud Computing, Evolution of Cloud Computing, advantages and disadvantages of Cloud Computing, Applications, Cloud computing vs. Cluster computing vs. Grid computing, NIST Definition of Cloud computing, features of cloud computing, Cloud Service Models, Deployment Models.

Unit II: Cloud Service Models and Virtualization: Infrastructure as a Service (IaaS): Introduction, Introduction to virtualization, Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, advantages and disadvantages of Cloud Computing, Technologies of virtualization.

UNIT III: Managing the Cloud, Security and Privacy issues in Cloud Computing: Administrating the Clouds, Cloud Management Products; Emerging Cloud Management Products, Managing Cloud Security, Cloud Security Challenges and Risks, Data Security, Virtual Machine Security, Identity Management and Access Control, Authentication in cloud computing

Unit IV: Emerging trends and applications of Cloud Computing: Cloud Databases, Mobile Cloud, Energy Efficient and Green Cloud Computing, Federated Clouds or Inter Cloud, Various Commercial and Scientific Applications of Cloud Computing e.g. Healthcare, Biology and Geoscience applications, CRM, Social networking and online gaming. **Various Cloud Computing and Big Data Toolkits/ Technologies:** Google Cloud Services, Amazon Cloud Services, Microsoft Azure, Oracle Public Cloud, Aneka toolkit , Eucalyptus, OpenStack, CloudStack, Hadoop and its components.

Text Books:

1. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India) Private Limited, 2013.
2. Kris A Jamsa: Cloud computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More, 2013, Jones & Bartlett Learning ISBN-13: 9781449647391.
3. Sosinsky B., "Cloud Computing Bible", Wiley India
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.
5. Web Reference: csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf.

IS-710: Decision Analysis Credits: 3 (2-1-0)

COURSE OBJECTIVE

This course introduces and applies advanced modelling techniques to decision problems with the objective of enhancing the decision-making skills as well as the spreadsheet knowledge base.

Unit-I: Probability:

Basic Probability: Laws of probability-addition law, conditional law. Random variables and probability distributions. Expectation of a random variable-mean and variance of a random variable, mean and variance of joint random variables. Probability distributions-Binomial, Poisson, Normal, Exponential. Empirical distributions.

Unit-II: Game Theory:

Introduction, definitions, two-person zero sum game. Game with pure strategies, saddle point, game value. Game with mixed strategies, solution methods-algebraic method, graphical method, dominance, linear programming method.

Unit-III: Decision Making:

Structuring the decision problem-payoff tables, decision trees. Decision making under certainty. Decision making under risk: Expected value criterion, expected value of perfect information, sensitivity analysis, decision making with sample information, expected value of sample information, computing branch probabilities, utility and decision making. Decision making under uncertainty: Laplace, Minimax, Savage, Hurwicz.

Unit-IV: Multicriteria Decision Making:

Multicriteria decision making: Goal programming, Scoring models, Analytical Hierarchy Process, TOPSIS. Markov Analysis.

TEXT BOOKS:

1. Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
2. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
3. William J. Stevenson: Introduction to Management Science, IRWIN.

IS-712: IT Strategy and Management Credits: 3 (2-1-0)

Objective: The main objective of this course is to student understand linkage between business and IT to develop IT strategy for competitive advantage.

UNIT I: Business Strategy: Challenges and Opportunities for IT Business Strategy: Challenges and Opportunities in the Globalized, Interconnected, Convergent World, Establish Principles before Practice, IT Strategy, Application Strategy, Technology Strategy for IT, IT Management Strategy, Developing IT Strategy for Competitive Advantage, Stages of IT Strategy Development and Implementation. Business and IT Strategy Alignment: Inhibitors of Business and IT Strategy Alignment, Three-D Framework for Business and IT Strategy Alignment, Achieve business and IT alignment.

Unit II : Strategic IT Planning: Business Implications for IT Strategic and Planning, Strategic IT Planning Motivations, SITP Process: Prevalent Planning Approaches, Difficulties in Developing and Executing SITP, Best Practices for Achieving Good SITP, SITP Approaches: Prevalent Researches; Planning Horizon, Resource Planning, change management issues, monitoring and measuring SITP performance.

Unit III: IT Service Management Strategy: Information Technology Infrastructure Library (ITIL), ITIL Overview, ITIL Service Support Processes, Incident Management, Problem Management, Service Delivery, Service Level Management, Financial Management, Capacity Management, IT Service Continuity Management (ITSCM).

Unit IV: Technology Management strategy for IT: Framework, Technology Strategy Prevalent Technology Reference Architectures Framework and Standards. IT sourcing strategy: Outsourcing, IT Management Layers, Variants of Outsourcing, Business Process Outsourcing, Insourcing.

Text Books:

1. Sanjiva Shankar Dubey, “IT Strategy and Management”,PHI.
2. Eng K. Chew, Petter Gottschalk, "Information Technology Strategy and Management: Best Practices",Information Science Reference , 2009

IS-722: Information Security Management Credits: 4 (3-1-0)

Objective: The purpose of this course is to provide fundamental knowledge of Information Security and introduction of some advance research topics.

Unit I: Need for security, Security approaches, Principles of security, various security attacks. Basic of Cryptography, secret key cryptography, Types of attack, Substitution ciphers, Transposition ciphers, block ciphers and steam ciphers, Hill Cipher, Data encryption standard, Cryptanalysis, brute force attack; Public key cryptography, Principles of Public key Cryptosystems, Cryptographic Algorithms RSA, Diffie-Hellman key exchange; Digital Signature.

Unit II: Authentication: One way Authentication, password based, certificate based, Mutual Authentication, shared secret based, Asymmetric based, Authentication and key agreement, centralized Authentication, eavesdropping, Kerberos, IP Security, Secure Socket Layer(SSL), Transport Layer Security (TLS).

Unit III Software vulnerabilities, Threats and Security Systems: Phishing Attacks, buffer overflow vulnerability, Format String attack, Cross Site Scripting, SQL injection Attacks, Denial-of-Service (DoS), Sniffing, Spoofing and Email security. Malware: Backdoors, Trojan horse, Viruses and it's Characteristics, Working, Infection Phases, Worms, Zombie. **Security Systems:** Intrusion Detection System, need and types of IDS, Intrusion Prevention Systems; Firewalls: functionality, Polices and Access Control, Packet filters, Application level gateway; Anti-Intrusion Technique: Honey pot; Anti-virus.

Unit IV Advance Concepts of IS: Introduction to Identity based Cryptography, Data Hiding and It's applications, Data hiding techniques: Steganography, Watermarking; Cloud Security; Biometric Security; Introduction to Computer Forensic, Hacking, Cyber Crime.

Text Books:

1. Cryptography and Network Security – B. Forouzan, McGraw-Hill.
2. William Stalling, "Cryptography and Network security", Pearson.
3. Cryptography & Network Security: Atul Kahate, TMH.
4. Matt Bishop, Computer Security- Arts and Science, Pearson Education, 2003.
5. Pieprzyk et.al, Fundamentals of Computer Securiry, Allied Publishers, 2004.
6. Rebecca Gurley Bace, Intrusion Detection, Technology Series MTP 2007.
7. Ingemar Cox, Matthew Miller, Jeffrey Bloom, Jessica Fridrich, Ton Kalker, Digital Watermarking and Steganography,2nd Edition, Morgan Kaufmann, 2007.

IS-724: Software Quality Assurance Credits: 4 (3-1-0)

Objective: The main Objective of the course is to student will learn basic concepts of software quality assurance and able to differentiate between the various activities of quality assurance, quality planning and quality control.

Unit I: Software Quality: Cost of quality, Quality models, Quality frameworks, Verification and Validation, Defect management, IEEE standards, Quality assurance and control processes, Verification techniques: Inspections, reviews, walk-throughs.

Unit II: Validation: Test plan, Test cases, Test Generation, Monitoring and Measuring Test Execution, Test Tools and Automation, Equivalence partitioning, Boundary value analysis, Category partition method, combinatorial generation, and Decision tables.

Unit III: Structural Testing: Test adequacy criteria, Control flow graph, Coverages: block, conditions, multiple conditions, Data flow graph – Definition and use coverages, C-use, P-use, Defclear, Def-use, Finite state machines, Transition coverage. Fault based testing, Mutation analysis.

Unit IV: Functional Testing: Test adequacy criteria, Test cases from use cases, Exploratory testing: Integration, system, acceptance, regression testing; testing for specific attributes: Performance, load and stress testing, Usability testing, Security testing, Test automation.

Text Books:

1. Aditya P. Mathur, "Foundations of Software Testing", Pearson, 2008.
2. P. Ammann and J. Offutt. Introduction to Software Testing. Cambridge University Press
3. Daniel Galin, Software Quality Assurance : From Theory to Implementation, Addison Wesley.
4. Nina S Godbole, "Software Quality Assurance: Principles and Practice", Alpha Science International
5. Mordechai Ben-Menachem, Garry S Marliss, "Software Quality", Vikas Publishing House.

IS-752: Technical Communications Credits: 4(3-1-0)

Objective:
This course is designed to help the students to develop skills that will enable them to produce clear and effective scientific and technical documents.

Unit I:
Technical writing: Definition, Similarities to other writings, Unique features, importance, technical writing as profession, qualifications for technical writing. Identifying audience. Problems involving content, words and phrases, punctuation, unity, coherence, logic, etc. Being concise.

Unit II:
Techniques of Technical Communication. Analysing-Division, Classification, Partition. Defining-Formal, informal, expanded. Describing-subjective versus objective, spatial description, description of mechanism, process, selected details. Illustrating-Tables, graphs, charts, pictorials. Researching-Basic types of research, original research, searching the literature. Abstracting of your own reports, the works of others, precautions. Oral communication-one to one reporting, participation in conferences, speaking to large audiences, organising the speech.

Unit III:
Basic forms of Technical Writings. The memorandum, The business letter, Formal report.

Unit IV:
Technical reports. Justification reports and proposals, the progress reports, periodic reports, status reports, trip reports. Laboratory reports, Feasibility reports, State-of-the-Art reports. Instructions and manuals.

Text Books:

1. James Sherlock: A Guide to Technical Communication.

M.B.A. in Business Analytics

Batch: 2017-19

Programme Structure

First Semester:

Code	Title	Credits (L T P)
CORE COURSES		
BA-501	Principles of Management	3 (2-1-0)
BA-503	Organisational Behaviour	3 (2-1-0)
BA-505	Business Mathematics and Statistics	3 (2-1-0)
BA-507	Principles of Economics	3 (2-1-0)
BA-509	Database Management	3 (2-0-2)
BA-511	Python for Analytics	3 (2-0-2)
BA-513	Spreadsheet Modelling	2 (0-0-4)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
BA-521	Fundamentals of Algorithms	3 (2-0-2)
BA-523	Decision Analysis	3 (2-1-0)
ELECTIVE GENERIC: The students can choose following course or any other PG level generic course being run in this campus.		
BA-551	Communication Skills	3 (2-1-0)

Second Semester:

Code	Title	Credits (L T P)
CORE COURSES		
BA-502	Operations Research	3 (2-1-0)
BA-504	Marketing Management	3 (2-1-0)
BA-506	Financial Management	3 (2-1-0)
BA-508	Big Data Technologies	3 (2-0-2)
BA-510	Data Mining and Data Warehousing	3 (2-0-2)
BA-512	Machine Learning	3 (2-0-2)
BA-514	Programming in R	3 (2-0-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
BA-522	Business Intelligence	3 (2-0-2)
BA-524	Business Dynamics	3 (2-1-0)
ELECTIVE GENERIC: The students can choose following course or any other PG level generic course being run in this campus.		
BA-552	Research Methodology	3 (2-1-0)

Third Semester:

Code	Title	Credits (L T P)
CORE COURSES		
BA-601	Forecasting Methods	3 (2-1-0)
BA-603	Project Management	3 (2-1-0)

BA-605	Supply Chain Management	3 (2-1-0)
BA-607	Econometrics	3 (2-1-0)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
BA-621	Marketing Analytics	3 (2-0-2)
BA-623	Financial Analytics	3 (2-0-2)

Fourth Semester:

Code	Title	Credits (L T P)
Project		
BA-602	Industry Internship	12

Note: The above course contents can be modified as per requirement from time to time in accordance with University Ordinance No. 31.

DETAILED SYLLABUS

FIRST SEMESTER:

BA-501: Principles of Management Credits: 3 (2-1-0)

Objective: Objective of this course is to help the students gain understanding the functions and responsibilities of the manager, provide them tools and techniques to be used in the performance of managerial job, and enable them to analyze and understand the environment of the organization.

COURSE DESCRIPTION:

Unit I: Concept of Management: Introduction to Management & Organizations, Functions and Responsibilities of Managers, Fayol's Principles of Management, Management thought; the Classical School, The Human Relations School, Systems theory, Contingency Management Developing Excellent Managers.

Unit II: Planning: Nature and purpose of planning process, principles of Planning, Types of planning, Advantages and Limitation of planning. Concept and Nature of Objectives: Types of Objectives, Importance of Objectives, Setting objectives, Management by Objective (MBO) benefits and weaknesses of MBO.

Unit III: Strategies and Policies: Concept of Corporate Strategy, formulation of strategy, Types of strategies, Types of policies, principles of formulation of policies, Decision Making Process, Individual Decision Making Models.

Organizing: Nature and Purpose of Organizing, Bases of Departmentation, Span Relationship, Line Staff Conflict, Bases of Delegation, Kind of Delegation and Decentralization, methods of Decentralization.

Unit IV: Controlling: Concept and Process of Control, Control Techniques. Human Aspects of Control, Control as a feedback system, feed forward Control, Preventive Control, Profit and loss Control, Control through Return on investment, the use of Computer of Controlling & Decision making, the challenges created by IT a Control tool.

Text Books:

1. Horold Koontz, O'Donnell and Heinz Weihrich, "Essentials of Management' New Delhi, Tata McGrow Hill, 1992.
2. R.D. Agrawal, "Organization and Management" New Delhi, Tata McGrow Hill 1995.
3. Stephen Robbins "Management" 8th Ed. New Delhi Pearson 2006
4. The New Era of Management (India Edition) by Richard L. Daft Suggested Reading:
5. Horold Koontz, Heinz Weihrich, "Management: A Global Perspective" New Delhi Tata McGrow Hill, 10^{th} Ed. 1994.
6. Robert Krietner, "Management" Houghton Miffin CO. 7 th Ed.1999.
7. Stephen Robbins "Management" 8th Ed. New Delhi Pearson 2006

BA-503: Organisational Behaviour Credits: 3 (2-1-0)

Objective: Objective of this course is to help students to understand Human Behavior in organizations so that they improve their managerial effectiveness.

COURSE DESCRIPTION:

Unit I: Foundations of Individual and Organizational Behaviour: OB Models, Personality Determinants and Attributes, Values, Job Attitudes, Learning and Learning Theories, Perception- Factors affecting Perception and Cognitive Dissonance theory.

Motivation: Needs, Contents and Processes; Maslow's Hierarchy of Needs, Herzberg's Two Factor theory, ERG theory, Vroom's Expectancy theory, Reinforcement theory and Behaviour Modification.

Unit II: Foundations of Group Behaviour: Defining and Classifying Groups, Group Structure and Processes, Process of Group formation, Group Decision Making, Group v/s Team, Team Effectiveness, and Decision Making.

Leadership: Trait theories, Behavioural theories-Ohio State Studies, Michigan Studies, and Managerial Grid. Contingency theories-- Fiedler's Model, Hersey and Blanchard's Situational theory, Leader-Member Exchange theory, Path Goal theory, Charismatic Leadership.

Unit III: Conflict: Intra-individual Conflict, Interpersonal Conflict, Intergroup Conflict, Organizational Conflict, Transitions in Conflict Thought, Functional versus Dysfunctional Conflict, Conflict Process, Conflict Management Techniques.

Unit IV: Organizational Change and Stress Management: forces of Change, Resistance to Change, and Lewin's Three-Step Model, Stress Management—Potential Sources, Consequences and Coping Strategies for Stress. Organizational Culture: Definition, Uniform Cultures, Relevance of Culture, Creating and Sustaining Culture, How Employees Learn Culture.

Text Books:

1. Stephen P. Robbins, "Organizational Behaviour: Concepts, Controversies, and Applications", New Delhi, Prentice Hall, 9th Ed., 2000.
2. Fred Luthans, "Organizational Behaviour", New York, McGraw Hill, 8th Edn., 1998.
3. Bill Scott, "The Skills of Communications", Jaico Publications, Bombay 1995.
4. John W. Newstrom and Keith Davis, "Organizational Behaviour: Human Behaviour at Work" New Delhi, Tata McGraw Hill, 1993.

BA-505: Business Mathematics and Statistics Credits: 3 (2-1-0)

Objective:

The objectives of the course are to equip the students with the mathematical and statistical techniques and their application to business problems. The emphasis will be on the concepts, application and cases rather than derivations.

COURSE DESCRIPTION:

UNIT I: Sets, Functions, and Progressions (with specific applications to compounding and discounting techniques) Implications of Limit of Functions, Continuity of a function of one variable.

Unit II: Differentiation and Integration of simple functions with one variable: Applications of differentiation in economic and managerial problems like marginal analysis, elasticity, Maxima and Minima, Consumer Surplus and Producer surplus. Integration Concepts: Economic application, consumer surplus and producer surplus.

Determinants and Matrices with Business application: Types of matrices, operations on matrices, Adjoint matrix, inverse matrix, elementary row operations. Solution of simultaneous linear equations using matrices, input/output analysis.

Unit III: Introduction to Statistics: Introduction to Measurement of Central Tendency and Variations. Probability Theory and Probability Distributions: Concepts, additive, multiplicative, conditional probability rules, Baye's Theorem, Binomial, Poisson and Normal distributions- their characteristics and applications

Unit IV: Correlation and Regression: Correlation (Karl Pearson's and Spearman's Coefficient), Methods of computing simple correlation and regression, Least square method.

Text Books:

1. J.K. Sharma, "Mathematics for Management and Computer Applications", New Delhi, Galgotia Publication.
2. S. Saha, "Business Mathematics and Quantitative Techniques", Calcutta, Central Book Agency, 2000.
3. Richard I. Levin and D.S. Rubin, "Statistics for Management", New Delhi: Prentice Hall of India, 2000
4. S. P. Gupta, "Statistical Methods", New Delhi, Sultan Chand and Sons, 2001
5. D. C. Sancheti and V. K. Kapoor, "Statistics: Theory, Methods and Applications", New Delhi: Sultan Chand and Sons., 2001
6. D.N. Elhance, Veena Elhance and B. M. Aggrawal, "Fundamentals of Statistics", Allahabad: Kitab Mahal, 1996.

BA-507: Principles of Economics Credits: 3 (2-1-0)

Course Objectives: The basic objective of this course is to make the students aware of the various economic issues that they are expected to face as managers at the corporate level and to equip them with the tools and techniques of economic analysis for improving their decision-making skills.

COURSE DESCRIPTION:

Unit-I: Introduction to Economics: Definitions, Nature and Scope of Economics; Difference between Microeconomics and Macroeconomics; Significance in decision-making and fundamental concepts. Consumer Demand Analysis: Meaning, Features and Determinants of demand; Law of Demand and its Exceptions; Reasons for Law of Demand; Importance of Law of Demand; Elasticity of Demand.

Unit-II: Supply Analysis: Meaning, Supply Function, Law of Supply, Determinants of Supply, Law of supply; Reasons for Law of Supply; Elasticity of supply and its measurement. **Theory of Production**: Production Function, Factors of Production; Law of Variable Proportions; Law of returns to scale Cost, Revenue and Profit Analysis: Cost Classifications for Predicting Cost Behavior; Concept of Profit, Gross Profit and Net Profit; Break Even Point (BEP).

Unit-III: Market Structure: Perfect Competition, features, determination of price under perfect competition. Monopoly: Feature, pricing under monopoly, Price Discrimination. Monopolistic: Features, pricing under monopolistic competition, product differentiation.

Unit-IV: National Income: Circular Flow of Income, Meaning and Concept of National Income: GNP/GNI, NNP/NNI, Personal Income and Disposable Income; Methods of Computing National Income -Production Method, Income Method, Expenditure Method.

Inflation-Types of Inflation, Causes, Effects, Inflation and Unemployment. **Economic Stabilization:** Monetary Policy- Meaning, Objectives, Tools; Fiscal Policy- Meaning, Objectives, Tools

Text Books:

1. J S Chandan, *Statistics for Business and Economics,*
2. H. L. Ahuja, Principles of Microeconomics,
3. D. N. Dwivedi, Macroeconomics Theory and Policy, Tata McGraw-Hill
4. S Damodaran, *Managerial Economics*.
5. Sunny Thomas & Wahida Thomas, Business Economics
6. Hirschey Mark, Economics for Managers, Thomson Publication

BA-509: Database Management Credits: 3 (2-0-2)

Objective: The purpose of this course is to provide fundamental knowledge of database management system and understanding of how to use and design a DBMS.

Unit I: DBMS Concepts, Comparison between Database approach and Traditional file accessing approach, Advantages of database systems, Schemas and instances, Data Dependency, Data Dictionary, and Meta Data. Data models, Types of Data models (Object Oriented, Record Based and Physical data models), E-R diagram, Relational Data models: Domains, Tuples, Attributes, Keys, Relational database, Schemas, Integrity constraints, Relational algebra and relational calculus.

Unit II: Database Design: Introduction to normalization, Normal forms (INF, 2NF, 3NF, BCNF), Functional dependency, Decomposition, Dependency preservation and lossless join, multi-valued dependencies. **Structured Query Language**: DDL, DML, DCL, TCL, SQL Functions, integrity constraints, various joins, sub-query, index, View, Sequence, and Clusters. PL/SQL: manipulating data using PL/SQL, Iteration, Exceptions, Cursors, Trigger. (Experiment on Oracle 11g)

Unit III: Transaction Processing and Concurrency Control: Transaction System, Serializability of schedules, conflict & view serializable schedule, Recovery from transaction failures, Log based recovery. Checkpoints dead lock handling, Concurrency Control, locking Techniques for concurrency control, time stamping protocols for concurrency control, validation based protocol, multiple granularity.

Unit IV: Advance Concepts: Introduction to Distributed databases, data mining, data warehousing, Basic Concepts of Object Oriented Database System, Comparative study of OODBMS V/s RDBMS. Introduction to Image and Multimedia databases and data structures, Web and mobile database, Spatial and Geographic Database, Accessing Database from front-end Application. Case Study: Oracle, MySql, DB2.

Reference Books:

1. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, fifth Edition McGraw-Hill.
2. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
3. Rob, Coronel, “Database Systems”, Seventh Edition, Cengage Learning.
4. Ramakrishnan: Database Management System , McGraw-Hill
5. Fred R.McFadden,Jeffrey A.Hoffer & Marry B.Prescott.?Modern Database Management, Fifth Edition,Pearson Education Asia,2001
6. Gray Jim and Reuter Address, “Transaction Processing: Concepts and Techniques”, Moragan Kauffman Publishers.

BA-511: Python for Analytics Credits: 3 (2-0-2)

Objective: The main objective is to help students to understand the fundamentals of python. Student will learn how to analysis data using Python.

COURSE DESCRIPTION:

UNIT I: Introduction to Python: Python versus Java, Python Interpreter and it’s Environment, Python installation, Python basics: variables, operators, Strings, Conditional and Control Statements, loops; Data structures: lists and dictionaries; functions: global functions, local functions, lambda functions and methods.

UNIT II: Object Oriented Programming Concepts: Class, object, constructor, destructor and inheritance; Modules & Packages, File Input and Output, Catching exceptions to deal with bad data, Multithreading, Database Connectivity.

UNIT III: Numpy: Creating Arrays, Arrays Operations, Multidimensional ArraysArrays transformation, Array Concatenation, Array Math Operations, Multidimensional Array and its Operations, Vector and Matrix. **Visualization:** Visualization with matplotlib, Figures and subplots, Labeling and arranging figures, Outputting graphics.

UNIT IV: Pandas: Manipulating data from CSV, Excel, HDF5, and SQL databases, Data analysis and modelling with Pandas, Time-series analysis with Pandas, Using Pandas, the Python data analysis library, Series and Data Frames, Grouping, aggregating and applying, Merging and joining.

Text Books:

1. McKinney Wes, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.
2. Hauck Trent, "Instant Data Intensive Apps with Pandas How-To", Packt Publishing Ltd, 2013.
3. Beazley David M.,"Advanced Python Programming", Pearson Education,2009.
4. Chun Wesley , Core Python Programming, 3rd Edition,Prentice Hall Professional, 2012.
5. Telles Matt "Python Power!: The Comprehensive Guide", Cengage Learning, 2008.
6. McKinney Wes & PyData Development Team, "pandas: powerful Python data analysis toolkit", Release 0.13.1, Feb 2014.
7. https://docs.python.org/3.4/tutorial/
8. http://www.tutorialspoint.com/python/python_quick_guide.htm

BA-513: Spreadsheet Modelling Credits: 2 (0-0-4)

Objective: The main objective of this course is to learn analysis of data using MS Excel, resulting in less time and better understands what the data means.

COURSE DESCRIPTION:

Unit I: Introduction to Excel User Interface**,** Application, Workbook, Worksheets & its Components, Named Ranges; Formatting: Cell Color, Font Color, Indents, Alignments, Number Formats, Custom Formats, Editing commands; Data Sorting: Built-in Sort, Sorting Levels, Custom Sort; Data Filtering: Auto Filter – Filter By Color, Filter by Icono Advanced Filter, Remove Duplicates; Data Subtotal – Built-In Subtotal (Nested Subtotal).

Unit II: Data Validation: Based on cell values (text length, whole no Based on Formulas, List Dropdown, Circle Invalid Data, Input & Error Messages; Data Grouping: Grouping Rows, Grouping Columns. Data Tables: Conditional Formatting, Formatting based on Cell values, Formatting based on Formulas, Icon Sets (bars, scales, icons), Freezing Panes, Text-to-Columns, Delimited, Fixed Length; Data Consolidation (from multiple files), Getting External Data into Excel, From MS Access, From Text files, From Web, Other Data Sources.

Unit III: Formulas, TEXT Functions, IF, ERROR Functions, LOGICAL Functions, VLOOKUP, HLOOKUP, COUNTIF, SUMIF, SUMPRODUCT, DATE & TIME FUNCTIONS, FORMULA TEXT, Information Functions (ISNA, ISEVEN, ISERR…).

Unit IV: Charts: Chart Types, Chart Components, Primary Vs Secondary Axis, Chart Formatting, Sparkline (2010 and above); Pivot Tables: Introduction & Creation, Slicer, TimeLine, Pivot Charts, Calculated Fields, Calculated Items, Grouping, Formatting – Number/Conditional, PowerPivot, PowerView.

Assignment: Dashboard design

Text Books:

1. John Walkenbac, "Excel 2016 Bible", John Willey & sons.
2. Jordan Goldmeier , "Advanced Excel Essentials", Apress Publisher.
3. Conrad George Carlberg , "Business Analysis with Microsoft Excel", Que Publishers.
4. Bernd Held, "Microsoft Excel Functions & Formulas", Wordware publishing, Inc.
5. Steven Roman ,"Writing Excel Macros with VBA" O'Reilly Media.

BA-521: Fundamentals of Algorithms Credits: 3 (2-0-2)

Objective: The main object of this course is to provide an introduction to create analytical skills, to enable the students to design algorithms for various applications, and to analyse the algorithms.

COURSE DESCRIPTION:

Unit I: Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation- Big oh notation, Omega notation, Theta notation and Little oh notation

Unit II: Divide and conquer: General method, applications-Binary search, Quick sort, Merge sort, Strassen's matrix multiplication.

Unit III: Greedy method: General method, applications-Job sequencing with deadlines, 0/1 knapsack problem, Minimum cost spanning trees, Single source shortest path problem. Dynamic Programming: General method, applications-Matrix chain multiplication, Optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem, Travelling sales person problem.

Unit IV: Backtracking: General method, applications-n-queen problem, sum of subsets problem, graph colouring, Hamiltonian cycles. Branch and Bound, NP-Hard and NP-Complete problems: Basic concepts, non-deterministic algorithms, NP - Hard and NP Complete classes, Cook's theorem.

TEXT BOOKS

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithm", Pearson Education Asia, 2003.
2. T.H.Cormen,C.E.Leiserson, R.L.Rivest,and C.Stein "Introduction to Algorithms", second edition, ,PHI Pvt. Ltd./ Pearson Education
3. R.C.T.Lee, S.S.Tseng, R.C.Chang and T.Tsai, "Introduction to Design and Analysis of Algorithms A strategic approach", Mc Graw Hill.
4. Ellis Horowitz,Satraj Sahni and Rajasekharam," Fundamentals of Computer Algorithms",Galgotia publications pvt. Ltd.
5. Parag Himanshu Dave, Himanshu Bhalchandra, " Design and Analysis Algorithms", Dave Publisher: Pearson

BA-523: Decision Analysis Credits: 3 (2-1-0)

OBJECTIVE:

This course introduces and applies advanced modelling techniques to decision problems with the objective of enhancing the decision-making skills as well as the spreadsheet knowledge base.

COURSE DESCRIPTION:

Unit-I: Probability: Basic Probability: Laws of probability-addition law, conditional law. Random variables and probability distributions. Expectation of a random variable-mean and variance of a random variable, mean and variance of joint random variables.

Unit-II: Game Theory: Introduction, definitions, two-person zero sum game. Game with pure strategies, saddle point, game value. Game with mixed strategies, solution methods-algebraic method, graphical method, dominance, linear programming method.

Unit-III: Decision Making: Structuring the decision problem-payoff tables, decision trees. Decision making under certainty. Decision making under risk: Expected value criterion, expected value of perfect information, sensitivity analysis, decision making with sample information, expected value of sample information, computing branch probabilities, utility and decision making. Decision making under uncertainty: Laplace, Minimax, Savage, Hurwicz.

Unit-IV: Multi-criteria Decision Making: Multi-criteria decision making: Goal programming, Scoring models, Analytical Hierarchy Process, TOPSIS. Markov Analysis.

TEXTBOOKS

1. Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
2. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
3. William J. Stevenson: Introduction to Management Science, IRWIN.

BA-551: Communication Skills Credits: 3 (2-1-0)

OBJECTIVE:

To make use of the opportunities and meet the challenges of the modern world, students need to develop effective communication skills. This is a skill that is most often quoted as lacking in IT professionals. Proper communication skills are also extremely important in interpersonal relationships. This course will help students in becoming confident and effective communicators.

COURSE DESCRIPTION:

Unit I: Introduction to Communication: Need for Effective Communication. The Process of Communication: Levels of communication; Flow of communication; Use of language in communication; Communication networks; Significance of business communication. Barriers to Communication: Types of barriers; miscommunication; noise; overcoming measures.

Unit II: Listening Skills: Listening as an active skill; Types of Listeners; Listening for general content; Listening to fill up information; Intensive Listening; Listening for specific information; Developing effective listening skills; Barriers to effective listening skills.

Reading Skills: Previewing techniques; Skimming; Scanning; Understanding the gist of an argument; Identifying the topic sentence; Inferring lexical and contextual meaning; recognizing coherence and sequencing of sentences; Improving comprehension skills.

Writing Skills: Sentence formation; Use of appropriate diction; Paragraph and Essay Writing; Coherence and Cohesion.

Unit III: Letter Writing: Formal, informal and demi-official letters; business letters. Job Application: Cover letter, Differences between bio-data, CV and Resume. Report Writing: Basics of Report Writing; Structure of a report; Types of reports. Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language.

Unit IV: Interview Skills: Types of Interviews; Ensuring success in job interviews; Appropriate use of non-verbal communication. Group Discussion: Differences between group discussion and debate; Ensuring success in group discussions. Presentation Skills: Oral presentation and public speaking skills; business presentations. Technology-based Communication: Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software.

Text Books:

1. Spoken English & Effective Communication (With 2 CDs): Mind Power Spoken English Institute by by Prof. Sharad Srivastava and Dr Amita Singhvi; Franklin International; New edition (2015).
2. Communication Skills by Sanjay Kumar and Pushp Lata; Oxford University Press India; (2015).
3. El Dorado: A Textbook of Communication Skills by R. Pushkala and P.A.Sarada; Orient Blackswan; (2013).

SECOND SEMESTER:

BA-502: Operations Research — Credits: 3 (2-1-0)

COURSE OBJECTIVE:

This course exposes the students in mathematical modelling, solving and analysing business and industrial problems using operations research methods.

COURSE DESCRIPTION:

Unit -I:

Introduction, History, Development of Operations Research, Characteristics of Operations Research, Models in Operations Research, Principles of Modelling. Pre-modelling-Need Recognition, Problem Formulation. Modelling-Model development, Data collection, Model solution, Model validation, and sensitivity analysis. Post-modelling-Interpretation of results and implications, Decision making, Implementation, and Control.

Unit-II:
Linear Programming, Formulation of Linear programming Problems. Solution Methods-Graphical, Simplex, M-Technique, Two-Phase. Special cases of LP problems. Duality, Primal-dual relationships, Dual simplex method. Sensitivity analysis. Solving LP problems using computer software.

Unit-III:
Transportation Model-Formulating the model, Initial Feasible Solution-North-West Method, Least Cost Method, Vogel's Approximation Method. Optimum Solution-MODI method, Stepping Stone Method. Special issues of transportation problems. Assignment Model: Formulating the model, Solving the assignment problem using Hungarian method. Special issues of assignment problems.

Integer programming: Types of integer programming problems, Formulating the model, Solution using Branch and bound method. Goal Programming.

Solving the problems using computer software.

Unit-IV:
Project Scheduling: CPM and PERT. Inventory models: Functions of inventory, information requirements for inventory management-demand, lead time, inventory costs, and quantity on hand. Objectives of inventory management. Economic Order Quantity Models-Economic order size, economic production run, quantity discounts. Determining the reorder point.

Queuing Models: Goals, elements and characteristics of queuing systems, Measures of system performance, Waiting line models-single channel, multiple channel. Cost considerations.

TEXT BOOKS
Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
William J. Stevenson: Introduction to Management Science, IRWIN.

BA-504: Marketing Management Credits: 3 (2-1-0)

COURSE OBJECTIVE:
The objectives of this course are to provide the students exposure to modern marketing concepts, tools, and techniques, and help them develop abilities and skills required for the performance of marketing functions.

COURSE DESCRIPTION:

Unit -I:
Marketing Concepts: Customer Value and Satisfaction, Customers Delight, Conceptualizing Tasks and approaches to Marketing Management, Value chain, scanning the Marketing Environment. Market Segmentation, Targeting, Positioning: Market segmentations, patterns, procedures, requirement for effective segmentation, Niche Marketing, selecting the market segments, tool for competitive differentiation, developing a positioning strategy.

Unit -II:
Marketing Information System and Marketing Research Process. Product Decision: Objectives, Product classification & Product Portfolio, Product life cycle strategies, branding, packaging, labelling. Pricing Decision: Factors affecting price, pricing methods and strategies, Types of competition.

Unit -III:
Distribution Decisions: Importance and Functions of Distribution Channel, Considerations in Distribution Channel Decisions, Types of Channel Members, Retail formats. Promotion Decisions: A view of Communication Process, developing effective communication, Promotion-Mix elements – Advertising, Personal Selling, Sales Promotion and Public Relation.

Unit -IV:
Introduction to International Marketing: EPRG framework, Deciding to go abroad, deciding which markets to enter, Deciding on the marketing program, Country of origin effect.

Emerging Trends in Marketing: An introduction to Digital Marketing, Multi level Marketing, and Introduction of CRM & EVENT marketing.

TEXT BOOKS:
1. Philip Kotler, Kelvin & Keller, Abraham Koshy, Mithileshwar Jha "Marketing Management", A South Asia perspective –New Delhi : Pearson Education.
2. Rajan Saxena – Marketing Management, TMH .
3. Dhiraj Sharma, Marketing – Cengage.
4. Czinkota & Kotabe – Marketing Management – Cengage Latest Edition.
5. Baines, Fill & Page – Marketing Management, Oxford University Press Latest Edition.

BA-506: Financial Management Credits: 3 (2-1-0)

COURSE OBJECTIVE:
The objectives of this course are to help the students learn the concepts, tools and skills of financial analysis and financial management, and application in the efficient conduct of business.

COURSE DESCRIPTION:

Unit -I:
Introduction: Concept of Finance, Corporate Finance, Finance Functions and other functions. Structures of the Financial System. Meaning and Objectives of Financial Management, Scope and Functions of Financial Management, Wealth Maximization v/s Profit Maximization. Short Term and Long Term Sources of Finance in India.

Unit -II:
Cost-Volume-Profit Analysis: Concept, BEP in units, BEP in rupees, Multiproduct BEP, Margin of Safety, P/V Ratio. Ratio Analysis: Liquidity, Profitability, Leverage and Activity Ratios. Calculation and Interpretation. Investment Decisions: Time Value of Money, DCF and Non DCF Methods for Evaluating Projects, Cost of Debt, Cost of Preference, Cost of Equity, Weighted Average Cost of Capital.

Unit -III:
Leverage Analysis: Determination of operating leverage, financial leverage and total leverage, Leverage and Financial Distress. Statement of Changes in Financial Position: Funds Flow Statement; Total Resource Method, Working Capital Method and Cash Method, Cash Flow Analysis. Capital Structure and Firms Value: Net Income Approach, Net Operating Income Approach, Traditional Approach, MM Approach. EBIT --- EPS Analysis, ROI - ROE Analysis.

Unit -IV:
Dividend Policy: Relevance and Irrelevance Theories of Dividend, Factors affecting the dividend policy, Alternative Forms of Dividend. Working Capital Management: Cash and Liquidity Management, Credit Management, Determination of Working Capital and its Financing, CMA form for Working Capital.

TEXT BOOKS

1. Pandey, I.M. financial Management, Vikas Publishing House, New Delhi.
2. Khan M.Y. and Jain P.K. Financial Management, Tata McGraw Hill, New Delhi.
3. Keown, Arthu J., Martin, John D., Petty, J. William and Scott, David F, Financial Management. Pearson Education.
4. Chandra, Prasanna; Financial Management TMH, New Delhi.
5. Van Horn, James C., Financial management and Policy, Prentice Hall of India.
6. Brigaham & Houston, Fundamentals of Financial Management, Thomson Learning, Bombay.
7. Kishore, R., Financial Management, Taxmans Publishing House, New Delhi.

BA-508: Big Data Technologies Credits: 3 (2-0-2)

Course Objective: The main objective of this course is to introduce big data technologies such as Hadoop, spark and analyzing big datasets in spark using python.

COURSE DESCRIPTION:

UNIT I: Introduction
Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting – Modern Data Analytic Tools. Big Data Analytics Process, Big Data Analytics for Business. Identifying problem and solving problem in Big Data environment. Analyzing Unstructured vs. Structured Data, Databases.

UNIT II: Hadoop and MapReduce
Introduction to Hadoop, Hadoop architecture, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases; Hadoop Distributed File system: Design of HDFS, HDFS Concepts. Introduction to MapReduce: MapReduce Basic Concepts, Understanding the Map Reduce architecture, Writing MapReduce Programs. understanding Map phase, shuffling, sorting, and reducing phase.

UNIT III: Spark

Introduction to Spark, Resilient Distributed Dataset (RDD), RDD Operations: actions and transforamtion funtions. Spark Dataframes, operations on Dataframes: Join, groupby, aggregate, handling missing data.

UNIT IV: SparkSQL and MLLib

SparkSQL and its basic operations. MLLib: Data types, Basic statistics, Classification (Logistic regression, Decision tree classifier)and linear regression model generation, Model Evaluation, Collaborative filtering, and Clustering.

Text Books:

1. Arvind Sathi, “Big Data Analytics: Disruptive Technologies for Changing the Game”, 1st Edition, IBM Corporation, 2012.
2. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, 1st Edition, Wiley and SAS Business Series, 2012.
3. Tom White,"Hadoop: The Definitive Guide", 3rd Edition, O'Reilly Media, 2012.
4. Donald Miner, Adam Shook, Eric Sammer, “Hadoop Operation”, O’Reilly, 2012.
5. Donald Miner, Adam Shook “MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems”, O’Reilly 2012.
6. Chuck Lam, "Hadoop in Action", Manning Publications, 2010.
7. https://spark.apache.org/docs/2.0.0/programming-guide.html

BA-510: Data Mining and Data Warehousing Credits: 3 (2-0-2)

Course Objective The main objective of this course is to provide understanding of data warehouse fundamentals and data mining techniques for business applications.

COURSE DESCRIPTION:

UNIT I: Data Warehousing: Introduction data warehousing, Data Mart, Data Warehouse Architecture; Star, Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning. ETL Concepts. OLAP technology: Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, indexing data.

UNIT II: Data Mining: Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining; Introduction to Web Mining, Text Mining. Data Processing: Data Cleaning, Data Integration and Transformation; Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Data Discretization and Concept hierarchy generation for numerical and categorical data.

UNIT III: Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, FP-Growth Algorithm, latest trends in association rules mining.

UNIT IV: Classification methods: Decision tree, Bayesian Classification, Rule based; clustering methods: Partitioning methods(K-Means, K-Mediods) and Hierarchical Clustering (Agglomerative and Divisive Clustering, Multi-phase method) Prediction: Linear and non-linear regression.

Text Books:

1. P.Ponnian, “Data Warehousing Fundamentals”, John Weliey.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.
3. P. N. Tan, M. Steinbach, Vipin Kumar, “Introduction to Data Mining”, Pearson Education.
4. G. Shmueli, N.R. Patel, P.C. Bruce, “Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner”, Wiley India.
5. Michael Berry and Gordon Linoff “Data Mining Techniques”,Wiley Publications.
6. M.H.Dunham, “Data Mining Introductory & Advanced Topics”, Pearson Education.

BA-512: Machine Learning Credits: 3 (2-0-2)

Objective: The main objective is to help students to understand the fundamental concepts of machine learning.

COURSE DESCRIPTION:

UNIT I: Introduction to Machine Learning, History and Overview of machine learning, Applications, Types of Machine Learning, Basic Concepts. Concept Learning and candidate elimination learning Algorithm.

UNIT II: Artificial Neural Network: biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervise & Unsupervised) and activation function. Supervised Learning: Perceptron learning, Single layer/multilayer, linear Separability, Adaline, Madaline, Back propagation network, RBFN.

UNIT III: Bayesian Learning, Bayes Theorem, Naïve Bayesian classifier, Bayesian belief, EM Algorithm. Dimensionality Reduction: Factor Analysis, Principal Component Analysis, Linear Discriminant Analysis.

UNIT IV: Markov and Hidden Markov Models, PAC Learning, Support Vector Machine, Evolutionary Learning: Genetic Algorithm, generating offspring, applications and genetic programming.

Text Books:

1. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
2. Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
4. Ethem Alpaydin, “Introduction to Machine Learning”, Prentice Hall of India, 2005.
5. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2006.
6. Sanjeev Kulkarni, Gilbert Harman, “An Elementary Introduction to Statistical Learning Theory”, 2011.
7. N. Shivnandam, “Principle of soft computing”, Wiley.

BA-514: Programming in R Credits: 3 (2-0-2)

Objective: This course is an introduction to R, a powerful and flexible statistical language and environment that also provides more flexible graphics capabilities than other popular statistical packages. After taking this course, students will be able to –

1. Use R for statistical programming, computation, graphics, and modeling,
2. Write functions and use R in an efficient way,
3. Fit some basic types of statistical models,
4. Use R in their own research,
5. Be able to expand their knowledge of R on their own

COURSE DESCRIPTION:

Unit I: Introduction to R programming language: Getting R, Managing R, Arithmetic and Matrix Operations, Introduction to Functions, Control Structures. Working with Objects and Data: Introduction to Objects, Manipulating Objects, Constructing Data Objects, types of Data items, Structure of Data items, Reading and Getting Data, Manipulating Data, Storing Data.

Unit II: Data Distribution and Statistical Testing: Types of Data distribution, Normal distribution, Poisson distribution, Random number generation, Chi-Square Testing, Student’s t-test, F-test, Monte Carlo Simulation.

Unit III: Graphical Analysis using R: Basic Plotting, Manipulating the plotting window, Box-Whisker Plots, Scatter Plots, Pair Plots, Pie Charts, Bar Charts.

Unit IV: Advanced R: Statistical models in R, Correlation and regression analysis, Analysis of Variance (ANOVA), creating data for complex analysis, Summarizing data, and case studies.

Text Books:

1. Mark Gardener: Beginning R: The Statistical Programming Language, Willey publications
2. Norman Matloff: The Art of R Programming: A Tour of Statistical Software Design, OREILLY & Associates Inc.

BA-522: Business Intelligence **Credits: 3 (2-0-2)**

COURSE OBJECTIVE:

This course contains multiple learning objectives:

1. To introduce basic business intelligence terminology
2. To provide you with a managerial overview of data driven decision making
3. To introduce real-world business intelligence examples across different industries
4. To reveal opportunities in improving business performances with business analytics
5. To train your skill in using business intelligence software
6. To expose you to trends in business intelligence
7. To practice your management skills in business intelligence project.

COURSE DESCRIPTION:

Unit I:

Business Intelligence an Introduction: Introduction, Definition, History and Evolution, Business Intelligence Segments, Difference between Information and Intelligence, Defining Business Intelligence Value Chain, Factors of Business Intelligence System, Real time Business Intelligence, Business Intelligence Applications.

Business Intelligence Essentials: Introduction, Creating Business Intelligence Environment, Business Intelligence Landscape, Types of Business Intelligence, Business Intelligence Platform, Dynamic roles in Business Intelligence, Roles of Business Intelligence in Modern Business- Challenges of BI.

Business Intelligence Types: Introduction, Multiplicity of Business Intelligence Tools, Types of Business Intelligence Tools, Modern Business Intelligence, the Enterprise Business Intelligence, Information Workers.

Unit II:

Knowledge Management: Introduction, Characteristics of Knowledge Management, Knowledge assets, Generic Knowledge Management Process, Knowledge Management Technologies, Essentials of Knowledge Management Process.

Business Intelligence Life Cycle: Introduction, Business Intelligence Lifecycle, **Enterprise Performance Life Cycle (EPLC)**Framework Elements, Life Cycle Phases, Human Factors in BI Implementation, BI Strategy, Objectives and Deliverables, Transformation Roadmap, Building a transformation roadmap, BI Development Stages and Steps, Parallel Development Tracks, BI Framework.

Unit III:

Business Intelligence User Model: Introduction, Evolution of Business Intelligence, Business Intelligence Opportunity Analysis Overview, Content Management System, End User Segmentation, Basic Reporting and Querying, Online Analytical Processing, OLAP Techniques, OLAP Applications, Applying the OLAP to Data Warehousing, Benefits of using OLAP, Dashboard, Advanced/Emerging BI Technologies, Future of Business Intelligence.

Business Intelligence Issues and Challenges: Introduction, Critical Challenges for Business Intelligence success, Cross-Organizational Partnership, Business Sponsors, Dedicated Business Representation, Availability of Skilled Team Members, Business Intelligence Application Development methodology, Planning the BI Projects, Business Analysis and Data Standardization, affect of Dirty Data on Business profitability, Importance of Meta-Data, Silver Bullet Syndrome, Customer Pain Points, Creating Cost Effective Enterprise friendly BI solution.

Unit IV:

Business Intelligence Strategy and Road Map: Introduction, Planning to implement a Business Intelligence Solution, Understand Limitations of Business Intelligence, Business Intelligence Usage, How to make the best use of Business Intelligence?, The Advantages of BI with Sales, How can BI be used for the rescue?, Organization Culture, Managing Total Cost of Ownership for Business Intelligence, Total Cost of Ownership and Business Intelligence, Managing the TCO of the Business Intelligence, Factors that Affect Total Cost of Ownership.

Implementing Business Intelligence: Introduction, Business Intelligence Platform, Business Intelligence Platform Capability Matrix, BI Target Databases, Data Mart, BI Products and Vendor, The Big Four Business Intelligence vendors.

Text Books:

1. Data Science for Business: What You Need to Know about Data Mining and Data Analytic Thinking, by Provost & Fawcett, O'Reilly, 2013. http://www.amazon.ca/DataScience-Business-data-analytic-thinking/dp/1449361323
2. Business Intelligence: A Managerial Perspective on Analytics, by Sharda, Delen and Turban, Pearson, 2013. http://www.amazon.ca/Business-Intelligence-ManagerialPerspective-Analytics/dp/0133051056
3. Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie or Die, by Eric Siegel, Wiley, 2012
4. The Signal and the Noise: Why So Many Predictions Fail — But Some Don’t, by Nate Silver, Pearson, 2012
5. Data Mining Techniques: For Marketing, Sales and Customer Relationship Management, by Linoff and Berry, Wiley, 2011.

6. Big Data: A Revolution that Will Transform How We Live, Work and Think by MayerSchonberger and Cukier, HMH, 2012

BA-524: Business Dynamics Credits: 3 (2-1-0)

COURSE OBJECTIVE:
The objective of teaching this course is to enable students to understand the behaviour of dynamic systems using dynamic models.

COURSE DESCRIPTION:
Unit-I:
Introduction and overview. System dynamics modelling process: purpose, steps of modelling, overview of modelling. Structure and behaviour of dynamic systems: Dynamic behaviour-exponential growth, goal seeking, oscillation. S-shaped growth, Overshoot and collapse, Equilibrium, Chaos.

Unit-II:
Reference modes, mapping and the grammar of causal links, Causal loop diagrams. Stocks and flows-diagramming notations, mathematical representation. Dynamics of stocks and flows. Dynamics of simple structures: first order systems, second order systems, positive feedback, negative feedback.

Unit-III:
Tools for modelling dynamics systems: Delays-Material delays, information delays, mathematics of delays. System Dynamics Modelling: principles, rate equations, level equations. Formulating non-linear relationships, table functions. Model testing.

Unit-IV:
The dynamics of growth: Modelling S-shaped growth-epidemics, innovation diffusion, growth of new product. Supply chains and origin of oscillations.

Texts and Software:
1. Sterman, J. (2000). Business Dynamics: Systems Thinking and Modeling for a Complex World (Text and CD-ROM). Irwin/McGraw Hill. ISBN 0-07-238915X.
2. Deaton, Michael L. and Winebrake James J. (1999): Dynamic Modeling of Environmental Systems, Springer.
3. Mohapatra P.K.J., Mandal P, Bora M.C. (1994), Introduction to System Dynamics Modeling, Universities Press.

Software packages for system dynamics simulation are available commercially, including **iThink**, from High Performance Systems, **Powersim**, from Powersim Corporation, and

Vensim, from Ventana Systems. All are highly recommended. You may wish to learn more about these packages, as all are used in the business world, and expertise in them is increasingly sought by potential employers. For further information, see the following resources:

iThink: See the High Performance Systems web site at www.hps-inc.com
Powersim: See the Powersim web site at www.powersim.com
Vensim: See the Ventana Systems web site for vensim at www.vensim.com

BA-552: Research Methodology Credits: 3 (2-1-0)

COURSE OBJECTIVE:
The objective of teaching this course is to enable students to conduct research.

COURSE DESCRIPTION:

Unit-I:
Introduction to research, Need, Importance and Characteristics of research, Types of research – An overview, Quantitative and qualitative research, Review of literature. Identification, Definition and Statement of Problem, Variables, Role of variables in research, Research Questions and Objectives.

Unit-II:
Hypotheses, Hypotheses Testing, Population and Sample, Probability Sampling Techniques, Non - Probability Sampling Techniques, Error, types of error.

Unit-III:
Research Design – An Overview, Philosophical and Historical, Survey, Case Studies, Experimental Designs, Research Tools. Process of Research Tools Designing, Questionnaire Designing, Test Designing, Scale Designing, Scaling Techniques. Process of Standardising Research Tools, Data Analysis Overview.

Unit-IV:
Frequency Distribution, Statistical Tools: Measures of Central Tendency, Measure of Variability, Comparing Means: Independent Sample t-test, Paired Sample t-test, One Way ANOVA, Factorial Design ANOVA, ANCOVA, Factor Analysis and Non-parametric Statistical Techniques.

Report Writing, IPR and Plagiarism, Statistical Software and Research Paper Writing.

Text Books:

1. Kerlinger, F.N: Foundations of Behavioral Research, Surjeet Publication, New Delhi, 1983.

2. Sterling, T. and Pollack, S: Introduction to Statistical Data Processing, Prentice Hall, 1968.
3. Campbell, W: Forms and style in Thesis Writing, 3rd ed., Boston., Houghton, Mifflim, 1969.
4. McNemar, Orinn: Psychological Statistics, John Wiely and Sons, 1960.
5. Molstad, John A.: Selective Review of Research Studies Showing Media Effectiveness: A Primer for Media Director. AV communication review vol.22, 1974.
6. S.P. Gupta, Statistical Methods, S.Chand
7. C.K.Kothari, Research Methodology, New Age Publications.

Third Semester:

BA-601: Forecasting Methods Credits: 3 (2-1-0)

COURSE OBJECTIVE:

This subject is designed in such a way to provide the basic concepts of forecasting models based on quantitative analysis. Risk and uncertainty in forecasting and it is generally considered good practice to indicate the degree of uncertainty attaching to forecasts.

COURSE DESCRIPTION:

Unit I: Introduction: Forecasting perspective, an overview of forecasting methods, basic steps in forecasting. Basic forecasting tools: time series and cross-sectional data, graphical and numerical summaries, forecasting accuracy, prediction intervals, transformations and adjustments.

Unit II: Time series: Decomposition, principles of decomposition, moving averages, classical decomposition, census bureau methods, forecasting and decomposition.

Unit III: Exponential smoothing: averaging methods, Single exponential smoothing methods, ARRSES, Double exponential soothing method comparison of methods, general aspects of smoothing methods.

Unit IV: Regression: Simple regression, forecasting with simple regression, non-linear relationships. Multiple regressions. Box-Jenkins methods: examining correlations in time series data, examining stationary, ARIMA models, forecasting with ARIMA models.

Text Book(s):

1. Spyros Makridakis :Forecasting Method's and application Wiley
2. N.P. Nagpal :Forecasting Techniques ,RBSA
3. Stephen A. Delurgio: Forecasting Principals and Application,McGraw Hill

BA-603: Project Management Credits: 3 (2-1-0)

COURSE OBJECTIVE:

To acquaint students with project management methods and to develop skills on project planning, analysis implementation and control.

COURSE DESCRIPTION:

Unit-I:

Project Planning and Phases: Need And Importance, Phases of Capital Budgeting, Project Analysis Facts, Resource Allocation Framework (Investment Strategies, Portfolio Planning Tools, and Interface between Strategic Planning and Capital Budgeting), Generation and Screening of Project Ideas.

Unit-II:

Project Analysis: Market and Demand Analysis, (Including Demand Forecasting), Location Analysis, Technical Analysis and Financial Analysis (Cost of Project, Working Capital Requirement & Its Financing), Social Cost Benefit Analysis.

Unit-III:

Project Selection: Project Cash Flows, Time Value of Money, Cost of Capital, Appraisal Criteria and Analysis of Risk. Preparing Project Report, Financial Projections, Estimating Costs. Project Financing, Project Appraisal by Financial Institutions.

Unit-IV:

Project Management and Control: Project Organizations, Planning and Control of Project& Human Aspects of Project Management, Project Control Tools (Gantt Charts, Line Off Balance) Network Techniques for Project Management: Basic Concepts of Networks, Line Estimation and Determination of Critical Path (For Both PERT and CPM Models), Network Cost Systems and Activity Crashing.

Project Review: Need for Reviews, Initial Review, Performance Evaluation, Abandonment Analysis, Evaluating the Capital Budgeting Systems. Public and Private Sector Projects, Other Issues: Tax Implications, Environmental, Health and Safety.

Text Books:

1. Prasanna Chandra. "Project Planning, Analysis, Selection, Implementation and Review", New Delhi, Tata McGraw Hill Publications.
2. P. Gopalkrishnan and E. Rama Moorthy."Text book of Project Management". NewDelhi, McGraw Hill Publications.
3. Harold Kerzner, "Project Management: A Systems Approach to Planning, Scheduling and Controlling", New Delhi, CBS Publications.
4. Rajive Anand, "Project Profiles with Model Franchise Agency and Joint Venture Agreement", New Delhi, Bharat Publications.

BA 605: SUPPLY CHAIN MANGEMENT Credits: 3 (2-1-0)

Objective: This course will familiarize students how Supply chain management is used in organization for effective out comes by increasing productivity and efficient use of sources.

COURSE DESCRIPTION:

Unit-I: Introduction to Supply Chain Management

Definition, Concept, Scope, Objectives and importance of supply chain. Supply chain components, Drivers of supply chain management. Views of supply chain Achieving strategic fit. Planning Demand and Supply Chain.

Unit-II: Managing Inventory

Aggregate Planning in a Supply Chain, Managing Supply and Demand, Models for Supply Chain. Role of Cycle Inventory, Estimating Cycle Inventory EOQ, Role of Safety Inventory, Determining Level of Safety Inventory. Estimating a Managing Safety Inventory. Optimal level of product availability

Unit-III: Transportation and Facility Decisions

Factors Affecting Transportation and Network Design Decisions. Modes of Transportation, Routing and Scheduling in Transportation. Models for Facility Location Capacity Allocation.

Unit-IV: Third Party Logistic Retailer

Supplier's relationships Types and Key issues: Distribution Integration, Types and Key Issue in Procurement and Outsourcing Strategies. Make v/s Buy, IT and e-business in supply chain management. Importance and use of information in supply chain Infrastructure and Interface Devices. Supply chain cases and uses in the field of data analysis.

Text Books:

- Sunil Chopra, Peter Meindl :Supply Chain Management, Pearson
- Sameer k Shrivastava : Business Logistic and Supply Chain Management, Pearson
- Janat Shah, Supply Chain Management Text and Cases ,Pearson

BA-607: Econometrics Credits: 3 (2-1-0)

Objective:

The objective of the course is to teach students how to apply relevant econometric methods to analyse data and interpret the results from such analyses. The focus is on conceptual understanding and 'hands on' applications using economic data drawn from real-world examples, rather than on formal theoretical proofs. By the end of the paper, students should be able to appreciate and interpret the econometric and statistical analysis and be able to carry out and interpret their own econometric analysis.

COURSE DESCRIPTION:

Unit-I:

Nature of Econometrics and Economic Data Definition of Econometrics – Steps in Empirical Economic Analysis - Econometric Model – The Role of Measurement in Economics – The Structure of Economic Data: Cross-Sectional data, Time Series data, Pooled Cross Section data, Panel Data.

Unit-II:

Simple Regression Model Two Variable Linear Regression Model: Assumptions, Estimation of Parameters, Tests of Significance and Properties of Estimators – Functional forms of

Regression models – Loglinear models, Semi log- models and Reciprocal models – Choice of Functional Form.

Unit-III:
The General Linear Model Review of Assumptions, Estimation and Properties of Estimators: Un-biasness, BLUEs and Tests of significance of estimates – Analysis of Variance - Dummay variables - Nature of Dummy variables – Use of Dummy Variables – Errors in Variables and its consequences.

Multicollinearity and Heteroscadasticity Multicollinearity: Source and Consequences, Tests for Multicollinearity and solutions for Multicollinearity. Heteroscadasticity: Sources and Consequences, Tests for Heteroscadasticity, Generalized Least Squares Method of Estimation.

Unit-IV:
Auto-regressive and Distributed Lag Models Introduction – Types of Lag schemes - Koyck's lag model, Almon's Lag scheme, Partial Adjustment and Expectations models - Causality in Economics – The Granger Causality Test.

Simultaneous Equation Models Specification – Simultaneous Bias – Inconsistency of OLS Estimators - The concept of Identification, Rank and Order conditions for Identification – Indirect Least Squares - Two stage Least Squares (without proof), Problems.

Text Books:
1. Johnston,J: Econometric Methods, McGraw-Hill Book Co., New York.
2. Maddala, G.S: Econometrics, McGraw-Hill Book Co., New York, 3rd Rd.
3. Gujarathi, D.N: Basic Econometrics, Fourth Edition, Tata McGraw-Hill, New Delhi.
4. Tintner,G: Econometrics, John Wiley & Sons, New York.
5. Wooldridge, Jeffery M: Econometrics, Cengage Learning India Pvt. Ltd, New Delhi.

BA-621: Marketing Analytics — Credits: 3 (2-0-2)

COURSE OBJECTIVE:
The objective of this course is to provide thorough knowledge required to address fundamental marketing decision problems. It will also train to view marketing processes and relationships systematically and analytically. The techniques discussed in this course are useful in market segmentation, targeting, and mapping market structure and product design.

- Learn how to tap a simple and cost-effective tool, Microsoft Excel, to solve specific business problems using powerful analytic techniques.
- Helps to forecast sales and improve response rates for marketing campaigns.
- Explores how to optimize price points for products and services, optimize store layouts, and improve online advertising.

COURSE DESCRIPTION:

Unit-I:

Descriptive marketing Analytics: Description of consumer behavior in reference to data, identification and collection of relevant data. Identifying data for causal relationship, data for correlative relations, synergy between data and decisions, principles for systematically collecting and interpreting data to make better business decisions. How to use data to explore a problem, question, to create products, to create marketing campaigns, and strategies.

Unit-II:

Predictive Marketing Analytics: forecasting based on time series data. Statistical tools to predict consumer behavior, applicability of tool for specific marketing decision, predictions of future behavior. Kinds of predictions to create future strategies, techniques for predictive models including regression analysis for marketing variables.

Prescriptive Analytics: How prescriptive analytics provide recommendations for actions, examples of prescriptive models, for relationship of quantity is impacted by price, to maximize revenue, to maximize profits, to best use online advertising. Models for optimization competitive dynamics.

Unit-III:

Statistical segmentation: workings of statistical segmentation, how to compute statistical indicators about customers such as recency or frequency, how to identify homogeneous groups of customers within a database. Statistical segmentation as a tool, especially to explore, summarizes, or make a snapshot of an existing database of customers, managerial segmentation.

Targeting and scoring models: How can Target predict which of its customers are worthy, How to model pricing of product, identification of customer, planning of marketing campaign, maximize profit by building a scoring model, building a customer score frequency and quantity.

Unit-IV:

Applications of Analytics: Customer lifetime value analyses. Estimate transition matrix –for segments. Market basket analysis, Retail analytics, customer analytics, sales analytics.

Application of analytics in Branding and advertising: how to build and define a brand architecture and how to measure the impact of marketing efforts on brand value over time. How to measure and track brand value.

Text Books:

1. Wayne.L.Winston, “Marketing Analytics: Data driven techniques with MS-Excel”, Wiley, 1st ed. 2014.

2. Stephan Sorger, “Marketing Analytics: Strategic models and metrics”, Create Space Independent Publishing Platform, 1st ed., 2013.
3. Mike Grigsby, “Marketing Analytics: A Practical Guide to Real Marketing Science”, Kogan Page, 2015.

BA-623: Financial Analytics   Credits: 3 (2-0-2)

Unit- 1 Financial Analytics: An Introduction
A Brief History of the Evolution of Analytics, Concept and Definition of Financial Analytics, Concept of Laptop Laboratory for Data Science, Importance of Analytics for the Finance Field, Changing Business Models and changing role of financial department, Key terms related to financial Analytics, Uses of Financial analytics

Unit- 2 An Introduction to R and its Use
Getting started with R, Working in the R Windowing Environment, R as a Calculator, Working with variables, Understanding Data Types, Storing Data in Vectors, Call Functions, Reading CSV Files, Reading Data files from other Statistical Tools, Comparison and Compatibility of Excel and R

Unit- 3 Financial Data Analytics using R
Define the Goal of Your Analysis, Collecting and Managing the data in R, Building the Predictive Model, Evaluating and Critiquing Model, Deploying Model, Presenting result and Documentation.

Unit- 4 Valuation of Securities using R
Bond Fundamentals, Bond Valuation Models: PV Model.Bonds Yield, Measures Duration, Modified Duration, Immunization Convexity, Bond Value Theorem. Equity: Constant Growth Model, Multi-Stage Growth Model, P/E Ratio and Earnings Multiplier Models. Valuation Of Preference Shares, Valuation of Warrants, Rights Issued. Mergers Growth & Synergy-- Valuation Methods, Benchmarks of Value & Valuation of the Target's Equity, Stock Split, Swap Ratio.

Unit- 5 Application of R in Derivatives and Portfolio Management
Concept of Forwards, Future, Options, Types of Options, Concept of Delta Theta, Gamma Vega, Rho, Determining Option Price, Black Scholes Model, Measurement of Expected Risk and Return of Portfolio, Optimal Portfolio Selection – Markowitz Models, Sharpe's Single Index Model. Treynor, Sharpe, Jensen Ratios. CAPM and Concept of Beta. SML and CML Valuations.

Unit- 6 Special Packages in R
Plotly package to generate dynamic graph, Swirl package to learn R, RPivottable package to generate Pivot table, plyr package to split and combine data

Text Book: ‘Financial Analytics with R’ by Bennett & Hugen, Cambridge University Press

M.Tech. in DATA SCIENCE

Batch: 2017-19

Programme Structure

First Semester:

Code	Title	Credits (L-T-P)
CORE COURSES		
DS-701	Operations Research	4 (3-1-0)
DS-703	Statistical Research Methods	4 (2-1-2)
DS-705	Data Science and Visualisation	3 (2-0-2)
DS-707	RDBMS and NOSQL	3 (2-0-2)
DS-709	Python for Analytics	3 (2-0-2)
DS-711	Laboratory-Advanced Excel	2 (0-0-4)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two)		
DS-721	Data Mining and Warehousing	3 (2-0-2)
DS-723	Statistical Programming in R	3 (2-0-2)
DS-725	Multivariate Analysis	3 (2-0-2)
ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus.		
DS-751	Communication Skills	3(2-1-0)

Second Semester:

Code	Title	Credits (L T P)
CORE COURSES		
DS-702	Forecasting Methods	4(2-1-2)
DS-704	Big Data Technologies	3(2-0-2)
DS-706	Linear Algebra and Advanced Calculus	3(2-1-0)
DS-708	System Dynamics	3(2-0-2)
DS-710	Machine Learning	3(2-0-2)
DS-712	Technology Forecasting	3(2-0-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two)		
DS-722	Cloud Computing	3(2-1-0)
DS-724	Natural Language Processing	3(2-0-2)
DS-726	Web Mining	3(2-0-2)
ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus.		
DS-752	Technical Communication	3(2-1-0)

Third & Fourth Semesters:

Code	Title	Credits
DS-800	M.Tech. Thesis	24

Note: The above course contents can be modified as per requirement from time to time in accordance with University Ordinance No. 14.

DETAILED SYLLABUS

SEMESTER-I:

DS-701: Operation Research Credits: 4 (3-1-0)

COURSE OBJECTIVE:

This course exposes the students in mathematical modelling, solving and analysing business and industrial problems using operations research methods.

COURSE DESCRIPTION:

Unit -I:

Introduction, History, Development of Operations Research, Characteristics of Operations Research, Models in Operations Research, Principles of Modelling. Pre-modelling-Need Recognition, Problem Formulation. Modelling-Model development, Data collection, Model solution, Model validation, and sensitivity analysis. Post-modelling-Interpretation of results and implications, Decision making, Implementation, and Control.

Unit-II:

Linear Programming, Formulation of Linear programming Problems. Solution Methods-Graphical, Simplex, M-Technique, Two-Phase. Special cases of LP problems. Duality, Primal-dual relationships, Dual simplex method. Sensitivity analysis. Solving LP problems using computer software.

Unit-III:

Transportation Model-Formulating the model, Initial Feasible Solution-North-West Method, Least Cost Method, Vogel's Approximation Method. Optimum Solution-MODI method, Stepping Stone Method. Special issues of transportation problems. Assignment Model: Formulating the model, Solving the assignment problem using Hungarian method. Special issues of assignment problems.

Integer programming: Types of integer programming problems, Formulating the model, Solution using Branch and bound method. Dynamic Programming.

Solving the problems using computer software.

Unit-IV:

Network models: Minimal spanning tree algorithm, Shortest-route problem, Maximal flow model, Minimum –cost capacitated flow problem. Project Scheduling: CPM and PERT.

Inventory models: Functions of inventory, information requirements for inventory management-demand, lead time, inventory costs, and quantity on hand. Objectives of inventory management. Economic Order Quantity Models-Economic order size, economic production run, quantity discounts. Determining the reorder point. Material Requirement Planning.

Queuing Models: Goals, elements and characteristics of queuing systems, Measures of system performance, Waiting line models-single channel, multiple channel. Cost considerations.

TEXT BOOKS

Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall

David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.

William J. Stevenson: Introduction to Management Science, IRWIN.

DS-703: Statistical Research Methods Credits: 4 (2-1-2)

Objective:

This course will familiarize students with the rudiments of statistical theory and ready them for effective academic and professional practice in the field of research process of industrial, system and social science.

COURSE DESCRIPTION:

Unit I: Introduction to Research Methods and Measures of central tendency

Meaning and Objectives of Research, Significance of Research, Arithmetic Mean, Geometric Mean, Harmonic Mean, Median, Mode. Mean deviation, Standard deviation, Variance, Co-efficient of variation.

Unit II: Probability and Statistical Distribution

Binomial distribution, Poison distribution and Normaldistributions, Fitting of Normal Curve. Concept of Probability, Theorems of Probability, Conditional Probability, Baye's Theorem, Random Variable and Probability distribution.

Unit III: **Correlation and Regression Analysis**

Types of correlation, Methods of Correlation, Co-efficient of correlation, Properties of correlation, Rank Correlation.Difference between correlation and regression, Regression Lines, Regression Equations.

Unit IV: Testing of Hypothesis

Procedure of Testing Hypothesis, Standard Error and Sampling distribution, Estimation, Student's t-distribution, Chi-Square test and goodness of fit, F-test and analysis of variance.

Text Books:

S.P. Gupta: Statistical Method, S. Chand

C.K. Kothari: Research Methodology, New Age International

DS-705: Data Science & Visualization Credits: 3 (2-0-2)

Objective: This course will help the student to understand data science and role of data scientist. Students will also get fundamental knowledge of data visualization techniques.

COURSE DESCRIPTION:

UNIT I: Introduction: What is Data Science, Data Science Process, Data Science for Business and Competition. Identifying problem and solving problem in data science. Introduction to algorithms. Data: Unstructured vs. Structured Data, Databases, Big Data. Role of Data Scientist, Data Analyst, and Business Analyst.

UNIT II: Introduction to Data Wrangling, Data Analysis, and Data Visuslization. Introduciton to Various Data Analysis Techniques. Introduction to Data Visualization, characteristics, need of data visualization, comparison of data science and data visuslaization. Data types, Intro to Tableas, Perception.

UNIT III: Intro to Processing, Views, Tabular data, Trees and graphs Text & Sets, Scalar field, scalar data.

UNIT IV: 3D graphics, Transfer function design, Vector fields, Visualization models, Design Study.

Text Books:

1. Mike Loukides, "What Is Data Science?", O'Reilly Media, Inc., 10-Apr-2011.
2. Lars Nielsen, Noreen Burlingame, "A Simple Introduction to Data Science", New Street Communications, LLC, 02-Nov-2012.
3. William Cleveland,"The Elements of Graphing Data",AT&T Bell Laboratories, 1994
4. Nathan Yau, "Visualize This: The FlowingData Guide to Design, Visualization, and Statistics", "Visual Thinking for Design", Colin Ware, Morgan Kaufman, 2008.
5. Daniel Shiffman,"Learning Processing", Morgan Kaufmann, 2008.
6. Casey Reas and Ben Fry, :Getting Started with Processing", O'Reilly Media, 2010.
7. Tamara Munzner,"Visualization Analysis and Design", AK Peters, 2014.

DS-707: RDBMS and NOSQL Credits: 3 (2-0-2)

Objective: The purpose of this course is to provide fundamental knowledge of relational database management system and SQL to students. Student will also learn new mechanism of storage and retrieval of data, NoSQL.

COURSE DESCRIPTION:

UNIT I: Overview of DBMS: Comparison between Database approach and Traditional file accessing approach, Advantages of database systems, Schemas and instances, Data Dependency, Data Dictionary, and Meta Data. Data models, Types of Data models (Object Oriented, Record Based and Physical data models), E-R Modelling.

UNIT II: Relational Data model: Domains, Tuples, Attributes, Keys, Relational database, Schemas, Integrity constraints, Relational algebra and relational calculus; Normalization: Normal forms (INF, 2NF, 3NF, BCNF), Functional dependency, Decomposition, Dependency preservation and lossless join.

UNIT III: Structured Query Language: DDL, DML, DCL, TCL, SQL Functions, integrity constraints, various joins, sub-query, index, View, Sequence, and Clusters.

UNIT IV: NoSQL: Nosql Basics, Storage Architecture, Operations, Query Model, Modifying Data Stores and Managing Evolution, Indexing and Ordering Data Sets, Managing Transactions and Data Integrity.Using Nosql in the Cloud, Scalable Parallel Processing with Mapreduce, Analyzing Big Data with Hive, Surveying Database Internals

Text Books:

1. A Silberschatz, H Korth, S Sudarshan, "Database System and Concepts", fifth Edition McGraw-Hill.
2. Elmasri Ramez and Novathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing. Company.
3. Rob, Coronel, "Database Systems", Seventh Edition, Cengage Learning**.**
4. Fred R.McFadden,Jeffrey A.Hoffer & Marry B.Prescott.?Modern Database Management, Fifth Edition,Pearson Education Asia,2001.
5. Bayross Ivan, "SQL, PL/SQL: The Programming Language Of Oracle", 4th Revised Edition, BPB Publications, 2010.
6. Tiwari Shashank, "Professional Nosql", Wiley India Pvt Ltd, 2011.

DS-709: Python for Analytics Credits: 3 (2-0-2)

Objective: The main objective is to help students to understand the fundamentals of python. Student will learn how to analysis data using Python.

COURSE DESCRIPTION:

UNIT I: Introduction to Python: Python versus Java, Python Interpreter and it's Environment, Python installation, Python basics: variables, operators, Strings, Conditional and Control Statements, loops; Data structures: lists and dictionaries; functions: global functions, local functions, lambda functions and methods.

UNIT II: Object Oriented Programming Concepts: Class, object, constructor, destructor and inheritance; Modules & Packages, File Input and Output, Catching exceptions to deal with bad data, Multithreading, Database Connectivity.

UNIT III: Numpy: Creating Arrays, Arrays Operations, Multidimensional ArraysArrays transformation, Array Concatenation, Array Math Operations, Multidimensional Array and its Operations, Vector and Matrix. **Visualization:** Visualization with matplotlib, Figures and subplots, Labeling and arranging figures, Outputting graphics.

UNIT IV: Pandas: Manipulating data from CSV, Excel, HDF5, and SQL databases, Data analysis and modelling with Pandas, Time-series analysis with Pandas, Using Pandas, the Python data analysis library, Series and Data Frames, Grouping, aggregating and applying, Merging and joining.

Text Books:

1. McKinney Wes, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.
2. Hauck Trent, "Instant Data Intensive Apps with Pandas How-To", Packt Publishing Ltd, 2013.
3. Beazley David M.,"Advanced Python Programming", Pearson Education,2009.
4. Chun Wesley , Core Python Programming, 3rd Edition,Prentice Hall Professional, 2012.
5. Telles Matt "Python Power!: The Comprehensive Guide", Cengage Learning, 2008.
6. McKinney Wes & PyData Development Team, "pandas: powerful Python data analysis toolkit", Release 0.13.1, Feb 2014.
7. https://docs.python.org/3.4/tutorial/
8. http://www.tutorialspoint.com/python/python_quick_guide.htm

DS-711: Laboratory-Advanced Excel Credits: 2 (0-0-4)

Objective: The main objective of this course is to learn analysis of data using MS Excel, resulting in less time and better understands what the data means.

COURSE DESCRIPTION:

Unit I: Introduction to Excel User Interface**,** Application, Workbook, Worksheets & its Components, Named Ranges; Formatting: Cell Color, Font Color, Indents, Alignments, Number Formats, Custom Formats, Editing commands; Data Sorting: Built-in Sort, Sorting Levels, Custom Sort; Data Filtering: Auto Filter – Filter By Color, Filter by Icono Advanced Filter, Remove Duplicates; Data Subtotal – Built-In Subtotal (Nested Subtotal).

Unit II: Data Validation: Based on cell values (text length, whole no Based on Formulas, List Dropdown, Circle Invalid Data, Input & Error Messages; Data Grouping: Grouping Rows, Grouping Columns. Data Tables: Conditional Formatting, Formatting based on Cell values, Formatting based on Formulas, Icon Sets (bars, scales, icons), Freezing Panes, Text-to-Columns, Delimited, Fixed Length; Data Consolidation (from multiple files), Getting External Data into Excel, From MS Access, From Text files, From Web, Other Data Sources.

Unit III: Formulas, TEXT Functions, IF, ERROR Functions, LOGICAL Functions, VLOOKUP, HLOOKUP, COUNTIF, SUMIF, SUMPRODUCT, DATE & TIME FUNCTIONS, FORMULA TEXT, Information Functions (ISNA, ISEVEN, ISERR…).

Unit IV: Charts: Chart Types, Chart Components, Primary Vs Secondary Axis, Chart Formatting, Sparkline (2010 and above); Pivot Tables: Introduction & Creation, Slicer, TimeLine, Pivot Charts, Calculated Fields, Calculated Items, Grouping, Formatting – Number/Conditional, PowerPivot, PowerView.

Text Books:

1. John Walkenbac, "Excel 2016 Bible", John Willey & sons.
2. Jordan Goldmeier , "Advanced Excel Essentials", Apress Publisher.
3. Conrad George Carlberg , "Business Analysis with Microsoft Excel", Que Publishers.
4. Bernd Held, "Microsoft Excel Functions & Formulas", Wordware publishing, Inc.
5. Steven Roman ,"Writing Excel Macros with VBA" O'Reilly Media.

DS-721: Data Mining and Warehousing   Credits: 3 (2-0-2)

Course Objective The main objective of this course is to provide understanding of data warehouse fundamentals and data mining techniques for business applications.

COURSE DESCRIPTION:

UNIT I: Data Warehousing: Introduction data warehousing, Data Mart, Data Warehouse Architecture; Star, Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning. ETL Concepts. OLAP technology: Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, indexing data.

UNIT II: Data Mining: Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining; Introduction to Web Mining, Text Mining. Data Processing: Data Cleaning, Data Integration and Transformation; Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Data Discretization and Concept hierarchy generation for numerical and categorical data.

UNIT III: Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, FP-Growth Algorithm, latest trends in association rules mining.

UNIT IV: Classification methods: Decision tree, Bayesian Classification, Rule based; clustering methods: Partitioning methods(K-Means, K-Mediods) and Hierarchical Clustering (Agglomerative and Divisive Clustering, Multi-phase method) Prediction: Linear and non-linear regression.

Text Books:

1. P.Ponnian, "Data Warehousing Fundamentals", John Weliey.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.
3. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education.
4. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", Wiley India.
5. Michael Berry and Gordon Linoff "Data Mining Techniques",Wiley Publications.
6. M.H.Dunham, "Data Mining Introductory & Advanced Topics", Pearson Education.

DS-723: Statistical Programming in R Credits: 3 (2-0-2)

Objective: This course is an introduction to R, a powerful and flexible statistical language and environment that also provides more flexible graphics capabilities than other popular statistical packages. After taking this course, students will be able to –

1. Use R for statistical programming, computation, graphics, and modeling,
2. Write functions and use R in an efficient way,
3. Fit some basic types of statistical models,
4. Use R in their own research,
5. Be able to expand their knowledge of R on their own

COURSE DESCRIPTION:

Unit I: Introduction to R programming language: Getting R, Managing R, Arithmetic and Matrix Operations, Introduction to Functions, Control Structures. Working with Objects and Data: Introduction to Objects, Manipulating Objects, Constructing Data Objects, types of Data items, Structure of Data items, Reading and Getting Data, Manipulating Data, Storing Data.

Unit II: Data Distribution and Statistical Testing: Types of Data distribution, Normal distribution, Poisson distribution, Random number generation, Chi-Square Testing, Student's t-test, F-test, Monte Carlo Simulation.

Unit III: Graphical Analysis using R: Basic Plotting, Manipulating the plotting window, Box-Whisker Plots, Scatter Plots, Pair Plots, Pie Charts, Bar Charts.

Unit IV: Advanced R: Statistical models in R, Correlation and regression analysis, Analysis of Variance (ANOVA), creating data for complex analysis, Summarizing data, and case studies.

Text Books:

1. Mark Gardener: Beginning R: The Statistical Programming Language, Willey publications
2. Norman Matloff: The Art of R Programming: A Tour of Statistical Software Design, OREILLY & Associates Inc.

DS-725: Multivariate Analysis Credits: 3 (2-0-2)

Objective:

1. To understand the main features of multivariate data.
2. To be able to use exploratory and confirmatory multivariate statistical methods properly.
3. To be able to carry out multivariate statistical techniques and methods efficiently and effectively.

COURSE DESCRIPTION:

UNIT I: Analysis of categorical data. Loglinear models for two- and higher-dimensional contingency tables, Characterizing and Displaying Multivariate Data, Tests on one or two mean vectors.

UNIT II: Multivariate Analysis of Variance, Aspects of multivariate analysis, random vectors, sample geometry and random sampling, multivariate normal distribution, inferences about the mean vector, MANOVA.

UNIT III: Classification and grouping techniques: discrimination and classification, clustering. Logistic regression models.

UNIT IV: Analysis of covariance structures, Principal Component Analysis (PCA), Factor Analysis, Cluster Analysis. Use of statistical computer packages.

Text Books:

1. Applied Multivariate Statistical Analysis, by Richard A. Johnson and Dean W.Wichern (6^{th} edition), Prentice Hall.
2. Characterizing and Displaying Multivariate Data, by A.C.Rencher, John Wiley and Sons.
3. Multivariate Data Analysis, by Joseph F.Hair, William, Babin and Anderson.
4. Cluster Analysis, by Brian S.Everitt, Sabine Landau, Morven Leese. Wiley

DS-751: Communication Skills Credits: 3 (2-1-0)

OBJECTIVE: To make use of the opportunities and meet the challenges of the modern world, students need to develop effective communication skills. This is a skill that is most often quoted as lacking in engineers and IT professionals. Proper communication skills are also extremely important in interpersonal relationships. This course will help students in becoming confident and effective communicators, who can project themselves positively to others.

Unit I: Introduction to Communication: Need for Effective Communication. The Process of Communication: Levels of communication; Flow of communication; Use of language in communication; Communication networks; Significance of technical communication. Barriers to Communication: Types of barriers; miscommunication; noise; overcoming measures.

Unit II: Listening Skills: Listening as an active skill; Types of Listeners; Listening for general content; Listening to fill up information; Intensive Listening; Listening for specific information; Developing effective listening skills; Barriers to effective listening skills.

Reading Skills: Previewing techniques; Skimming; Scanning; Understanding the gist of an argument; Identifying the topic sentence; Inferring lexical and contextual meaning; recognizing coherence and sequencing of sentences; Improving comprehension skills.

Writing Skills: Sentence formation; Use of appropriate diction; Paragraph and Essay Writing; Coherence and Cohesion.

Unit III: Letter Writing: Formal, informal and demi-official letters; business letters. Job Application: Cover letter, Differences between bio-data, CV and Resume. Report Writing: Basics of Report Writing; Structure of a report; Types of reports. Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language.

Unit IV: Interview Skills: Types of Interviews; Ensuring success in job interviews; Appropriate use of non-verbal communication. Group Discussion: Differences between group discussion and debate; Ensuring success in group discussions. Presentation Skills: Oral presentation and public speaking skills; business presentations. Technology-based Communication: Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software.

Text Books:

1. Spoken English & Effective Communication (With 2 CDs): Mind Power Spoken English Institute by by Prof. Sharad Srivastava and Dr Amita Singhvi; Franklin International; New edition (2015)
2. Communication Skills by Sanjay Kumar and Pushp Lata; Oxford University Press India; (2015)
3. El Dorado: A Textbook of Communication Skills by R. Pushkala and P.A.Sarada; Orient Blackswan; (2013)

SEMESTER-II:

DS-702: Forecasting Methods Credits: 4 (2-1-2)

COURSE OBJECTIVE

This subject is designed in such a way to provide the basic concepts of forecasting models based on quantitative analysis. Risk and uncertainty in forecasting and it is generally considered good practice to indicate the degree of uncertainty attaching to forecasts.

COURSE DESCRIPTION:

Unit I: Introduction: Forecasting perspective, an overview of forecasting methods, basic steps in forecasting. Basic forecasting tools: time series and cross-sectional data, graphical and numerical summaries, forecasting accuracy, prediction intervals, transformations and adjustments.

Unit II: Time series: Decomposition, principles of decomposition, moving averages, classical decomposition, census bureau methods, forecasting and decomposition.

Unit III: Exponential smoothing: averaging methods, Singleexponential smoothing methods, ARRSES, Double exponential soothing methodcomparison of methods, general aspects of smoothing methods.

Unit IV: Regression: Simple regression, forecasting with simple regression, non-linear relationships. Multiple regressions. Box-Jenkins methods: examining correlations in time series data, examining stationary, ARIMA models, forecasting with ARIMA models.

Text Book(s):

1. Spyros Makridakis :Forecasting Method's and application Wiley
2. N.P. Nagpal :Forecasting Techniques ,RBSA
3. Stephen A. Delurgio: Forecasting Principals and Application,McGraw Hill

DS-704: Big Data Technologies Credits: 3 (2-0-2)

Course Objective: The main objective of this course is to introduce big data technologies such as Hadoop, spark and analyzing big datasets in spark using python.

COURSE DESCRIPTION:

UNIT I: Introduction
Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting – Modern Data Analytic Tools. Big Data Analytics Process, Big Data Analytics for Business. Identifying problem and solving problem in Big Data environment. Analyzing Unstructured vs. Structured Data, Databases.

UNIT II: Hadoop and MapReduce
Introduction to Hadoop, Hadoop architecture, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases; Hadoop Distributed File system: Design of HDFS, HDFS Concepts. Introduction to MapReduce: MapReduce Basic Concepts, Understanding the Map Reduce architecture, Writing MapReduce Programs. understanding Map phase, shuffling, sorting, and reducing phase.

UNIT III: Spark
Introduction to Spark, Resilient Distributed Dataset (RDD), RDD Operations: actions and transforamtion funtions. Spark Dataframes, operations on Dataframes: Join, groupby, aggregate, handling missing data.

UNIT IV: SparkSQL and MLLib
SparkSQL and its basic operations. MLLib: Data types, Basic statistics, Classification(Logistic regression, Decision tree classifier)and linear regression model generation, Model Evaluation,

Collaborative filtering, and Clustering.

Text Books:

1. Arvind Sathi, “Big Data Analytics: Disruptive Technologies for Changing theGame”, 1st Edition, IBM Corporation, 2012.
2. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, 1st Edition, Wiley and SAS Business Series, 2012.
3. Tom White,"Hadoop: The Definitive Guide", 3rd Edition, O'Reilly Media, 2012.
4. Donald Miner, Adam Shook, Eric Sammer, “Hadoop Operation”, O’Reilly 2012.
5. Donald Miner, Adam Shook “MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems”, O’Reilly 2012.
6. Chuck Lam, "Hadoop in Action", Manning Publications, 2010.
7. https://spark.apache.org/docs/2.0.0/programming-guide.html

DS-706: Linear Algebra and Advanced Calculus Credits: 3 (2-1-0)

Objective: The main objective is to students will learn to solve many types of data science problems using Linear Algebra and Calculus.

Course Description:

Unit I: Vector spaces over fields, subspaces, bases and dimension. Systems of linear equations, matrices, rank, Gaussian elimination. Linear transformations, representation of linear transformations by matrices, rank-nullity theorem, duality and transpose.

Unit II: Determinants, cofactors, adjoint, Cramer's Rule. Eigenvalues and eigenvectors, characteristic polynomials, minimal polynomials, Cayley-Hamilton Theorem, triangulation, diagonal-lization, rational canonical form, Jordan canonical form.

Unit III: Inner product spaces, Gram-Schmidt orthonormalization, orthogonal projections, linear functionals and adjoints, Hermitian, self-adjoint, unitary and normal operators, Spectral Theorem for normal operators, Rayleigh quotient, Min-Max Principle.

Unit IV: Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor’s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange’s method of undetermined multipliers. Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

Text Books:

1. K. Hoffman and R. Kunze, Linear Algebra, Pearson Education (India), 2003. Prentice-Hall of India, 1991.
2. S. Lang, Linear Algebra, Undergraduate Texts in Mathematics, Springer-Verlag, New York, 1989.
3. P. Lax, Linear Algebra, John Wiley & Sons, New York,. Indian Ed. 1997
4. H.E. Rose, Linear Algebra, Birkhauser, 2002.
5. Hildebrand, Francis. Advanced Calculus for Applications. 2nd ed. Englewood Cliffs: Prentice Hall, March 31, 1976.

6. Kaplan W., “Advanced Calculus”, Addison Wesley (Pearson Education, Inc.), 5 th Edition, 2003
7. Grewal. B.S, “Higher Engineering Mathematics”, 41st Edition, Khanna Publications, Delhi, (2011).

DS-708: Introduction to System Dynamics Credits: 3 (2-0-2)

COURSE OBJECTIVES

To understand cause-effect relations in social and management systems.
To analyze complex, dynamic and nonlinear interactions in social systems.
To develop new structures and policies to improve the system behaviour.

COURSE DESCRIPTION:

Unit -I:

Introduction. System concepts, system theories, models. Classification of systems-continuous and discrete, stochastic and deterministic and open and closed systems. System studies: subsystems, types of system studies.

System dynamics paradigm-foundations, framework, viewpoints, philosophy, flexibility, strengths and weaknesses. Stages of problem solving with system dynamics. Examples of managerial and social problems.

Unit-II:

Elements of system dynamics modelling. Physical flows, Level and rate variables, Information flows, Diagramming aids, Delays, Smooth functions, equations, Table functions. Causal-loop diagramming, flow diagramming.

Unit-III:

Steps in system dynamics: Problem identification, Fixing model aggregates and boundary, Detailed model, Model validation, Model analysis. Principles of modelling. Model equations.

Unit-IV:

Development of system dynamics models. Behavior of linear systems, positive feedback, negative feedback systems. Simulation of low order systems. Validation. Applications in planning and policy design for industrial / social systems. System dynamics packages. Case studies.

TEXTBOOKS

Pratap K J Mohapatra, Purnendu Mandal, Madhab C Bora: Introduction to System Dynamics Modelling, Universities Press
Sushil: System Dynamics, Wiley Eastern

DS-710: Machine Learning Credits: 3 (2-0-2)

Objective: The main objective is to help students to understand the fundamental concepts of machine learning.

COURSE DESCRIPTION:

UNIT I: Introduction to Machine Learning, History and Overview of machine learning, Applications, Types of Machine Learning, Basic Concepts. Concept Learning and candidate elimination learning Algorithm.

UNIT II: Artificial Neural Network: biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervise & Unsupervised) and activation function. Supervised Learning: Perceptron learning, Single layer/multilayer, linear Separability, Adaline, Madaline, Back propagation network, RBFN.

UNIT III: Bayesian Learning, Bayes Theorem, Naïve Bayesian classifier, Bayesian belief, EM Algorithm. Dimensionality Reduction: Factor Analysis, Principal Component Analysis, Linear Discriminant Analysis.

UNIT IV: Markov and Hidden Markov Models, PAC Learning, Support Vector Machine, Evolutionary Learning: Genetic Algorithm, generating offspring, applications and genetic programming.

Text Books:

1. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
2. Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
4. Ethem Alpaydin, “Introduction to Machine Learning”, Prentice Hall of India, 2005.
5. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2006.
6. Sanjeev Kulkarni, Gilbert Harman, “An Elementary Introduction to Statistical Learning Theory”, 2011.
7. N. Shivnandam, “Principle of soft computing”, Wiley.

DS-712: Technology Forecasting Credits: 3 (2-0-2)

Objective: Primarily, a technological forecast deals with the characteristics of technology, such as levels of technical performance, the accuracy or precision of a technology. The forecast does not have to state how characteristics will be achieved. Secondly, technological forecasting usually deals with useful machines, procedures or techniques for society**.**

Unit I: Introduction Technology forecasting- it’s meaning and need, alternatives to forecasting, stages of innovation. Delphi: advantages and disadvantages of committees, Delphi procedure, conducting a Delphi based study.

Unit II: Forecasting technology. Growth curves substitution curves, Pearl curve, Gompertz curve, Fisher-Pry curve, selection of proper growth curve, estimation of upper limit.

Unit III: Trend extrapolation- exponential trends, non-exponential growth, qualitative trends etc. Measures of technology-scoring models, constrained scoring models, planar tradeoff surfaces. Correlation models-lead lag correlation, technology progress function, maximum installation size etc.

Unit IV: Causal models-technology only models, techno economic model, simulation model. Forecasting breakthroughs. Combining forecasts-trend and growth curves, trend and analogy, components and aggregates, scenarios, cross impact models. Normative methods-relevance trees, morphological models, mission flow diagrams.

Text Book:
Technological Forecasting by Martino, Joseph Paul New York, American Elsevier Pub. Co. Publication

DS-722: Cloud Computing Credits: 3 (2-1-0)

Objective: The main objective of this subject is to help student to understand Cloud and It's Services, Architecture, Deployment, Core Issues, Strengths and limitations of cloud computing.

UNIT I Introduction to Cloud Computing: Overview of Cloud Computing, History of Cloud Computing, Importance of Cloud Computing, advantages and disadvantages of Cloud Computing, Applications, Cloud computing vs. Cluster computing vs. Grid computing, Future of Cloud Computing; Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Cloud Service Models(XaaS), Deployment Models (Public cloud, Private cloud, Hybrid cloud).

Unit II: Cloud Service Models and Virtualization: Infrastructure as a Service (IaaS): Introduction, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Virtual Machine(VM), Resource Virtualization(Server, Storage, Network),VMware vSphere, Machine Image ,Porting Applications Case study on Amazon EC2;Platform as a Service(PaaS): Introduction to PaaS, advantages and disadvantages of PaaS, case study on Microsoft Azure; Software as a Service(SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS; Development Services and Tools : Amazon Ec2, Google App Engine, IBM Clouds.

UNIT III: Capacity Planning: Defining Baseline and Metrics, Baseline measurements, System metrics, Load testing, Resource ceilings, Server and instance types, Network Capacity, Scaling. Understanding Service Oriented Architecture, Moving Applications to the Cloud, Working with Cloud-Based Storage, Working with Productivity Software.

UNIT IV: Managing the Cloud: Administrating the Clouds, Cloud Management Products; Cloud Security: Security Overview, Cloud Security Challenges and Risks, Security Governance, Risk Management: Security Monitoring, Security Architecture Design, Data Security, Application Security, Virtual Machine Security, Identity Management and Access Control, Authentication in cloud computing, Client access in cloud, Cloud contracting Model. Using the Mobile Cloud: Working with Mobile Devices and Working with Mobile Web Services;

Case Studies on Various Clouds: Google Web Services, Amazon Web Services, Microsoft Cloud Services, IBM Clouds, Eucalyptus.

Text Books:

1. Kris A Jamsa: Cloud computing : SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More 2013Jones & Bartlett Learning ISBN-13: 9781449647391.
2. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH, 2009.
4. Sosinsky B., "Cloud Computing Bible", Wiley India
5. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011.
6. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.

DS-724: Natural Language Processing Credits: 3 (2-0-2)

Objective: The main object of this course is to provide an introduction to the field of computational linguistics, and natural language processing (NLP).

COURSE DESCRIPTION:

UNIT I: Introduction to NLP, NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field.

UNIT II: The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Lexical syntax. Hidden Markov Models. Maximum Entropy Models. Conditional Random Fields.

UNIT III: Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing.

UNIT IV: Named entity recognition and relation extraction. IE using sequence labeling. Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars. Web 2.0 Applications : Sentiment Analysis; Text Entailment.

Text Books:

1. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.

2. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
3. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
4. Steven Bird, Ewan Klein, and Edward Loper,"Natural Language Processing with Python - Analyzing Text with the Natural Language Toolkit", O'Reilly Media, 2009.
5. Ian H. Witten and Eibe Frank. "Data Mining: Practical Machine Learning Tools and Techniques" , 3rd edition, Morgan Kaufmann, 2005.
6. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

DS-726: Web Mining Credits: 3 (2-0-2)

Objective: The main objective of this course s to student will learn how to apply web mining to derive data driven results.

COURSE DESCRIPTION:

UNIT I: Introduction to Web Mining: Web content, web usage mining and web structure mining. Web crawling: Crawling Basics; Indexing, Text analysis and classification.

UNIT II: Similarity and Clustering/community algorithms: Partitioning Approaches, Geometric Embedding Approaches, and Probabilistic Approaches; Topical locality,

UNIT III: Supervised Text Learining: Evaluating Text Classifiers, Nearest Neighbor Learners, Greedy Inclusion Algorithms, Truncation Algorithms, Exploiting Hierarchy among Topics, Discriminative Classification, Regression, Support Vector Machines, Hypertext Classification. SEMISUPERVISED LEARNING: Expectation Maximization, Labeling Hypertext Graphs.

UNIT IV: Link analysis: PageRank and HITS ranking methods, Ranking algorithms; Web search and retrieval, Web growth models, Web traffic models;Social tagging, Social networks and social media, Information diffusion.Applications of Web mining in Recommendtion system.

Text Books:

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008.
2. Michael Berry and Gordon Linoff, "Data Mining Techniques for Marketing, Sales, and Customer Relationship Management", Third Edition, John Wiley, 2011.
3. Soumen Chakrabarti,"Mining the Web: Discovering Knowledge from Hypertext Data",Morgan Kaufmann, 2003.
4. Bing Liu "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data",2011 edition, Springer.
5. Anthony Scime,"Web Mining: Applications and Techniques", Idea Group Inc (IGI), 2005.

DS-752: Technical Communication Credits: 3 (2-1-0)

Objective:

This course is designed to help the students to develop skills that will enable them to produce clear and effective scientific and technical documents.

Unit I:

Technical writing: Definition, Similarities to other writings, Unique features, importance, technical writing as profession, qualifications for technical writing. Identifying audience. Problems involving content, words and phrases, punctuation, unity, coherence, logic, etc. Being concise.

Unit II:

Techniques of Technical Communication. Analysing-Division, Classification, Partition. Defining-Formal, informal, expanded. Describing-subjective versus objective, spatial description, description of mechanism, process, selected details. Illustrating-Tables, graphs, charts, pictorials. Researching-Basic types of research, original research, searching the literature. Abstracting of your own reports, the works of others, precautions. Oral communication-one to one reporting, participation in conferences, speaking to large audiences, organising the speech.

Unit III:

Basic forms of Technical Writings. The memorandum, The business letter, Formal report.

Unit IV:

Technical reports. Justification reports and proposals, the progress reports, periodic reports, status reports, trip reports. Laboratory reports, Feasibility reports, State-of-the-Art reports. Instructions and manuals.

Text Books:

1. James Sherlock: A Guide to Technical Communication

M.Tech. in Systems Management

Specialization in Information Systems

Batch: 2016-18 & Batch 2017-19

Programme Structure

First Semester:

Code	Title	Credits
CORE COURSES		
IS-701	Database Management Systems	4
IS-703	Object Oriented Programming in Java	4
IS-705	Distributed Systems	3
IS-707	Modelling and Simulation	3
IS-709	Probability and Statistics	3
IS-711	System Analysis and Design	3
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
IS-721	Electronic Commerce	4
IS-723	Business Intelligence	4
ELECTIVE GENERIC: The students can choose following course or any other PG level generic course being run in this campus.		
IS-751	Communication Skills	4

Second Semester:

Code	Title	Credits
CORE COURSES		
IS-702	Enterprise Resource Planning	4
IS-704	IT Project Management	4
IS-706	Data Mining and Warehousing	3
IS-708	Big Data and Cloud Computing	3
IS-710	Decision Analysis	3
IS-712	IT Strategy & Management	3
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
IS-722	Information Security Management	4
IS-724	Software Quality Assurance	4
ELECTIVE GENERIC: The students can choose following course or any other PG level generic course being run in this campus.		
IS-752	Technical Communication	4

Third & Fourth Semesters:

Code	Title	Credits
IS-800	M.Tech. Thesis	24

Note: The above course contents can be modified as per requirement from time to time in accordance with University Ordinance No. 31.

<u>**DETAILED SYLLABUS**</u>

SEMESTER-I:

IS-701: Database Management Systems   Credits: 4 (3-1-0)

Objective: The purpose of this course is to provide fundamental knowledge of database management system and understanding of how to use and design a DBMS.

Unit I: DBMS Concepts, Comparison between Database approach and Traditional file accessing approach, Advantages of database systems, Schemas and instances, Data Dependency, Data Dictionary, and Meta Data. Data models, Types of Data models (Object Oriented, Record Based and Physical data models), E-R diagram, Relational Data models: Domains, Tuples, Attributes, Keys, Relational database, Schemas, Integrity constraints, Relational algebra and relational calculus.

Unit II: Database Design: Introduction to normalization, Normal forms (INF, 2NF, 3NF, BCNF), Functional dependency, Decomposition, Dependency preservation and lossless join, multi-valued dependencies. **Structured Query Language**: DDL, DML, DCL, TCL, SQL Functions, integrity constraints, various joins, sub-query, index, View, Sequence, and Clusters. PL/SQL: manipulating data using PL/SQL, Iteration, Exceptions, Cursors, Trigger. (Experiment on Oracle 11g)

Unit III: Transaction Processing and Concurrency Control: Transaction System, Serializability of schedules, conflict & view serializable schedule, Recovery from transaction failures, Log based recovery. Checkpoints dead lock handling, Concurrency Control, locking Techniques for concurrency control, time stamping protocols for concurrency control, validation based protocol, multiple granularity.

Unit IV: Advance Concepts: Introduction to Distributed databases, data mining, data warehousing, Basic Concepts of Object Oriented Database System, Comparative study of OODBMS V/s RDBMS. Introduction to Image and Multimedia databases and data structures, Web and mobile database, Spatial and Geographic Database, Accessing Database from front-end Application. Case Study: Oracle, MySql, DB2.

Reference Books:

1. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, fifth Edition McGraw-Hill.
2. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
3. Rob, Coronel, “Database Systems”, Seventh Edition, Cengage Learning.
4. Ramakrishnan: Database Management System , McGraw-Hill
5. Fred R.McFadden,Jeffrey A.Hoffer & Marry B.Prescott.?Modern Database Management, Fifth Edition,Pearson Education Asia,2001
6. Gray Jim and Reuter Address, “Transaction Processing: Concepts and Techniques”, Moragan Kauffman Publishers.

IS-703: Object Oriented Programming in Java Credits: 4 (3-1-0)

Objective: The main objective is to help students to understand the fundamentals object oriented programming, concurrent programming using java.

UNIT I: Introduction to Object Oriented Programming paradigm, classes and instances, Abstraction, encapsulation Association, Aggregation, Inheritance, Generalization and Specialization; Introduction to Java: History, Byte Code and Java Virtual Machine, JDK, Data types, variables, scope and life time of variables, arrays, expressions, control statements, type conversion, classes, objects, constructors, methods, access control, this keyword, garbage collection, method overloading, string class, final keyword.

UNIT II: Inheritance: Inheritance, Inheriting Data members and Methods, constructor in inheritance, Multilevel Inheritance, method overriding, super keyword. Packages and Interfaces: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages, differences between abstract classes and interfaces, interface, implementing interface. Explore java.io.

UNIT III: Exception handling: introduction to exception handling, benefits of exception handling, usage of try, catch, throw, throws and finally, built in exceptions, creating own exception sub classes; Multithreading: Introduction to multi-threading, multitasking, thread life cycle, creating threads, thread priorities, synchronizing thread, daemon threads.

UNIT IV: Java IO: IO Streams and the new IO Capabilities, Working with File Object, File I/O Basics, Reading and Writing to Files, Buffer and Buffer Management, Read/Write Operations with File Channel, Serializing Objects. Introduction to Collection classes & Interfaces, Core Collections Interfaces: List, Set & Map, Collection Classes – Lists, Sets, Maps & Using an Iterator.

Text Books:

1. Cay S. Horstmann and Gary Cornell, “Core Java: Volume I – Fundamentals”, Eighth Edition, Sun Microsystems Press, 2008.
2. K. Arnold and J. Gosling, “The JAVA programming language”, Third edition, Pearson Education, 2000.
3. Timothy Budd, “Understanding Object-oriented programming with Java”, Updated Edition, Pearson Education, 2000.
4. C. Thomas Wu, “An introduction to Object-oriented programming with Java”, Fourth Edition, Tata McGraw-Hill Publishing company Ltd., 2006.

IS-705: Distributed Systems Credits: 3 (2-1-0)

Objective: The main objective of this course is to provide students detail understanding of distributed systems.

Unit I: Distributed Systems, Communication in distributed systems, processes and processors in distributed systems. Threads, systems Models, Process allocation, scheduling in distributed systems, fault tolerance, real-time distributed systems.

Unit II: Theoretical issues in distributed systems: Logical clock, mutual exclusion, deadlock detection, agreement protocols, resource security and protection, concurrency control.

Unit III: Distributed File System: Design and implementation, trends.

Unit IV: Distributed shared Memory, consistency models, page-based distributed shared memory, shared variable distributed shared memory, object-based distributed shared memory.

Text Books:

1. Andrew S Tannebaum , Distributed Operating Systems, Pearson
2. Pradeep K. Sinha, Distributed Operating Systems Concepts and Design, PHI
3. Nancy A. Lynch, "Distributed Algorithms", The Morgan Kaufmann Series in Data Management System, Morgan Kaufmann Publishers.
4. George Coulouris, Jean Dollimore,Tim Kindberg,, Distributed Systems: Concepts and Design Pearson.

IS-707: Modelling and Simulation Credits: 3 (2-1-0)

COURSE OBJECTIVE

This course exposes the students in simulation modelling, solving and analysing business and industrial problems using simulation models.

Unit -I: System modelling, classification of models, validation and verification. System simulation, simulation terminology, applications of simulation, Simulation steps, advantages and disadvantages of simulation. Monte Carlo (MC) simulation. An inventory simulation. A waiting line simulation.

Basic probability and statistics. Random variables and their properties, simulation output data and stochastic processes, estimation of means, variances, and correlations, confidence intervals, and hypothesis testing, Strong law of large numbers.

Unit-II: Generation of Random Numbers: Pseudo random numbers: Pseudorandom numbers and algorithm for generating them-mid-square method, linear congruential method, additive congruential method, quadratic congruential method. Testing and validating of pseudo random sequences. Generating random variants: inverse-transform method; generating continuous Random variates: uniform, exponential; generating discrete random variates: Binomial, Poisson. Variance reduction techniques, Experimental design.

Unit-III: Discrete-Event Simulation: Time advance mechanisms. Components and Organization of a discrete event simulation model. Simulation of a single-server queuing system. Simulation of an inventory system. Simulation Languages: Comparison of simulation languages with general purpose languages. Classification of simulation software. Desirable software features. Simulation language – GPSS / SIMSCRIPT – II.5.

Unit-IV: Building valid and credible simulation models, determining the level of model detailing, techniques for increasing model validity and credibility. Output data analysis.

TEXTBOOKS:

1. Averill M. Law: Simulation Modeling & Analysis, Tata McGraw-Hill
2. Geoffrey Gordon: System Simulation, Prentice Hall of India
3. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management

IS-709: Probability and Statistics Credits: 3 (2-1-0)

Objective: The main objective of this course is to provide students fundamental knowledge of probability and statistics.

UNIT I: Probability Theory: Set Theory, Random Experiments and Outcomes, Measure of Probability of Events, Independence Events, Conditional Probability, Some Basic Rules/Theorems of Probability; Counting Techniques and Application to Problems; Random Variables and Probability Distributions: Discrete distributions: degenerate, Bernoulli, Binomial, Poisson, Geometric, Negative binomial, hyper-geometric, uniform, Multinomial distribution and its marginal and conditional distributions. Continuous distributions: Uniform, Normal, Lognormal, Exponential, Laplace, Pareto, Beta, Gamma, Cauchy.

UNIT II: General Introduction, including the Uses and Applications of Statistics, Types of Data and their Collection Methods, Stages of Statistical Investigation; Descriptive Analysis of Data including Exploratory Data Analysis; Central Tendency: mean, mode, median, percentile, moments, kurtosis, and skewness, measures of dispersion: mean deviation, standard deviation, variance.

UNIT III: Correlation: correlation coefficient and its properties, Correlation ratio, Correlation Index, Intra class correlation; Rank correlation: Spearman's and Kendall's measures; Concept of Regression: Principles of least squares, Fitting of polynomial and exponential curves; ANOVA, Design of Experiment.

UNIT IV: Introduction to Sampling Techniques and Sampling Distributions of Sample Means, Hypothesis Testing: Basic Concepts, Significance Tests for Parameters including Analysis of Variance; Non-Parametric Tests: Chi-square Tests, Tests for Independent and Paired Samples; Type I and Type II Errors and Power Function, Neyman-Pearson Lemma and Likelihood Ratio Test for Most Powerful Critical Region.

Text Books:

1. Chung K.L. "Elementary Probability Theory with Stochastic Process", Springer / Narosa
2. Feller W. "An Introduction to Probability Theory & its Applications", John Wiley
3. Goon A.M., Gupta M. K., Dasgupta B., "Fundamentals of Statistics (V-1)",World Press
4. Yule G.U & Kendall M.G., "An Introduction to the Theory of Statistics", C.Griffin
5. Snedecor & Cochran "Statistical Methods" 6th edition, Iowa State Univ. Press.

IS-711: System Analysis and Design Credits: 3 (2-1-0)

Objective:

This course has been designed to provide a foundation of systems principles and an understanding of how analysts can analyze complex business system and develop solution.

Unit I Introduction: System, Concepts, characteristics and components; Types of Systems: Physical System and abstract system, Open and closed system, Man-Made Information System and Formal Information System, Computer based Information System; System analysis and design, Role, task and attribute of the system analyst.

Unit II System Development Life Cycle (SDLC): Recognition of needs, Impetus for System Change, Feasibility Study, Analysis, Design, Implementation, Post implementation and Maintenance; Computer-Aided Software Engineering (CASE) Tools; Different models their advantages and disadvantages: Waterfall approach, Iterative approach, RAD model, Evolutionary software process model (Incremental model, Spiral model, Concurrent development model).

Unit III System Analysis and System Design: Systems Planning and initial investigation, Information Gathering, Tools of structure Analysis (Data Flow Diagram, Data Dictionary, Decision Tree, Structured English and Decision Table), Feasibility Study. **System Design:** Process and Stages of Systems Design, Logical and Physical Design, Design Methodologies (Structured Design), Major Development Activities (Personnel Allocation, Audit Considerations, Processing Controls and Data Validation), Input/output and Form Design, File organization and database design. **Modular and structured design:** Module specifications, Module coupling and cohesion, Top-down and bottom-up design.

Unit IV Object Oriented Analysis and design: Introduction to Object Oriented Analysis and design, Association, Aggregation, Inheritance, encapsulation, Generalization and Specialization. **Unified Modeling Language (UML)**: Class diagram, sequence diagram, Use case diagram, Collaboration diagram, state chart diagram, Activity diagram, component diagram, deployment diagram. **System Implementation:** System Testing and Quality Assurance, Implementation and Software Maintenance, Security and Disaster Recovery.

Text Books:

1. System Analysis and Design Elias M. Award, Galgotia Publication.
2. Essential of System Analysis and Design, Jeffrey A. Hofer Joey F. George Joseph . Valacich Addison Weseley.
3. Systems Analysis and Design, Kenneth E. Kendall, Julie E Kendall, PHI
4. Michael Blaha and J. Rumbugh, "Object oriented Modeling and design with UML", Pearson Education
5. O'Docherty, "Object Oriented Analysis and Design Understanding, System Development with UML2.0", Wiley India.

IS-721: Electronic Commerce Credits: 4 (3-1-0)

OBJECTIVES:

- To understand the concepts of e-commerce

- To know and understand the e-advertising and e-payments systems and marketing strategies.
- To understand the e-security, e-CRM.

Unit I: Framework, Architecture, Benefits and Impact of e-Commerce, The Anatomy of e-Commerce applications, e-Commerce Consumer applications, e-Commerce Organisation Applications, e-commerce in India, Prospects of e-commerce.

Unit II: Network Infrastructure for e-commerce: Intranet, Extranet, & Internet, Internet Backbone in India, ISP and services in India, OSI Model, Standards & Overview of TCP/IP, Internet Security, e-commerce & Internet. E-commerce Models: Business-to-Business-Hubs, Market Places, Business-to-Business Exchange, Business-to-Consumer, Consumer-to-consumer, Business-to-Government, Government-to-Government.

Unit III: e-Advertising & Marketing: The new age of information-based Marketing, Emergence of internet as a competitive advertising media, Market Research, Weakness in Internet Advertising, e-Advertising & Marketing in India. Electronic Payment Systems: Introduction to Payment Systems, On-Line Payment Systems, Pre-Paid e-Payment System, Post-Paid e-Payment System, Requirements Metrics of a Payment System.

Unit IV: Electronic Data Exchange: EDI- Definitions & Applications, Standardisation and EDI, EDI-Legal Security and Privacy Issues, Advantages & Limitations of EDI. E-Security: Securing the Business on Internet- Security Policy, Procedures and Practices, Transaction Security, Cryptology, Digital Signatures, Security Protocols for Web Commerce. e-CRM: CRM, what is e-CRM, it's Applications, The e-CRM Marketing in India, Major Trends, Global Scenario for e-CRM, CRM utility in India.

References:

1. Jeffrey F.Rayport & Bernard J.Jaworski: Introduction to E-commerce, TMH, 2003.
2. Kalakota & Winston: Frontiers of E-commerce, Pearson Education, Mumbai, 2002.
3. David Whiteley: E-Commerce- Strategy technologies and Applications, Tata Mac-Graw Hill, New Delhi, 2000.
4. C.S.V.Murthy: E-Commerce-Concepts, Models & Strategies, Himalaya Publishing house, Mumbai, 2003.
5. Kamalesh K Bajaj & Debjani Nag: E-Commerce, the Cutting Edge of Business- Tata McGraw-Hill, New Delhi, 2002.
6. Bharat Bhaskar: Electronic Commerce,Tata Mc-Graw-Hill, New Delhi, 2003.
7. Perry: E-Commerce, Thomson Publications, New Delhi,2003.
8. Elias M.Awad: Electronic Commerce,Prentice-Hall India, New Delhi,.2002.

IS-723: Business Intelligence Credits: 4 (3-1-0)

Objective: The main objective of the course is to prepare to lead, build and manage effective Business Intelligence systems in today's dynamic and challenging business environment.

Unit I: Introduction, Creating Business Intelligence Environment, Business Intelligence Landscape, Types of Business Intelligence, Business Intelligence Platform, Dynamic roles in Business Intelligence, Roles of Business Intelligence in Modern Business- Challenges of BI.

Unit II: Business Intelligence Life Cycle: Introduction, Business Intelligence Lifecycle, Enterprise Performance Life Cycle Framework Elements, Life Cycle Phases, Human Factors in BI Implementation, BI Strategy, Objectives and Deliverables, Transformation Roadmap, Building a transformation roadmap, BI Development Stages and Steps, Parallel Development Tracks, BI Framework.

Unit III: Business Intelligence User Model: Introduction, Evolution of Business Intelligence, Business Intelligence Opportunity Analysis Overview, Content Management System, End User Segmentation, Basic Reporting and Querying, Online Analytical Processing, OLAP Techniques, OLAP Applications, Applying the OLAP to Data Warehousing, Benefits of using OLAP, Dashboard, Advanced/Emerging BI Technologies, Future of Business Intelligence.

Unit IV: Business Intelligence Issues and Challenges: Introduction, Critical Challenges for Business Intelligence success, Cross-Organizational Partnership, Business Sponsors, Dedicated Business Representation, Availability of Skilled Team Members, Business Intelligence Application Development methodology, Planning the BI Projects, Business Analysis and Data Standardization, effect of Dirty Data on Business profitability, Importance of Meta-Data, Silver Bullet Syndrome, Customer Pain Points, Creating Cost Effective Enterprise friendly BI solution.

Text Books:

1. Larissa T. Moss and Shaku Atre, "Business Intelligence Roadmap, the complete project lifecycle for decision support applications", Addison-Wesley Professional.
2. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", Wiley India.
3. Michael Berry and Gordon Linoff "Data Mining Techniques",Wiley Publications.

IS-751: Communication Skills Credits: 4 (3-1-0)

OBJECTIVE: To make use of the opportunities and meet the challenges of the modern world, students need to develop effective communication skills. This is a skill that is most often quoted as lacking in engineers and IT professionals. Proper communication skills are also extremely important in interpersonal relationships. This course will help students in becoming confident and effective communicators, who can project themselves positively to others.

Unit I: Introduction to Communication: Need for Effective Communication. The Process of Communication: Levels of communication; Flow of communication; Use of language in communication; Communication networks; Significance of technical communication. Barriers to Communication: Types of barriers; miscommunication; noise; overcoming measures.

Unit II: Listening Skills: Listening as an active skill; Types of Listeners; Listening for general content; Listening to fill up information; Intensive Listening; Listening for specific information; Developing effective listening skills; Barriers to effective listening skills.

Reading Skills: Previewing techniques; Skimming; Scanning; Understanding the gist of an argument; Identifying the topic sentence; Inferring lexical and contextual meaning; recognizing coherence and sequencing of sentences; Improving comprehension skills.

Writing Skills: Sentence formation; Use of appropriate diction; Paragraph and Essay Writing; Coherence and Cohesion.

Unit III: Letter Writing: Formal, informal and demi-official letters; business letters. Job Application: Cover letter, Differences between bio-data, CV and Resume. Report Writing: Basics of Report Writing; Structure of a report; Types of reports. Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language.

Unit IV: Interview Skills: Types of Interviews; Ensuring success in job interviews; Appropriate use of non-verbal communication. Group Discussion: Differences between group discussion and debate; Ensuring success in group discussions. Presentation Skills: Oral presentation and public speaking skills; business presentations. Technology-based Communication: Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software.

Text Books:

1. Spoken English & Effective Communication (With 2 CDs): Mind Power Spoken English Institute by by Prof. Sharad Srivastava and Dr Amita Singhvi; Franklin International; New edition (2015)
2. Communication Skills by Sanjay Kumar and Pushp Lata; Oxford University Press India; (2015)
3. El Dorado: A Textbook of Communication Skills by R. Pushkala and P.A.Sarada; Orient Blackswan; (2013)

SEMESTER-II:

IS-702: Enterprise Resource Planning Credits: 4 (3-1-0)

Objective: The main objective is to help student to understand strategic importance of ERP in business process and how to create competitive advantage from managerial point of view.

UNIT I: Introduction to ERP, Need of ERP, Evolution of ERP, ERP and Related Technologies: Business Intelligence, E-Commerce and E-Business, Business Process Reengineering, Decision Support Systems (DSS), Executive Support Systems (ESS), Data Warehousing, Data Mining, OLTP, OLAP, Product life Cycle management, SCM, CRM, M-Commerce.

UNIT II: ERP Business Modules: Finance, Manufacturing, Human Resources, Plant maintenance, Materials Management, Production Planning, Quality management, Marketing, Sales, Distribution and service.

UNIT III: ERP Implementation: Implementation Challenges, Strategies, Life Cycle, Pre-implementation Tasks, Requirements Definition, Methodologies, ERP Package selection, Project Planning, Project Teams, Process Definitions, role of Vendors and Consultants, Project management, End User Training, Testing, Post Evaluation and Maintenance.

UNIT IV: ERP in Market place: Dynamics, SAP AG, Oracle, PeopleSoft, JD Edwards, QAD Inc, SSA Global, Lawson Software, Baan Enterprise, Epicor. Application Integration: ERP and E-Business, ERP II, ERP III, Total quality management, Future Directions, Trends in ERP. Cloud ERP, Open Source ERP and its vendors, Case studies of ERP Implementations.

Reference Books:

1. Alexis Leon, “ERP DEMYSTIFIED”, Tata McGraw Hill, Second Edition, 2008.
2. V. K. Garg & N. K. Venkita Krishnan, “ERP Concepts & Planning”.
3. V. K. Garg & N. K. Venkita Krishnan, “ERP Ware: ERP Implementation Framework”.
4. Joseph A Brady, Ellen F Monk, Bret Wagner, “Concepts in Enterprise Resource Planning”, Thompson Course Technology, USA, 2001.
5. Mary Sumner, “Enterprise Resource Planning”, Pearson Education, 2007.

IS-704: IT Project Management Credits: 4 (3-1-0)

Course Objective: This course is aimed at providing both basic and some advanced exposure to Project Management, so as to enable the manager of tomorrow to successfully complete sophisticated projects within the constraints of capital, time, and other resource**s.**

UNIT I: Introduction, Project Management Purpose, Project, Project Management, Relationships - Portfolio Management, Program Management, Project Management, Operations Management, Organizational Project Management and Organizational Strategy, Business Value, Project Manager Role. Organizational Influences on Project Management, Project Stakeholders & Governance, Project Team, Project Life Cycle, Project Management & Information Technology Context, System view of Project Management, Context of Information Technology Projects.

Project Management Process Groups (Initiating, Planning, Executing, Monitoring & Controlling, Closing), Project Management Processes & Knowledge Areas. Common Process Interactions. Project Integration Management, Processes -Develop Project Charter, Develop Project Management Plan, Direct and Manage Project Work, Monitor and Control Project Work, Perform Integrated Change Control, Close Project or Phase

UNIT II: Project Scope Management, Processes - Plan Scope Management, Collect Requirements, Define Scope, Create WBS, Validate Scope, Control Scope. Project Time Management, Processes - Plan Schedule Management, Define Activities, Sequence Activities, Estimate Activity Resources, Estimate Activity Durations, Develop Schedule, Control Schedule

Project Cost Management, Processes - Plan Cost Management, Estimate Costs, Determine Budget, Control Costs. Project Quality Management, Processes - Plan Quality Management, Perform Quality Assurance, Control Quality.

UNIT III: Project Human Resource Management, Processes - Plan Human Resource Management, Acquire Project Team, Develop Project Team, Manage Project Team. Project Communications Management, Processes - Plan Communications Management, Manage Communications, Control Communications.

Project Risk Management, Processes -Plan Risk Management, Identify Risks, Perform Qualitative Risk Analysis, Perform Quantitative Risk Analysis, Plan Risk Responses, Control Risks. Project Procurement Management, Processes - Plan Procurement Management, Conduct Procurements, Control Procurements, Close Procurements.

UNIT IV: Project Stakeholder Management, Processes - Identify Stakeholders, Plan Stakeholder Management, Manage Stakeholder Engagement, Control Stakeholder Engagement. Project Management Styles in Industry, Agile Methodology, Scrum, Lean, Extreme, Benefits Realization Model.

Text Books:

1. Information Technology Project Management, Kathy Schwalbe, 5th Edition, Thomson
2. Project Management Prassana Chandra
3. Project Management Mantle, Meredith
4. PMBOK 5th Edition, PMI
5. Head First Project Management
6. Project Management by Kim Heldman

IS-706: Data Mining and Warehousing Credits: 3 (2-1-0)

Course Objective The main objective of this course is to provide understanding of data warehouse fundamentals and data mining techniques for business applications.

UNIT I: Data Warehousing: Introduction data warehousing, Data Mart, Data Warehouse Architecture; Star, Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning. ETL Concepts.
OLAP technology: Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, indexing data.

UNIT II: Data Mining: Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining; Introduction to Web Mining, Text Mining.
Data Processing: Data Cleaning, Data Integration and Transformation; Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Data Discretization and Concept hierarchy generation for numerical and categorical data.

UNIT III: Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, FP-Growth Algorithm, latest trends in association rules mining.

UNIT IV: Classification methods: Decision tree, Bayesian Classification, Rule based; clustering methods: Partitioning methods(K-Means, K-Mediods) and Hierarchical Clustering(Agglomerative and Divisive Clustering, Multi-phase method) Prediction: Linear and non-linear regression;

Text Books:

1. P.Ponnian, "Data Warehousing Fundamentals", John Weliey.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.
3. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education.
4. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", Wiley India.
5. Michael Berry and Gordon Linoff "Data Mining Techniques",Wiley Publications.
6. M.H.Dunham, "Data Mining Introductory & Advanced Topics", Pearson Education.

IS-708: Big Data and Cloud Computing Credits: 3 (2-1-0)

Objective: The main objective of this subject is to help student to understand basic concepts and technologies of Big data and Cloud.

Unit I: Basics of Big Data and Cloud Computing: Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting – Modern Data Analytic Tools. Overview of Cloud Computing, Evolution of Cloud Computing, advantages and disadvantages of Cloud Computing, Applications, Cloud computing vs. Cluster computing vs. Grid computing, NIST Definition of Cloud computing, features of cloud computing, Cloud Service Models, Deployment Models.

Unit II: Cloud Service Models and Virtualization: Infrastructure as a Service (IaaS): Introduction, Introduction to virtualization, Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, advantages and disadvantages of Cloud Computing, Technologies of virtualization.

UNIT III: Managing the Cloud, Security and Privacy issues in Cloud Computing: Administrating the Clouds, Cloud Management Products; Emerging Cloud Management Products, Managing Cloud Security, Cloud Security Challenges and Risks, Data Security, Virtual Machine Security, Identity Management and Access Control, Authentication in cloud computing

Unit IV: Emerging trends and applications of Cloud Computing: Cloud Databases, Mobile Cloud, Energy Efficient and Green Cloud Computing, Federated Clouds or Inter Cloud, Various Commercial and Scientific Applications of Cloud Computing e.g. Healthcare, Biology and Geoscience applications, CRM, Social networking and online gaming. **Various Cloud Computing and Big Data Toolkits/ Technologies:** Google Cloud Services, Amazon Cloud Services, Microsoft Azure, Oracle Public Cloud, Aneka toolkit , Eucalyptus, OpenStack, CloudStack, Hadoop and its components.

Text Books:

1. Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India) Private Limited, 2013.
2. Kris A Jamsa: Cloud computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More, 2013, Jones & Bartlett Learning ISBN-13: 9781449647391.
3. Sosinsky B., "Cloud Computing Bible", Wiley India
4. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.
5. Web Reference: csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf.

IS-710: Decision Analysis Credits: 3 (2-1-0)

COURSE OBJECTIVE

This course introduces and applies advanced modelling techniques to decision problems with the objective of enhancing the decision-making skills as well as the spreadsheet knowledge base.

Unit-I: Probability:

Basic Probability: Laws of probability-addition law, conditional law. Random variables and probability distributions. Expectation of a random variable-mean and variance of a random variable, mean and variance of joint random variables. Probability distributions-Binomial, Poisson, Normal, Exponential. Empirical distributions.

Unit-II: Game Theory:

Introduction, definitions, two-person zero sum game. Game with pure strategies, saddle point, game value. Game with mixed strategies, solution methods-algebraic method, graphical method, dominance, linear programming method.

Unit-III: Decision Making:

Structuring the decision problem-payoff tables, decision trees. Decision making under certainty. Decision making under risk: Expected value criterion, expected value of perfect information, sensitivity analysis, decision making with sample information, expected value of sample information, computing branch probabilities, utility and decision making. Decision making under uncertainty: Laplace, Minimax, Savage, Hurwicz.

Unit-IV: Multicriteria Decision Making:

Multicriteria decision making: Goal programming, Scoring models, Analytical Hierarchy Process, TOPSIS. Markov Analysis.

TEXT BOOKS:

1. Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
2. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
3. William J. Stevenson: Introduction to Management Science, IRWIN.

IS-712: IT Strategy and Management Credits: 3 (2-1-0)

Objective: The main objective of this course is to student understand linkage between business and IT to develop IT strategy for competitive advantage.

UNIT I: Business Strategy: Challenges and Opportunities for IT Business Strategy: Challenges and Opportunities in the Globalized, Interconnected, Convergent World, Establish Principles before Practice, IT Strategy, Application Strategy, Technology Strategy for IT, IT Management Strategy, Developing IT Strategy for Competitive Advantage, Stages of IT Strategy Development and Implementation. Business and IT Strategy Alignment: Inhibitors of Business and IT Strategy Alignment, Three-D Framework for Business and IT Strategy Alignment, Achieve business and IT alignment.

Unit II : Strategic IT Planning: Business Implications for IT Strategic and Planning, Strategic IT Planning Motivations, SITP Process: Prevalent Planning Approaches, Difficulties in Developing and Executing SITP, Best Practices for Achieving Good SITP, SITP Approaches: Prevalent Researches; Planning Horizon, Resource Planning, change management issues, monitoring and measuring SITP performance.

Unit III: IT Service Management Strategy: Information Technology Infrastructure Library (ITIL), ITIL Overview, ITIL Service Support Processes, Incident Management, Problem Management, Service Delivery, Service Level Management, Financial Management, Capacity Management, IT Service Continuity Management (ITSCM).

Unit IV: Technology Management strategy for IT: Framework, Technology Strategy Prevalent Technology Reference Architectures Framework and Standards. IT sourcing strategy: Outsourcing, IT Management Layers, Variants of Outsourcing, Business Process Outsourcing, Insourcing.

Text Books:

1. Sanjiva Shankar Dubey, “IT Strategy and Management”,PHI.
2. Eng K. Chew, Petter Gottschalk, "Information Technology Strategy and Management: Best Practices",Information Science Reference , 2009

IS-722: Information Security Management Credits: 4 (3-1-0)

Objective: The purpose of this course is to provide fundamental knowledge of Information Security and introduction of some advance research topics.

Unit I: Need for security, Security approaches, Principles of security, various security attacks. Basic of Cryptography, secret key cryptography, Types of attack, Substitution ciphers, Transposition ciphers, block ciphers and steam ciphers, Hill Cipher, Data encryption standard, Cryptanalysis, brute force attack; Public key cryptography, Principles of Public key Cryptosystems, Cryptographic Algorithms RSA, Diffie-Hellman key exchange; Digital Signature.

Unit II: Authentication: One way Authentication, password based, certificate based, Mutual Authentication, shared secret based, Asymmetric based, Authentication and key agreement, centralized Authentication, eavesdropping, Kerberos, IP Security, Secure Socket Layer(SSL), Transport Layer Security (TLS).

Unit III Software vulnerabilities, Threats and Security Systems: Phishing Attacks, buffer overflow vulnerability, Format String attack, Cross Site Scripting, SQL injection Attacks, Denial-of-Service (DoS), Sniffing, Spoofing and Email security. Malware: Backdoors, Trojan horse, Viruses and it's Characteristics, Working, Infection Phases, Worms, Zombie. **Security Systems:** Intrusion Detection System, need and types of IDS, Intrusion Prevention Systems; Firewalls: functionality, Polices and Access Control, Packet filters, Application level gateway; Anti-Intrusion Technique: Honey pot; Anti-virus.

Unit IV Advance Concepts of IS: Introduction to Identity based Cryptography, Data Hiding and It's applications, Data hiding techniques: Steganography, Watermarking; Cloud Security; Biometric Security; Introduction to Computer Forensic, Hacking, Cyber Crime.

Text Books:

1. Cryptography and Network Security – B. Forouzan, McGraw-Hill.
2. William Stalling, "Cryptography and Network security", Pearson.
3. Cryptography & Network Security: Atul Kahate, TMH.
4. Matt Bishop, Computer Security- Arts and Science, Pearson Education, 2003.
5. Pieprzyk et.al, Fundamentals of Computer Securiry, Allied Publishers, 2004.
6. Rebecca Gurley Bace, Intrusion Detection, Technology Series MTP 2007.
7. Ingemar Cox, Matthew Miller, Jeffrey Bloom, Jessica Fridrich, Ton Kalker, Digital Watermarking and Steganography,2nd Edition, Morgan Kaufmann, 2007.

IS-724: Software Quality Assurance Credits: 4 (3-1-0)

Objective: The main Objective of the course is to student will learn basic concepts of software quality assurance and able to differentiate between the various activities of quality assurance, quality planning and quality control.

Unit I: Software Quality: Cost of quality, Quality models, Quality frameworks, Verification and Validation, Defect management, IEEE standards, Quality assurance and control processes, Verification techniques: Inspections, reviews, walk-throughs.

Unit II: Validation: Test plan, Test cases, Test Generation, Monitoring and Measuring Test Execution, Test Tools and Automation, Equivalence partitioning, Boundary value analysis, Category partition method, combinatorial generation, and Decision tables.

Unit III: Structural Testing: Test adequacy criteria, Control flow graph, Coverages: block, conditions, multiple conditions, Data flow graph – Definition and use coverages, C-use, P-use, Defclear, Def-use, Finite state machines, Transition coverage. Fault based testing, Mutation analysis.

Unit IV: Functional Testing: Test adequacy criteria, Test cases from use cases, Exploratory testing: Integration, system, acceptance, regression testing; testing for specific attributes: Performance, load and stress testing, Usability testing, Security testing, Test automation.

Text Books:

1. Aditya P. Mathur, "Foundations of Software Testing", Pearson, 2008.
2. P. Ammann and J. Offutt. Introduction to Software Testing. Cambridge University Press
3. Daniel Galin, Software Quality Assurance : From Theory to Implementation, Addison Wesley.
4. Nina S Godbole, “Software Quality Assurance: Principles and Practice”, Alpha Science International
5. Mordechai Ben-Menachem, Garry S Marliss, “Software Quality”, Vikas Publishing House.

IS-752: Technical Communications Credits: 4(3-1-0)

Objective:
This course is designed to help the students to develop skills that will enable them to produce clear and effective scientific and technical documents.

Unit I:
Technical writing: Definition, Similarities to other writings, Unique features, importance, technical writing as profession, qualifications for technical writing. Identifying audience. Problems involving content, words and phrases, punctuation, unity, coherence, logic, etc. Being concise.

Unit II:
Techniques of Technical Communication. Analysing-Division, Classification, Partition. Defining-Formal, informal, expanded. Describing-subjective versus objective, spatial description, description of mechanism, process, selected details. Illustrating-Tables, graphs, charts, pictorials. Researching-Basic types of research, original research, searching the literature. Abstracting of your own reports, the works of others, precautions. Oral communication-one to one reporting, participation in conferences, speaking to large audiences, organising the speech.

Unit III:
Basic forms of Technical Writings. The memorandum, The business letter, Formal report.

Unit IV:
Technical reports. Justification reports and proposals, the progress reports, periodic reports, status reports, trip reports. Laboratory reports, Feasibility reports, State-of-the-Art reports. Instructions and manuals.

Text Books:

1. James Sherlock: A Guide to Technical Communication.

SCHOOL OF DATA SCIENCE AND FORECASTING

Ph.D. Course Work

The Ph.D. course work shall contain the following courses:

Course Code	Course Title	Credits (L-T-P)
DS9Z-901	Research Methodology	4 (2-1-2)
DS9Z-902	Review of Published Research	3 (0-0-6)
DS9Z-903	Computer Applications	3 (1-0-4)
DS9Z-904	Predictive Analytics	3 (2-0-2)
DS9Z-905	Comprehensive Viva-Voce	3

Combined classes will be conducted in following courses/ papers:

(i) Research Methodology
(ii) Computer Applications

Classes of Advanced paper in the subject will be conducted at the respective research centre. The course on Review of Published Research in the relevant field will be undertaken under the supervisor and the student has to consult the library or other resources to carry out the literature review. At the end of the semester he/ she has to submit a brief report on the literature review for evaluation.

DS9Z-901: Research Methodology: 4 (2-1-2)

Course contents:

- Introduction to research, Need, Importance and Characteristics of research, Types of research – An overview, Quantitative and qualitative research, Review of literature
- Identification, Definition and Statement of Problem, Variables, Role of variables in research, Research Questions and Objectives
- Hypotheses, Hypotheses Testing, Population and Sample, Probability Sampling Techniques, Non - Probability Sampling Techniques
- Research Design – An Overview, Philosophical and Historical, Survey, Case Studies
- Experimental Designs, Research Tools

- Process of Research Tools Designing, Questionnaire Designing, Test Designing, Scale Designing, Scaling Techniques
- Process of Standardising Research Tools, Data Analysis Overview
- Frequency Distribution, Statistical Tools: Measures of Central Tendency, Measure of Variability, Comparing Means: Independent Sample t-test, Paired Sample t-test, One Way ANOVA, Factorial Design ANOVA, ANCOVA, Correlation, Regression, Factor Analysis and Non-parametric Statistical Techniques.
- Report Writing, IPR and Plagiarism, Statistical Software and Research Paper Writing

Text Books:

1. Kerlinger, F.N: Foundations of Behavioral Research, Surjeet Publication, New Delhi, 1983.
2. Sterling, T. and Pollack, S: Introduction to Statistical Data Processing, Prentice Hall, 1968.
3. Campbell, W: Forms and style in Thesis Writing, 3rd ed., Boston., Houghton, Mifflim, 1969.
4. McNemar, Orinn: Psychological Statistics, John Wiely and Sons, 1960.
5. Molstad, John A.: Selective Review of Research Studies Showing Media Effectiveness: A Primer for Media Director. AV communication review vol.22, 1974.

DS9Z-902: Review of Published Research: **3 (0-0-6)**

- Introduction to Literature Review
- Problem Identification
- Process of Literature Review
  - Searching for related literature to research problem
  - Methods of organizing the literature
  - Synthesize the results
  - Finalize the review

DS9Z-903: Computer Applications: **3 (1-0-4)**

Unit I: Basic Knowledge of Computer

Unit II: Use of Computer in Research

Unit III: Use of technology and other equipment in Research

Unit IV: Data Analysis Softwares and Analysis Techniques (SPSS)

- MS Excel
- MS Office
- Power Point Presentations
- Use of Internet for Research Purpose
- Introduction to UGCinfonet, INFLIBNET and ERNET etc.

Unit V: Practical Work

DS9Z- 904: Predictive Analytics **3 (2-0-2)**

Unit-I

Overview of Predictive Analytics: Supervised and Unsupervised learning, Parametric and non-parametric models, Business Intelligence, Data mining, etc. Problem identification: Predictive analytics processing steps, business understanding, defining data for analytics, defining target variable, measures of success. Data Understanding: Single variable summaries-mean, standard deviation, Normal distribution, Uniform distribution, Data understanding with simple statistics. Data visualisation in one dimension, Multiple variables summaries-Correlation, etc. Data visualisation in multiple dimensions.

Unit-II

Data preparation-Variable cleaning, feature creation. Itemsets and association rules-terminology, parameter settings, measures of interesting rules, deploying association rules, problems, with association rules, building classification and association rules. Descriptive modelling-principal component analysis, Clustering algorithms. Interpreting Descriptive models.

Unit-III

Predictive modelling-Decision tress, Logistic regression, neural networks, K-nearest neighbour, Naïve Bayes, Regression models, Linear regression. Assessing Predictive Models.

Unit-IV

Model ensembles, Text mining, Model deployment. Case studies.

Books:

1. Dean Abbott , Applied Predictive Analytics, WILEY, 2014
2. Eric Siegel , Predictive Analytics, WILEY, 2016
3. Anasse Bari, Mohamed Chaouchi, and Tommy Jung, Predictive Analytics For Dummies, WILEY, 2016
4. Max Kuhn, Kjell Johnson, Applied Predictive Modeling, Springer Science & Business Media, 2013.

SCHOOL OF DATA SCIENCE AND FORECASTING

PROGRAM CODE: DS5A BATCH: 2018-20

PROGRAM TITLE: MASTER OF BUSINESS ADMINISTRATION (M.B.A.)
- BUSINESS ANALYTICS

PROGRAM OUTCOMES:

- Developing of managerial and analytical skills covering both technical and business domains.
- Getting opportunities of higher studies in the area of Business Analytics.
- Demonstrate use of team work, leadership skills, decision making and organization theory.
- Apply Data Science techniques to the solution of real world business problems, communicate findings, and effectively present results.

PROGRAM SPECIFIC OUTCOMES:

- Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.
- Employ cutting edge tools and technologies to analyze Big Data.
- Understanding of the key technologies in business analytics: data mining, data visualization, forecasting methods, and statistics.
- Use of Data Science technologies in finance and marketing analytics.

PROGRAM STRUCTURE (2018-20):

First Semester:

Code	Title	Credits (L T P)
CORE COURSES		
DS5A-501	Principles of Management	3 (2-1-0)
DS5A-503	Database Management	3 (2-0-2)
DS5A-505	Principles of Economics	3 (2-1-0)
DS5A-507	Probability and Statistics	3 (2-1-0)
DS5A-509	Python for Analytics	3 (2-0-2)
DS5A-511	Spreadsheet Modelling	2 (0-0-4)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
DS5A-521	Fundamentals of Algorithms	3 (2-0-2)
DS5A-523	Decision Analysis	3 (2-1-0)
ELECTIVE GENERIC: The students can choose following course or any other PG level generic course being run in this campus.		
DS5A-551	Business Communication	3 (2-1-0)

Second Semester:

Code	Title	Credits (L T P)
CORE COURSES		
DS5A-502	Organisational Behaviour	3 (2-1-0)
DS5A-504	Operations Research	4 (3-1-0)
DS5A-506	Data Mining and Data Warehousing	3 (2-0-2)
DS5A-508	Business Mathematics	3 (2-1-0)
DS5A-510	Statistical Programming in R	3 (2-0-2)
DS5A-512	Machine Learning	3 (2-0-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
DS5A-522	Marketing Management	3 (2-1-0)
DS5A-524	Financial Management	3 (2-1-0)
ELECTIVE GENERIC: The students can choose following course or any other PG level generic course being run in this campus.		
DS5A-552	Research Methodology	3 (2-1-0)

Third Semester:

Code	Title	Credits (L T P)
CORE COURSES		
DS5A-601	Forecasting Methods	3 (2-1-0)
DS5A-603	Econometrics	3 (2-1-0)
DS5A-605	Supply Chain Management	4 (3-1-0)
DS5A-607	Big Data Technologies	3 (2-0-2)
DS5A-609	Data Visualization	3 (2-0-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
DS5A-621	Marketing Analytics	4 (3-0-2)
DS5A-623	Financial Analytics	4 (3-0-2)
ELECTIVE GENERIC: The students can choose following course or any other PG level generic course being run in this campus.		
DS5A-651	Strategic Management	3 (2-1-0)

Fourth Semester:

Code	Title	Credits (L T P)
Project		
DS5A-602	Major Research Project / Industry Internship	12

Note: The above course contents can be modified as per requirement from time to time in accordance with University Ordinance No. 14.

DETAILED SYLLABUS:

First Semester:

DS5A-501: Principles of Management Credits: 3 (2-1-0)

Objective: Objective of this course is to help the students gain understanding the functions and responsibilities of the manager, provide them tools and techniques to be used in the performance of managerial job, and enable them to analyze and understand the environment of the organization.

COURSE DESCRIPTION:

Unit I: Concept of Management: Introduction to Management & Organizations, Functions and Responsibilities of Managers, Fayol's Principles of Management, Management thought; the Classical School, The Human Relations School, Systems theory, Contingency Management Developing Excellent Managers.

Unit II: Planning: Nature and purpose of planning process, principles of Planning, Types of planning, Advantages and Limitation of planning. Concept and Nature of Objectives: Types of Objectives, Importance of Objectives, Setting objectives, Management by Objective (MBO) benefits and weaknesses of MBO.

Unit III: Strategies and Policies: Concept of Corporate Strategy, formulation of strategy, Types of strategies, Types of policies, principles of formulation of policies, Decision Making Process, Individual Decision Making Models.

Organizing: Nature and Purpose of Organizing, Bases of Departmentation, Span Relationship, Line Staff Conflict, Bases of Delegation, Kind of Delegation and Decentralization, methods of Decentralization.

Unit IV: Controlling: Concept and Process of Control, Control Techniques. Human Aspects of Control, Control as a feedback system, feed forward Control, Preventive Control, Profit and loss Control, Control through Return on investment, the use of Computer of Controlling & Decision making, the challenges created by IT a Control tool.

Text Books:

1. Horold Koontz, O'Donnell and Heinz Weihrich, "Essentials of Management' New Delhi, Tata McGrow Hill, 1992.
2. R.D. Agrawal, "Organization and Management" New Delhi, Tata McGrow Hill 1995.
3. Stephen Robbins "Management" 8th Ed. New Delhi Pearson 2006
4. The New Era of Management (India Edition) by Richard L. Daft Suggested Reading:
5. Horold Koontz, Heinz Weihrich, "Management: A Global Perspective" New Delhi Tata McGrow Hill, 10th Ed. 1994.
6. Robert Krietner, "Management" Houghton Miffin CO. 7 th Ed.1999.
7. Stephen Robbins "Management" 8th Ed. New Delhi Pearson 2006

Course Outcomes:

At the end of the course students will be able to-

- Define Management and explain how management differs according to level and whether a manager is a line manager or an enabling role.
- Briefly describe and contrast four models of management; rational, goal, scientific, human relations, open systems
- Describe and attain some elementary level of skills in the main management processes; planning, organizing, decision making and control.

DS5A-503: Database Management Credits: 3 (2-0-2)

Objective: The purpose of this course is to provide fundamental knowledge of database management system and understanding of how to use and design a DBMS.

Unit I: DBMS Concepts, Comparison between Database approach and Traditional file accessing approach, Advantages of database systems, Schemas and instances, Data Dependency, Data Dictionary, and Meta Data. Data models, Types of Data models (Object Oriented, Record Based and Physical data models), E-R diagram, Relational Data models: Domains, Tuples, Attributes, Keys, Relational database, Schemas, Integrity constraints, Relational algebra and relational calculus.

Unit II: Database Design: Introduction to normalization, Normal forms (INF, 2NF, 3NF, BCNF), Functional dependency, Decomposition, Dependency preservation and lossless join, multi-valued dependencies. **Structured Query Language**: DDL, DML, DCL, TCL, SQL Functions, integrity constraints, various joins, sub-query, index, View, Sequence, and Clusters. PL/SQL: manipulating data using PL/SQL, Iteration, Exceptions, Cursors, Trigger. (Experiment on Oracle 11g)

Unit III: Transaction Processing and Concurrency Control: Transaction System, Serializability of schedules, conflict & view serializable schedule, Recovery from transaction failures, Log based recovery. Checkpoints dead lock handling, Concurrency Control, locking Techniques for concurrency control, time stamping protocols for concurrency control, validation based protocol, multiple granularity.

Unit IV: Advance Concepts: Introduction to Distributed databases, data mining, data warehousing, Basic Concepts of Object Oriented Database System, Comparative study of OODBMS V/s RDBMS. Introduction to Image and Multimedia databases and data structures, Web and mobile database, Spatial and Geographic Database, Accessing Database from front-end Application. Case Study: Oracle, MySql, DB2.

Reference Books:

1. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, fifth Edition McGraw-Hill.
2. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.

3. Rob, Coronel, “Database Systems”, Seventh Edition, Cengage Learning.
4. Ramakrishnan: Database Management System , McGraw-Hill
5. Fred R.McFadden,Jeffrey A.Hoffer & Marry B.Prescott.?Modern Database Management, Fifth Edition,Pearson Education Asia,2001
6. Gray Jim and Reuter Address, “Transaction Processing: Concepts and Techniques”, Morgan Kauffman Publishers.

Course Outcomes:

- The student will learn the basics of database management.
- The student will be able to design database using ER diagram.
- The student will able to optimize database using normalization.
- The student will able to work on database software MYSQL/Oracle.
- The student will learn how to write SQL queries.

DS5A-505: Principles of Economics Credits: 3 (2-1-0)

Course Objectives: The basic objective of this course is to make the students aware of the various economic issues that they are expected to face as managers at the corporate level and to equip them with the tools and techniques of economic analysis for improving their decision-making skills.

COURSE DESCRIPTION:

Unit-I: Introduction to Economics: Definitions, Nature and Scope of Economics; Difference between Microeconomics and Macroeconomics; Significance in decision-making and fundamental concepts. Consumer Demand Analysis: Meaning, Features and Determinants of demand; Law of Demand and its Exceptions; Reasons for Law of Demand; Importance of Law of Demand; Elasticity of Demand.

Unit-II: Supply Analysis: Meaning, Supply Function, Law of Supply, Determinants of Supply, Law of supply; Reasons for Law of Supply; Elasticity of supply and its measurement. **Theory of Production**: Production Function, Factors of Production; Law of Variable Proportions; Law of returns to scale Cost, Revenue and Profit Analysis: Cost Classifications for Predicting Cost Behavior; Concept of Profit, Gross Profit and Net Profit; Break Even Point (BEP).

Unit-III: Market Structure: Perfect Competition, features, determination of price under perfect competition. Monopoly: Feature, pricing under monopoly, Price Discrimination. Monopolistic: Features, pricing under monopolistic competition, product differentiation.

Unit-IV: National Income: Circular Flow of Income, Meaning and Concept of National Income: GNP/GNI, NNP/NNI, Personal Income and Disposable Income; Methods of Computing National Income -Production Method, Income Method, Expenditure Method.

Inflation-Types of Inflation, Causes, Effects, Inflation and Unemployment. **Economic Stabilization:** Monetary Policy- Meaning, Objectives, Tools; Fiscal Policy- Meaning, Objectives, Tools

Text Books:

1. J S Chandan, *Statistics for Business and Economics,*
2. H. L. Ahuja, Principles of Microeconomics*,*
3. D. N. Dwivedi, Macroeconomics Theory and Policy, Tata McGraw-Hill
4. S Damodaran, *Managerial Economics*.
5. Sunny Thomas & Wahida Thomas, Business Economics
6. Hirschey Mark, Economics for Managers, Thomson Publication

Course Outcomes:

Upon completing the course, students will be able to:

· Demonstrate knowledge of the laws of supply and demand and equilibrium; and apply the supply and demand model to analyze responses of markets to external events.

· Evaluate economic issues and public policy by using economic models or data analysis while identifying underlying assumptions of the model(s) and limitations.

· To generate and interpret summary statistics and regression models.

· Solve economic problems involving comparison and selection of alternatives by using analytical techniques including benefit-cost ratio and break-even analysis.

DS5A-507: Probability and Statistics Credits: 3 (2-1-0)

Objective: The main objective of this course is to provide students fundamental knowledge of probability and statistics.

COURSE DESCRIPTION:

UNIT I: Probability Theory: Set Theory, Random Experiments and Outcomes, Measure of Probability of Events, Independence Events, Conditional Probability, Some Basic Rules/Theorems of Probability; Counting Techniques and Application to Problems; Random Variables and Probability Distributions: Discrete distributions: degenerate, Bernoulli, Binomial, Poisson, Geometric, Negative binomial, hyper-geometric, uniform, Multinomial distribution and its marginal and conditional distributions. Continuous distributions: Uniform, Normal, Lognormal, Exponential, Laplace, Pareto, Beta, Gamma, Cauchy.

UNIT II:

General Introduction, including the Uses and Applications of Statistics, Types of Data and their Collection Methods, Stages of Statistical Investigation; Descriptive Analysis of Data including Exploratory Data Analysis; Central Tendency: mean, mode, median, percentile, moments, Kurtosis, and Skewness, measures of dispersion: mean deviation, standard deviation, variance.

UNIT III:

Correlation: correlation coefficient and its properties, Correlation ratio, Correlation Index, Intra class correlation; Rank correlation: Spearman’s and Kendall’s measures; Concept of Regression: Principles of least squares, Fitting of polynomial and exponential curves; ANOVA, Design of Experiment.

UNIT IV:

Introduction to Sampling Techniques and Sampling Distributions of Sample Means, Hypothesis Testing: Basic Concepts, Significance Tests for Parameters including Analysis of Variance; Non-Parametric Tests: Chi-square Tests, Tests for Independent and Paired Samples; Type I and Type II Errors and Power Function, Neyman-Pearson Lemma and Likelihood Ratio Test for Most Powerful Critical Region.

Text Books:

1. Chung K.L. “Elementary Probability Theory with Stochastic Process”, Springer / Narosa
2. Feller W. “An Introduction to Probability Theory & its Applications”, John Wiley
3. Goon A.M., Gupta M. K., Dasgupta B., “Fundamentals of Statistics (V-1)”,World Press
4. Yule G.U & Kendall M.G., “An Introduction to the Theory of Statistics”, C.Griffin
5. Snedecor & Cochran “Statistical Methods” 6th edition, Iowa State Univ. Press.

Course Outcomes:

1. Learn about data driven decision making under probabilistic framework.
2. Translate a business problem into a statistical inference problem.
3. Identify an appropriate statistical method to solve the problem.
4. Perform statistical analysis and draw conclusions from the analysis to solve the business problem.

DS5A-509: Python for Analytics Credits: 3 (2-0-2)

Objective: The main objective is to help students to understand the fundamentals of python. Student will learn how to analysis data using Python.

COURSE DESCRIPTION:

UNIT I: Introduction to Python: Python versus Java, Python Interpreter and it’s Environment, Python installation, Python basics: variables, operators, Strings, Conditional and Control Statements, loops; Data structures: lists and dictionaries; functions: global functions, local functions, lambda functions and methods.

UNIT II: Object Oriented Programming Concepts: Class, object, constructor, destructor and inheritance; Modules & Packages, File Input and Output, Catching exceptions to deal with bad data, Multithreading, Database Connectivity.

UNIT III: Numpy: Creating Arrays, Arrays Operations, Multidimensional Arrays. Arrays transformation, Array Concatenation, Array Math Operations, Multidimensional Array and its Operations, Vector and Matrix. **Visualization:** Visualization with matplotlib, Figures and subplots, Labeling and arranging figures, Outputting graphics.

UNIT IV: Pandas: Manipulating data from CSV, Excel, HDF5, and SQL databases, Data analysis and modelling with Pandas, Time-series analysis with Pandas, Using Pandas, the Python data analysis library, Series and Data Frames, Grouping, aggregating and applying, Merging and joining.

Text Books:

1. McKinney Wes, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.
2. Hauck Trent, "Instant Data Intensive Apps with Pandas How-To", Packt Publishing Ltd, 2013.
3. Beazley David M.,"Advanced Python Programming", Pearson Education,2009.
4. Chun Wesley , Core Python Programming, 3rd Edition,Prentice Hall Professional, 2012.
5. Telles Matt "Python Power!: The Comprehensive Guide", Cengage Learning, 2008.
6. McKinney Wes & PyData Development Team, "pandas: powerful Python data analysis toolkit", Release 0.13.1, Feb 2014.
7. https://docs.python.org/3.4/tutorial/
8. http://www.tutorialspoint.com/python/python_quick_guide.htm

Course Outcomes:

- The student will learn core data types of python.
- The student will learn conditional and looping operations in python.
- The student will be able to work with Object-oriented concepts and Database connectivity in python.
- The student will be able to analyze data using Pandas and Numpy.
- The student will be able to visualize the data using seaborn and matplotlib.

DS5A-511: Spreadsheet Modelling Credits: 2 (0-0-4)

Objective: The main objective of this course is to learn analysis of data using MS Excel, resulting in less time and better understands what the data means.

COURSE DESCRIPTION:

Unit I: Introduction to Excel User Interface**,** Application, Workbook, Worksheets & its Components, Named Ranges; Formatting: Cell Color, Font Color, Indents, Alignments, Number Formats, Custom Formats, Editing commands; Data Sorting: Built-in Sort, Sorting Levels, Custom Sort; Data Filtering: Auto Filter – Filter By Color, Filter by Icono Advanced Filter, Remove Duplicates; Data Subtotal – Built-In Subtotal (Nested Subtotal).

Unit II: Data Validation: Based on cell values (text length, whole no Based on Formulas, List Dropdown, Circle Invalid Data, Input & Error Messages; Data Grouping: Grouping Rows, Grouping Columns. Data Tables: Conditional Formatting, Formatting based on Cell values, Formatting based on Formulas, Icon Sets (bars, scales, icons), Freezing Panes, Text-to-Columns, Delimited, Fixed Length; Data Consolidation (from multiple files), Getting External Data into Excel, From MS Access, From Text files, From Web, Other Data Sources.

Unit III: Formulas, TEXT Functions, IF, ERROR Functions, LOGICAL Functions, VLOOKUP, HLOOKUP, COUNTIF, SUMIF, SUMPRODUCT, DATE & TIME FUNCTIONS, FORMULA TEXT, Information Functions (ISNA, ISEVEN, ISERR…).

Unit IV: Charts: Chart Types, Chart Components, Primary Vs Secondary Axis, Chart Formatting, Sparkline (2010 and above); Pivot Tables: Introduction & Creation, Slicer, TimeLine, Pivot Charts, Calculated Fields, Calculated Items, Grouping, Formatting – Number/Conditional, PowerPivot, PowerView.

Assignment: Dashboard design

Text Books:

1. John Walkenbac, “Excel 2016 Bible”, John Willey & sons.
2. Jordan Goldmeier , “Advanced Excel Essentials”, Apress Publisher.
3. Conrad George Carlberg , “Business Analysis with Microsoft Excel”, Que Publishers.
4. Bernd Held, ”Microsoft Excel Functions & Formulas”, Wordware publishing, Inc.
5. Steven Roman ,”Writing Excel Macros with VBA” O’Reilly Media.

Course Outcomes:

- The student will be able to perform basic operations in Excel.
- The student will be able to summarize data using Grouping and pivot table.
- The student will be able to write conditional statements and perform LOOKUP operations.
- The student will be able to create charts in excel.
- The student will be able to create a dashboard in excel.

DS5A-521: Fundamentals of Algorithms Credits: 3 (2-0-2)

Objective: The main object of this course is to provide an introduction to create analytical skills, to enable the students to design algorithms for various applications, and to analyse the algorithms.

COURSE DESCRIPTION:

Unit I: Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation- Big oh notation, Omega notation, Theta notation and Little oh notation

Unit II: Divide and conquer: General method, applications-Binary search, Quick sort, Merge sort, Strassen's matrix multiplication.

Unit III: Greedy method: General method, applications-Job sequencing with deadlines, 0/1 knapsack problem, Minimum cost spanning trees, Single source shortest path problem. Dynamic Programming: General method, applications-Matrix chain multiplication, Optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem, Travelling sales person problem.

Unit IV: Backtracking: General method, applications-n-queen problem, sum of subsets problem, graph colouring, Hamiltonian cycles. Branch and Bound, NP-Hard and NP-Complete problems: Basic concepts, non-deterministic algorithms, NP - Hard and NP Complete classes, Cook's theorem.

TEXT BOOKS

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithm", Pearson Education Asia, 2003.
2. T.H.Cormen,C.E.Leiserson, R.L.Rivest,and C.Stein "Introduction to Algorithms", second edition, ,PHI Pvt. Ltd./ Pearson Education
3. R.C.T.Lee, S.S.Tseng, R.C.Chang and T.Tsai, "Introduction to Design and Analysis of Algorithms A strategic approach", Mc Graw Hill.
4. Ellis Horowitz,Satraj Sahni and Rajasekharam," Fundamentals of Computer Algorithms",Galgotia publications pvt. Ltd.
5. Parag Himanshu Dave, Himanshu Bhalchandra, " Design and Analysis Algorithms", Dave Publisher: Pearson

Course Outcomes:

- The student will be able to understand the basics of algorithms.
- The student will be able to work with the divide and conquer method.
- The student will be able to work with Greedy methods.
- The student will be able to work with backtracking algorithms.
- The student will be able to understand NP-Hard and NP-Complete Problem.

DS5A-523: Decision Analysis Credits: 3 (2-1-0)

OBJECTIVE:

This course introduces and applies advanced modelling techniques to decision problems with the objective of enhancing the decision-making skills as well as the spreadsheet knowledge base.

COURSE DESCRIPTION:

Unit-I: Game Theory: Introduction, definitions, two-person zero sum game. Game with pure strategies, saddle point, game value. Game with mixed strategies, solution methods-algebraic method, graphical method, dominance, linear programming method.

Unit-II: Decision Theory: Structuring the decision problem-payoff tables, decision trees. Decision making under certainty. Decision making under uncertainty: Optimistic, Conservative, Minimax regret. Decision making under risk: Expected value criterion, expected value of perfect information. Sensitivity analysis. Decision making with sample information, expected value of sample information, efficiency of sample information. Computing branch probabilities. Utility and decision making: meaning of utility, developing utilities and payoffs, the expected utility approach.

Unit-III: Multi-criteria Decision Making: Multi-criteria decision making: Goal programming, Scoring models, Analytical Hierarchy Process.

Unit-IV: Markov Analysis: Transition probabilities, system behaviour. Methods of Analysis: Tree diagram, Matrix multiplication, Algebraic solution. Cyclical and absorbing states, Market share analysis, Accounts receivable analysis.

TEXTBOOKS

1. Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
2. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
3. William J. Stevenson: Introduction to Management Science, IRWIN.

Course Outcomes:

After completing the course the student will -

1. Learn basics of decision making and uncertainty analysis under a risky situation.
2. Understand concepts in Strategic Game Theory.
3. Learn how to model and solve real life cases using Game Theory.

DS5A-551: Business Communication Credits: 3 (2-1-0)

OBJECTIVE:

This course is designed to give students a comprehensive view of communication, its scope and importance in business, and the role of communication in establishing a favorable outside the firm environment, as well as an effective internal communications program. The various types of business communication media are covered. This course also develops an awareness of the importance of succinct written expression to modern business communication.

COURSE DESCRIPTION:

Unit-I: Basic Principles of Communication: Introduction, Understanding Communication, the Communication Process, Barriers to Communication, the Importance of Communication in the Workplace. Types and Channels of Communication: Introduction, Types of Communication, Classification of Communication Channels.

Unit II: The Nature of Business Communication: Introduction, Types of Business Communication, Communication Network in Organizations. The Importance of Listening in the Workplace: Introduction, what is listening? Barriers to Listening, Strategies for Effective Listening, Listening in a Business Context. Guidelines for Written Business Communication: Introduction, General Principles of Writing, Principles of Business Writing.

Developing Oral Business Communication Skills: Introduction, Advantages of Oral Communication, Oral Business Presentations. Reading Skills for Effective Business Communication: Introduction, what is reading? Types of reading, SQ3R Technique of Reading. Internal Business Communication: Guidelines for Meetings: Introduction, Types of Meetings, Before the Meeting, During the Meeting, After the Meeting, and Common Mistakes made at Meetings.

Unit III: Internal Business Communication: Writing Memos, Circulars and Notices: Introduction, What is a Memo? Circulars and Notices. Internal Business Communication – Electronic Media and Shareholder Communication: Introduction, what is an Intranet? Communicating through Email, Communication with Shareholders.

External Business Communication – Writing Business Letters: Introduction, Principles of Business Letter Writing, Types of Business Letters, Format for Business Letters. Other Forms of External Business Communication: Introduction, Communication with Media through News Releases, Communication about the Organization through Advertising. Internal and External Business -Communication – Writing Business Reports: Introduction, What is a Report? Types of Business Reports, Format for Business Reports, Steps in Report Preparation.

Unit IV: Employment Communication – Resumes and Cover Letters: Introduction, Writing a Resume, Writing Job Application Letters, Other Letters about Employment. Employment Communication – Group Discussions and Interviews: Introduction, What is a Group Discussion? Attending Job Interviews.

TEXTBOOKS

1. Essentials of Business Communication, Sixth Edition, Mary Ellen Guffey, South-Western College Publishing.
2. Business Communication Today by Courtland L. Bovee, John V. Thill, Barbara E. Schatzman, Hardcover: 730 pages, Publisher: Prentice Hall

3. Excellence In Business Communication (6th Edition) by John Thill, Courtland L. Bovee, Paperback: 656 pages, Publisher: Prentice Hall
4. Business Communication: Building Critical Skills by Kitty O. Locker, Stephen Kyo Kaczmarek, Hardcover: 637 pages, Publisher: Irwin/McGraw-Hill
5. Business Communication for Managers: An Advanced Approach by John M. Penrose, Robert W. Rasberry, Robert J. Myers, Hardcover: 480 pages, Publisher: **South-**Western College.

Course Outcomes:

At the end of the course the students will be able-

1. To make business communication with the parties concerned.
2. To write memorandum, circulars, notices, business letters, and business reports.
3. To write resume and job application.
4. To participate in group discussion and interviews.

Second Semester:

DS5A-502: Organisational Behaviour Credits: 3 (2-1-0)

Objective: Objective of this course is to help students to understand Human Behaviour in organizations so that they improve their managerial effectiveness.

COURSE DESCRIPTION:

Unit I: Foundations of Individual and Organizational Behaviour: OB Models, Personality Determinants and Attributes, Values, Job Attitudes, Learning and Learning Theories, Perception- Factors affecting Perception and Cognitive Dissonance theory.

Motivation: Needs, Contents and Processes; Maslow's Hierarchy of Needs, Herzberg's Two Factor theory, ERG theory, Vroom's Expectancy theory, Reinforcement theory and Behaviour Modification.

Unit II: Foundations of Group Behaviour: Defining and Classifying Groups, Group Structure and Processes, Process of Group formation, Group Decision Making, Group v/s Team, Team Effectiveness, and Decision Making.

Leadership: Trait theories, Behavioural theories-Ohio State Studies, Michigan Studies, and Managerial Grid. Contingency theories-Fiedler's Model, Hersey and Blanchard's Situational theory, Leader-Member Exchange theory, Path Goal theory, Charismatic Leadership.

Unit III: Conflict: Intra-individual Conflict, Interpersonal Conflict, Intergroup Conflict, Organizational Conflict, Transitions in Conflict Thought, Functional versus Dysfunctional Conflict, Conflict Process, Conflict Management Techniques.

Unit IV: Organizational Change and Stress Management: forces of Change, Resistance to Change, and Lewin's Three-Step Model, Stress Management—Potential Sources, Consequences and Coping Strategies for Stress. Organizational Culture: Definition, Uniform Cultures, Relevance of Culture, Creating and Sustaining Culture, How Employees Learn Culture.

Text Books:

1. Stephen P. Robbins, "Organizational Behaviour: Concepts, Controversies, and Applications", New Delhi, Prentice Hall, 9^{th} Ed., 2000.
2. Fred Luthans, "Organizational Behaviour", New York, McGraw Hill, 8^{th} Edn., 1998.
3. Bill Scott, "The Skills of Communications", Jaico Publications, Bombay 1995.
4. John W. Newstrom and Keith Davis, "Organizational Behaviour: Human Behaviour at Work" New Delhi, Tata McGraw Hill, 1993.

Course Outcomes:

At the end of the course students should be able to

- Understand different aspects and components of individual behaviour.
- Describe factors that are responsible to make an individual an effective manager.

DS5A-504: Operations Research Credits: 4 (3-1-0)

COURSE OBJECTIVE:

This course exposes the students in mathematical modelling, solving and analysing business and industrial problems using operations research methods.

COURSE DESCRIPTION:

Unit -I:

Introduction, History, Development of Operations Research, Characteristics of Operations Research, Models in Operations Research, Principles of Modelling. Pre-modelling-Need Recognition, Problem Formulation. Modelling-Model development, Data collection, Model solution, Model validation, and sensitivity analysis. Post-modelling-Interpretation of results and implications, Decision making, Implementation, and Control.

Unit-II:

Linear Programming, Formulation of Linear programming Problems. Solution Methods-Graphical, Simplex, M-Technique, Two-Phase. Special cases of LP problems. Duality, Primal-dual relationships, Dual simplex method. Sensitivity analysis. Solving LP problems using computer software.

Unit-III:

Transportation Model-Formulating the model, Initial Feasible Solution-North-West Method, Least Cost Method, Vogel's Approximation Method. Optimum Solution-MODI method, Stepping Stone Method. Special issues of transportation problems. Assignment Model: Formulating the model, Solving the assignment problem using Hungarian method. Special issues of assignment problems.

Integer programming: Types of integer programming problems, Formulating the model, Solution using Branch and bound method. Goal Programming.

Solving the problems using computer software.

Unit-IV:
Project Scheduling: CPM and PERT. Inventory models: Functions of inventory, information requirements for inventory management-demand, lead time, inventory costs, and quantity on hand. Objectives of inventory management. Economic Order Quantity Models-Economic order size, economic production run, quantity discounts. Determining the reorder point.

Queuing Models: Goals, elements and characteristics of queuing systems, Measures of system performance, Waiting line models-single channel, multiple channel. Cost considerations.

TEXT BOOKS
Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
William J. Stevenson: Introduction to Management Science, IRWIN.

Course Outcomes:

- Understand the verbal description of the real system and accordingly identify and development of operational research models.
- Understand the mathematical tools that are needed to solve optimisation problems.
- Use of mathematical software to solve the OR models developed.
- Develop a technical report that describes the model, solving technique, results analysis and recommendations.

DS5A-506: Data Mining and Data Warehousing Credits: 3 (2-0-2)

Course Objective The main objective of this course is to provide understanding of data warehouse fundamentals and data mining techniques for business applications.

COURSE DESCRIPTION:
UNIT I: Data Warehousing: Introduction data warehousing, Data Mart, Data Warehouse Architecture; Star, Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning. ETL Concepts. OLAP technology: Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, indexing data.

UNIT II: Data Mining: Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining; Introduction to Web Mining, Text Mining. Data Processing: Data Cleaning, Data Integration and Transformation; Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Data Discretization and Concept hierarchy generation for numerical and categorical data.

UNIT III: Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, FP-Growth Algorithm, latest trends in association rules mining.

UNIT IV: Classification methods: Decision tree, Bayesian Classification, Rule based; clustering methods: Partitioning methods(K-Means, K-Mediods) and Hierarchical Clustering (Agglomerative and Divisive Clustering, Multi-phase method) Prediction: Linear and non-linear regression.

Text Books:

1. P.Ponnian, "Data Warehousing Fundamentals", John Wiley.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.
3. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education.
4. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", Wiley India.
5. Michael Berry and Gordon Linoff "Data Mining Techniques", Wiley Publications.
6. M.H.Dunham, "Data Mining Introductory & Advanced Topics", Pearson Education.

Course Outcomes:

- The student will learn basics of Data Warehouse.
- The student will learn basics of Data Mining.
- The student will be able to Pre process the data.
- The student will be able to perform Market Basket analysis.
- The student will be able to work with Classification Algorithms.
- The student will be able to cluster the data.

DS5A-508: Business Mathematics Credits: 3 (2-1-0)

Objective:

The objectives of the course are to equip the students with the mathematical techniques and their applications to business problems. The emphasis will be on the concepts, application and cases rather than derivations. For several topics R implementation will also be demonstrated.

COURSE DESCRIPTION:

Unit-I:

Concept of Sets, Functions and Applications (e.g., total Cost, Total Revenue, and Profit; Break-Even Analysis; Supply, Demand, and Market Equilibrium, Growth and Decay, Gompertz Curves and Logistic Functions). Graphs and Graphing Utilities. Sequences and series; (applications to compounding and discounting techniques, annuities, perpetuities).

Unit-II:

Linear Equations and Inequalities in One Variable, Quadratic equations (graphical representation), Simultaneous Equations, Graphical Solutions of Equations, Solutions of Systems of Linear Equations (up to three variables).

Unit-III:

Matrices, Matrix operations, Determinant, Rank, Eigen values, Quadratic forms, Adjoint, Inverse of a Matrix, Row operations, Special matrices (e.g., idempotent), Matrix decomposition, Solution of system of equations using matrices, Cramer's Rule, Leontief Input-Output Models.

Unit-IV:

Continuity of a function in one variable, Differentiation and Integration of simple functions with one variable (Applications of differentiation in economic and managerial problems like marginal analysis, elasticity). Integration Concepts: Economic application, consumer surplus and producer surplus. Maxima and Minima (e.g., portfolio optimization)

Text Books:

1. J.K. Sharma, "Mathematics for Management and Computer Applications", New Delhi, Galgotia Publication.
2. S. Saha, "Business Mathematics and Quantitative Techniques", Calcutta, Central Book Agency, 2000.
3. Richard I. Levin and D.S. Rubin, "Statistics for Management", New Delhi: Prentice Hall of India, 2000
4. S. P. Gupta, "Statistical Methods", New Delhi, Sultan Chand and Sons, 2001
5. D. C. Sancheti and V. K. Kapoor, "Statistics: Theory, Methods and Applications", New Delhi: Sultan Chand and Sons., 2001
6. D.N. Elhance, Veena Elhance and B. M. Aggrawal, "Fundamentals of Statistics", Allahabad: Kitab Mahal, 1996.

Course Outcomes:

After completion of the course the students will-

- Develop basic quantitative aptitude.
- Learn basic concepts of mathematics required for further coursework.
- Learn fundamental mathematics that is required for quantitative research in management discipline.

DS5A-510: Statistical Programming in R Credits: 3 (2-0-2)

Objective: This course is an introduction to R, a powerful and flexible statistical language and environment that also provides more flexible graphics capabilities than other popular statistical packages. After taking this course, students will be able to –

1. Use R for statistical programming, computation, graphics, and modeling,
2. Write functions and use R in an efficient way,
3. Fit some basic types of statistical models,
4. Use R in their own research,
5. Be able to expand their knowledge of R on their own

COURSE DESCRIPTION:

Unit I: Introduction to R programming language: Getting R, Managing R, Arithmetic and Matrix Operations, Introduction to Functions, Control Structures. Working with Objects and Data: Introduction to Objects, Manipulating Objects, Constructing Data Objects, types of Data items, Structure of Data items, Reading and Getting Data, Manipulating Data, Storing Data.

Unit II: Data Distribution and Statistical Testing: Types of Data distribution, Normal distribution, Poisson distribution, Random number generation, Chi-Square Testing, Student's t-test, F-test, Monte Carlo Simulation.

Unit III: Graphical Analysis using R: Basic Plotting, Manipulating the plotting window, Box-Whisker Plots, Scatter Plots, Pair Plots, Pie Charts, Bar Charts.

Unit IV: Advanced R: Statistical models in R, Correlation and regression analysis, Analysis of Variance (ANOVA), creating data for complex analysis, Summarizing data, and case studies.

Text Books:

1. Mark Gardener: Beginning R: The Statistical Programming Language, Willey publications
2. Norman Matloff: The Art of R Programming: A Tour of Statistical Software Design, OREILLY & Associates Inc.

Course Outcomes:

- Data manipulation - acquiring skills in flexible matrix manipulation
- Access online resources for R and import new function packages into the R workspace
- Scripting in such a way that the script can be used with minimal effort for similar datasets and analyses and for especially large datasets
- Explore data-sets to create testable hypotheses and identify appropriate statistical tests
- Perform appropriate statistical tests using R
- Learn how to create high-quality figures, especially associated with more complex analyses (e.g. three dimensional scatter plots, animated chart Trellis displays, etc.).

DS5A-512: Machine Learning Credits: 3 (2-0-2)

Objective: The main objective is to help students to understand the fundamental concepts of machine learning.

COURSE DESCRIPTION:

UNIT I: Introduction to Machine Learning, History and Overview of machine learning, Applications, Types of Machine Learning, Basic Concepts. Concept Learning and candidate elimination learning Algorithm.

UNIT II: Artificial Neural Network: biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervise & Unsupervised) and activation function. Supervised Learning: Perceptron learning, Single layer/multilayer, linear Separability, Adaline, Madaline, Back propagation network, RBFN.

UNIT III: Bayesian Learning, Bayes Theorem, Naïve Bayesian classifier, Bayesian belief, EM Algorithm. Dimensionality Reduction: Factor Analysis, Principal Component Analysis, Linear Discriminant Analysis.

UNIT IV: Markov and Hidden Markov Models, PAC Learning, Support Vector Machine, Evolutionary Learning: Genetic Algorithm, generating offspring, applications and genetic programming.

Text Books:

1. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
2. Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
4. Ethem Alpaydin, “Introduction to Machine Learning”, Prentice Hall of India, 2005.
5. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2006.
6. Sanjeev Kulkarni, Gilbert Harman, “An Elementary Introduction to Statistical Learning Theory”, 2011.
7. N. Shivnandam, “Principle of soft computing”, Wiley.

Course Outcomes:

After completion of the course the students will be able to-
understand the basics of machine learning.
understand Regression analysis.
work on classification problems.
work with unsupervised learning approaches.
perform machine learning operations in scikit-learn.

DS5A-522: Marketing Management Credits: 3 (2-1-0)

COURSE OBJECTIVE:

The objectives of this course are to provide the students exposure to modern marketing concepts, tools, and techniques, and help them develop abilities and skills required for the performance of marketing functions.

COURSE DESCRIPTION:

Unit -I:

Marketing Concepts: Customer Value and Satisfaction, Customers Delight, Conceptualizing Tasks and approaches to Marketing Management, Value chain, scanning the Marketing Environment. Market Segmentation, Targeting, Positioning: Market segmentations, patterns, procedures, requirement for effective segmentation, Niche Marketing, selecting the market segments, tool for competitive differentiation, developing a positioning strategy.

Unit -II:

Marketing Information System and Marketing Research Process. Product Decision: Objectives, Product classification & Product Portfolio, Product life cycle strategies, branding, packaging, labelling. Pricing Decision: Factors affecting price, pricing methods and strategies, Types of competition.

Unit -III:

Distribution Decisions: Importance and Functions of Distribution Channel, Considerations in Distribution Channel Decisions, Types of Channel Members, Retail formats. Promotion Decisions: A view of Communication Process, developing effective communication, Promotion-Mix elements – Advertising, Personal Selling, Sales Promotion and Public Relation.

Unit -IV:

Introduction to International Marketing: EPRG framework, Deciding to go abroad, deciding which markets to enter, Deciding on the marketing program, Country of origin effect.

Emerging Trends in Marketing: An introduction to Digital Marketing, Multi level Marketing, and Introduction of CRM & EVENT marketing.

TEXT BOOKS:

1. Philip Kotler, Kelvin & Keller, Abraham Koshy, Mithileshwar Jha “Marketing Management”, A South Asia perspective –New Delhi : Pearson Education.
2. Rajan Saxena – Marketing Management, TMH .
3. Dhiraj Sharma, Marketing – Cengage.
4. Czinkota & Kotabe – Marketing Management – Cengage Latest Edition.
5. Baines, Fill & Page – Marketing Management, Oxford University Press Latest Edition.

Course Outcomes:

Students will be able

- To understand the key concept of marketing and its evolution
- To develop an ability to access the dynamic marketing environment

- To develop marketing strategy and evolving and matching marketing mix to consumer behaviour and perceptions of the product
- To understand the segmentation, targeting and positioning process and its importance in light of changing marketing environment.
- To develop the required skills to understand the effect of economic, political-legal, and cultural environments of a foreign country on company's international marketing decisions

DS5A-524: Financial Management Credits: 3 (2-1-0)

COURSE OBJECTIVE:

The objectives of this course are to help the students learn the concepts, tools and skills of financial analysis and financial management, and application in the efficient conduct of business.

COURSE DESCRIPTION:

Unit -I:

Introduction: Concept of Finance, Corporate Finance, Finance Functions and other functions. Structures of the Financial System. Meaning and Objectives of Financial Management, Scope and Functions of Financial Management, Wealth Maximization v/s Profit Maximization. Short Term and Long Term Sources of Finance in India.

Unit -II:

Cost-Volume-Profit Analysis: Concept, BEP in units, BEP in rupees, Multiproduct BEP, Margin of Safety, P/V Ratio. Ratio Analysis: Liquidity, Profitability, Leverage and Activity Ratios. Calculation and Interpretation. Investment Decisions: Time Value of Money, DCF and Non DCF Methods for Evaluating Projects, Cost of Debt, Cost of Preference, Cost of Equity, Weighted Average Cost of Capital.

Unit -III:

Leverage Analysis: Determination of operating leverage, financial leverage and total leverage, Leverage and Financial Distress. Statement of Changes in Financial Position: Funds Flow Statement; Total Resource Method, Working Capital Method and Cash Method, Cash Flow Analysis. Capital Structure and Firms Value: Net Income Approach, Net Operating Income Approach, Traditional Approach, MM Approach. EBIT --- EPS Analysis, ROI - ROE Analysis.

Unit -IV:

Dividend Policy: Relevance and Irrelevance Theories of Dividend, Factors affecting the dividend policy, Alternative Forms of Dividend. Working Capital Management: Cash and Liquidity Management, Credit Management, Determination of Working Capital and its Financing, CMA form for Working Capital.

TEXT BOOKS

1. Pandey, I.M. financial Management, Vikas Publishing House, New Delhi.
2. Khan M.Y. and Jain P.K. Financial Management, Tata McGraw Hill, New Delhi.
3. Keown, Arthu J., Martin, John D., Petty, J. William and Scott, David F, Financial Management. Pearson Education.

4. Chandra, Prasanna; Financial Management TMH, New Delhi.
5. Van Horn, James C., Financial management and Policy, Prentice Hall of India.
6. Brigaham & Houston, Fundamentals of Financial Management, Thomson Learning, Bombay.
7. Kishore, R., Financial Management, Taxmans Publishing House, New Delhi.

Course Outcomes:

- The students will be able to understand the basic concepts of financial management and contemporary theory and policy in order to master the concepts, theories and technique of financial management, what represents the condition of profitable business operations and survival respectively development of business subjects and the economy as a whole.
- Students should acquire the basic knowledge by means of combining theoretical cognitions and practical attitudes to enable them the understanding of financial problems in business practice after completed the vocational studies.
- The students will also learn relevant, systematic, efficient and actual knowledge of financial management that can be applied in practice with making financial decisions and resolving financial problems.

BA-552: Research Methodology Credits: 3 (2-1-0)

COURSE OBJECTIVE:

The objective of teaching this course is to enable students to conduct research.

COURSE DESCRIPTION:

Unit-I:

Introduction to research, Need, Importance and Characteristics of research, Types of research – An overview, Quantitative and qualitative research, Review of literature. Identification, Definition and Statement of Problem, Variables, Role of variables in research, Research Questions and Objectives.

Unit-II:

Hypotheses, Hypotheses Testing, Population and Sample, Probability Sampling Techniques, Non - Probability Sampling Techniques, Error, types of error.

Unit-III:

Research Design – An Overview, Philosophical and Historical, Survey, Case Studies, Experimental Designs, Research Tools. Process of Research Tools Designing, Questionnaire Designing, Test Designing, Scale Designing, Scaling Techniques. Process of Standardising Research Tools, Data Analysis Overview.

Unit-IV:

Frequency Distribution, Statistical Tools: Measures of Central Tendency, Measure of Variability, Comparing Means: Independent Sample t-test, Paired Sample t-test, One Way

ANOVA, Factorial Design ANOVA, ANCOVA, Factor Analysis and Non-parametric Statistical Techniques.

Report Writing, IPR and Plagiarism, Statistical Software and Research Paper Writing.

Text Books:

1. Kerlinger, F.N: Foundations of Behavioral Research, Surjeet Publication, New Delhi, 1983.
2. Sterling, T. and Pollack, S: Introduction to Statistical Data Processing, Prentice Hall, 1968.
3. Campbell, W: Forms and style in Thesis Writing, 3rd ed., Boston., Houghton, Mifflim, 1969.
4. McNemar, Orinn: Psychological Statistics, John Wiely and Sons, 1960.
5. Molstad, John A.: Selective Review of Research Studies Showing Media Effectiveness: A Primer for Media Director. AV communication review vol.22, 1974.
6. S.P. Gupta, Statistical Methods, S.Chand
7. C.K.Kothari, Research Methodology, New Age Publications.

Third Semester:

DS5A-601: Forecasting Methods Credits: 3 (2-1-0)

COURSE OBJECTIVE

This subject is designed in such a way to provide the basic concepts of forecasting models based on quantitative analysis. Risk and uncertainty in forecasting and it is generally considered good practice to indicate the degree of uncertainty attaching to forecasts.

COURSE DESCRIPTION:

Unit I: Introduction: Fo**re**casting perspective, an overview of forecasting methods, basic steps in forecasting. Basic forecasting tools: time series and cross-sectional data, graphical and numerical summaries, forecasting accuracy, prediction intervals, transformations and adjustments.

Unit II: Time series: Decomposition, principles of decomposition, moving averages, classical decomposition, census bureau methods, forecasting and decomposition.

Unit III: Exponential smoothing: averaging methods, Single exponential smoothing methods, ARRSES, Double exponential soothing method comparison of methods, general aspects of smoothing methods.

Unit IV: Regression: Simple regression, forecasting with simple regression, non-linear relationships. Multiple regressions. Box-Jenkins methods: examining correlations in time series data, examining stationary, ARIMA models, forecasting with ARIMA models.

Text Book(s):

1. Spyros Makridakis: Forecasting Method’s and application Wiley

2. N.P. Nagpal: Forecasting Techniques ,RBSA
3. Stephen A. Delurgio: Forecasting Principals and Application,McGraw Hill

Course Outcomes:

- Discuss the key factors which affect the success of forecasting procedures.
- Use Basic Statistical Techniques and statistical Graphics to forecast values.
- Find different sets of Smoothed or Average values to be used when forecasting.
- Understand the key concepts needed to use the Linear Regression model when forecasting.
- Model and Forecast the Seasonal component of a set of values.
- Model the different types of cyclical behaviour observed in different sets of values.
- Understand and use the Box-Jenkins or ARMA Procedure.

DS5A-603: Econometrics Credits: 3 (2-1-0)

Objective:

The objective of the course is to teach students how to apply relevant econometric methods to analyse data and interpret the results from such analyses. The focus is on conceptual understanding and 'hands on' applications using economic data drawn from real-world examples, rather than on formal theoretical proofs. By the end of the paper, students should be able to appreciate and interpret the econometric and statistical analysis and be able to carry out and interpret their own econometric analysis.

COURSE DESCRIPTION:

Unit-I:

Nature of Econometrics and Economic Data Definition of Econometrics – Steps in Empirical Economic Analysis - Econometric Model – The Role of Measurement in Economics – The Structure of Economic Data: Cross-Sectional data, Time Series data, Pooled Cross Section data, Panel Data.

Unit-II:

Simple Regression Model Two Variable Linear Regression Model: Assumptions, Estimation of Parameters, Tests of Significance and Properties of Estimators – Functional forms of Regression models – Loglinear models, Semi log- models and Reciprocal models – Choice of Functional Form.

Unit-III:

The General Linear Model Review of Assumptions, Estimation and Properties of Estimators: Un-biasness, BLUEs and Tests of significance of estimates – Analysis of Variance - Dummay *variables - Nature of Dummy variables – Use of Dummy Variables – Errors in Variables and its consequences.*

Multicollinearity and Heteroscadasticity Multicollinearity: Source and Consequences, Tests for Multicollinearity and solutions for Multicollinearity. Heteroscadasticity: Sources and Consequences, Tests for Heteroscadasticity, Generalized Least Squares Method of Estimation.

Unit-IV:
Auto-regressive and Distributed Lag Models Introduction – Types of Lag schemes - Koyck's lag model, Almon's Lag scheme, Partial Adjustment and Expectations models - Causality in Economics – The Granger Causality Test.

Simultaneous Equation Models Specification – Simultaneous Bias – Inconsistency of OLS Estimators - The concept of Identification, Rank and Order conditions for Identification – Indirect Least Squares - Two stage Least Squares (without proof), Problems.

Text Books:
1. Johnston,J: Econometric Methods, McGraw-Hill Book Co., New York.
2. Maddala, G.S: Econometrics, McGraw-Hill Book Co., New York, 3rd Rd.
3. Gujarathi, D.N: Basic Econometrics, Fourth Edition, Tata McGraw-Hill, New Delhi.
4. Tintner,G: Econometrics, John Wiley & Sons, New York.
5. Wooldridge, Jeffery M: Econometrics, Cengage Learning India Pvt. Ltd, New Delhi.

Course Outcomes:
Upon completing the course, students will be able to:

Use various advanced econometric models, estimation methods and related econometric theories.
Application of appropriate econometric methods to test an economic theory including deriving and test a specific hypothesis relevant to a general economic or policy question.
Interpretation and critical evaluation of the outcomes of empirical analysis.

DS5A-605: Supply Chain Management Credits: 3 (2-1-0)

COURSE OBJECTIVE
The course aims at developing an understanding of Supply Chain Management and its significance in the managerial process.

Unit-I:
Introduction and a Strategic View of Supply Chains, The Role of Supply Chain Management in Economy and Organization, Supply Chain Strategy and Performance Measures, Outsourcing: Make versus Buy.

Unit II:
Managing Material Flow in Supply Chains Inventory, Management Transportation Network Design and Operations: Facility Location.

Unit III:
Managing Information Flow in Supply Chains, Demand Forecasting, The Role of Information Technology in Supply Chain Management.

Unit IV:
Supply Chain Innovations, Supply Chain Integration, Supply Chain Restructuring, Agile Supply Chains Pricing and Revenue Management.

Text Books:
1. Shah Janat, "Supply Chain Management-Text and Cases", New Delhi: Pearson Education.
2. Chopra Sunil, Meindl Peter, Kalra D.V., "Supply Chain Management-Strategy, Planning, and Operation", New Delhi: Pearson Education.
3. Sinha Amit, Kotzab Herbert, "Supply Chain management- A Managerial approach", New Delhi: Tata McGraw-Hill.

Course Outcomes:

- Develop a sound understanding of the important role of supply chain management in today's business environment.
- Become familiar with current supply chain management trends Understand and apply the current supply chain theories, practices and concepts utilizing case problems and problem-based learning situations.
- Learn to use and apply computer-based supply chain optimization tools including the use of selected state of the art supply chain software suites currently used in business.
- Develop and utilize critical management skills such as negotiating, working effectively within a diverse business environment, ethical decision making and use of information technology.
- Demonstrate the use of effective written and oral communications, critical thinking, team building and presentation skills as applied to business problems.
- Successfully complete a year-long team research or case project concluding with a written and oral presentation of the findings.

DS5A-607: Big Data Technologies Credits: 3 (2-0-2)

Course Objective: The main objective of this course is to introduce big data technologies such as Hadoop, spark and analyzing big datasets in spark using python.

COURSE DESCRIPTION:

UNIT I: Introduction
Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting – Modern Data Analytic Tools. Big Data Analytics Process, Big Data Analytics for Business. Identifying problem and solving problem in Big Data environment. Analyzing Unstructured vs. Structured Data, Databases.

UNIT II: Hadoop and MapReduce

Introduction to Hadoop, Hadoop architecture, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases; Hadoop Distributed File system: Design of HDFS, HDFS Concepts. Introduction to MapReduce: MapReduce Basic Concepts, Understanding the Map Reduce architecture, Writing MapReduce Programs. understanding Map phase, shuffling, sorting, and reducing phase.

UNIT III: Spark
Introduction to Spark, Resilient Distributed Dataset (RDD), RDD Operations: actions and transforamtion funtions. Spark Dataframes, operations on Dataframes: Join, groupby, aggregate, handling missing data.

UNIT IV: SparkSQL and MLLib
SparkSQL and its basic operations. MLLib: Data types, Basic statistics, Classification(Logistic regression, Decision tree classifier)and linear regression model generation, Model Evaluation, Collaborative filtering, and Clustering.

Text Books:

1. Arvind Sathi, “Big Data Analytics: Disruptive Technologies for Changing theGame”, 1st Edition, IBM Corporation, 2012.
2. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, 1st Edition, Wiley and SAS Business Series, 2012.
3. Tom White,"Hadoop: The Definitive Guide", 3rd Edition, O'Reilly Media, 2012.
4. Donald Miner, Adam Shook, Eric Sammer, “Hadoop Operation”, O’Reilly 2012.
5. Donald Miner, Adam Shook “MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems”, O’Reilly 2012.
6. Chuck Lam, "Hadoop in Action", Manning Publications, 2010.
7. https://spark.apache.org/docs/2.0.0/programming-guide.html

Course Outcomes:

- The student will be able to understand core concepts of Hadoop.
- The student will know the HDFS and MapReduce.
- The student will be able to work with Big Data tool such as Spark.
- The student will be able to analyze big data sets.
- The student will be able to create machine learning models for Big data.

DS5A-609: Data Visualization Credits: 3 (2-0-2)

Objective: This course will help to student understand what data visualization is, and how data scientist/analyst use visualization technique to represents results.

UNIT I: Introduction to Data Visualization, characteristics, goals, need of data visualization, comparison of data science and data visualization, Types of Data, Operations on datatypes, Data Dimensions, Designing Visuals, Visual attributes, Designing Visuals, Mackinlay Design Criteria, Retinal Variables: Size, texture, shape, orientation, color, color Saturation, color hue; Where to use which variable?, Bertin's visual attributes, Seven Stages of Visualizing Data.

UNIT II: Types of visualization chart: Scatter, line, pie, bar, histogram, Bubble, stacked area chart, pair plot, Heatmaps. Smart Charts: List, Process, Cycle, Hierarchy, Relationships, matrix, pyramid, pictures. Text Visualization.

UNIT III: Dashboard, Characteristics, Types of dashboards, best practices and design issues, visual perception, limits of short-term memory, visual encoding data, Gestalt principles, principles of visual perception. Case studies: sales dashboard, CIO dashboard, Telesales dashboard, marketing analysis dashboard.

UNIT IV: Tableau Data Visualization Tools: Data loading, Connecting with Databases, Data Prep with Text and Excel Files, Drill Down and Hierarchies, Sorting, Grouping, Filters, Filtering for Top and Top N, Parameters Formatting; Tableau's Mapping, Custom Geocoding, Polygon Maps, WMS; Dashboards and Stories, Dashboard Layouts and Formatting.

Text Books:

1. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.
2. Stephen Few, "Information dashboard design: The effective visual communication of data",O'Reilly, 2006.
3. Edward R. Tufte, "The visual display of quantitative information", Second Edition, GraphicsPress, 2001.
4. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
5. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment",O'Reilly, 2008.
6. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.

Course Outcomes:

- The student will learn basic principles of data visualization.
- The student will learn various types of charts to visualize data.
- The student will understand Dashboard concepts.
- The student will be able to use data visualization tools Tableau/Qlik view.
- The student will be able to tell stories using the dashboard and visualization.

DS5A-621: Marketing Analytics Credits: 3 (2-0-2)

COURSE OBJECTIVE:

The objective of this course is to provide thorough knowledge required to address fundamental marketing decision problems. It will also train to view marketing processes and relationships systematically and analytically. The techniques discussed in this course are useful in market segmentation, targeting, and mapping market structure and product design.

- Learn how to tap a simple and cost-effective tool, Microsoft Excel, to solve specific business problems using powerful analytic techniques.
- Helps to forecast sales and improve response rates for marketing campaigns.
- Explores how to optimize price points for products and services, optimize store layouts, and improve online advertising.

COURSE DESCRIPTION:

Unit-I:

Descriptive marketing Analytics: Description of consumer behavior in reference to data, identification and collection of relevant data. Identifying data for causal relationship, data for correlative relations, synergy between data and decisions, principles for systematically collecting and interpreting data to make better business decisions. How to use data to explore a problem, question, to create products, to create marketing campaigns, and strategies.

Unit-II:

Predictive Marketing Analytics: forecasting based on time series data. Statistical tools to predict consumer behavior, applicability of tool for specific marketing decision, predictions of future behavior. Kinds of predictions to create future strategies, techniques for predictive models including regression analysis for marketing variables.

Prescriptive Analytics: How prescriptive analytics provide recommendations for actions, examples of prescriptive models, for relationship of quantity is impacted by price, to maximize revenue, to maximize profits, to best use online advertising. Models for optimization competitive dynamics.

Unit-III:

Statistical segmentation: workings of statistical segmentation, how to compute statistical indicators about customers such as recency or frequency, how to identify homogeneous groups of customers within a database. Statistical segmentation as a tool, especially to explore, summarizes, or make a snapshot of an existing database of customers, managerial segmentation.

Targeting and scoring models: How can Target predict which of its customers are worthy, How to model pricing of product, identification of customer, planning of marketing campaign, maximize profit by building a scoring model, building a customer score frequency and quantity.

Unit-IV:

Applications of Analytics: Customer lifetime value analyses. Estimate transition matrix –for segments. Market basket analysis, Retail analytics, customer analytics, sales analytics.

Application of analytics in Branding and advertising: how to build and define a brand architecture and how to measure the impact of marketing efforts on brand value over time. How to measure and track brand value.

Text Books:

1. Wayne.L.Winston, "Marketing Analytics: Data driven techniques with MS-Excel", Wiley, 1st ed. 2014.
2. Stephan Sorger, "Marketing Analytics: Strategic models and metrics", CreateSpace Independent Publishing Platform, 1st ed., 2013.
3. Mike Grigsby, "Marketing Analytics: A Practical Guide to Real Marketing Science", Kogan Page, 2015.

Course Outcomes:
This course will enhance the analytical skills of the student. He will be able to perform research and gather data to help a company market its products or services after studying relevant data on consumer demographics, preferences, needs, and buying habits. Also, student will efficiently be able to:

- Monitor and forecast marketing and sales trends
- Measure the effectiveness of marketing programs and strategies
- Devise and evaluate methods for collecting data, such as surveys, questionnaires, and opinion polls
- Gather data about consumers, competitors, and market conditions
- Analyze data using statistical software
- Convert complex data and findings into understandable tables, graphs, and written reports
- Prepare reports and present results to clients and management.

DS5A-623: Financial Analytics Credits: 3 (2-0-2)

Objective:
The course aims to train the students to conduct financial analytics using R, valuation of financial securities, derivative analytics and portfolio management.

COURSE DESCRIPTION:
Unit- 1 Financial Analytics: An Introduction
A Brief History of the Evolution of Analytics, Concept and Definition of Financial Analytics, Concept of Laptop Laboratory for Data Science, Importance of Analytics for the Finance Field, Changing Business Models and changing role of financial department, Key terms related to financial Analytics, Uses of Financial analytics

Unit- 2 An Introduction to R and its Use
Getting started with R, Working in the R Windowing Environment, R as a Calculator, Working with variables, Understanding Data Types, Storing Data in Vectors, Call Functions, Reading CSV Files, Reading Data files from other Statistical Tools, Comparison and Compatibility of Excel and R

Unit- 3 Financial Data Analytics using R

Define the Goal of Your Analysis, Collecting and Managing the data in R, Building the Predictive Model, Evaluating and Critiquing Model, Deploying Model, Presenting result and Documentation.

Unit- 4 Valuation of Securities using R
Bond Fundamentals, Bond Valuation Models: PV Model.Bonds Yield, Measures Duration, Modified Duration, Immunization Convexity, Bond Value Theorem. Equity: Constant Growth Model, Multi-Stage Growth Model, P/E Ratio and Earnings Multiplier Models. Valuation Of Preference Shares, Valuation of Warrants, Rights Issued. Mergers Growth & Synergy-- Valuation Methods, Benchmarks of Value & Valuation of the Target's Equity, Stock Split, Swap Ratio.

Unit- 5 Application of R in Derivatives and Portfolio Management
Concept of Forwards, Future, Options, Types of Options, Concept of Delta Theta, Gamma Vega, Rho, Determining Option Price, Black Scholes Model, Measurement of Expected Risk and Return of Portfolio, Optimal Portfolio Selection – Markowitz Models, Sharpe's Single Index Model. Treynor, Sharpe, Jensen Ratios. CAPM and Concept of Beta. SML and CML Valuations.

Unit- 6 Special Packages in R
Plotly package to generate dynamic graph, Swirl package to learn R, RPivottable package to generate Pivot table, plyr package to split and combine data

Text Book: 'Financial Analytics with R' by Bennett & Hugen, Cambridge University Press

Course Outcomes: After completing the course the students will be able

- To apply tools and techniques involved in financial analytics
- To perform financial data analytics using R
- To do the valuation of financial securities using R
- To carry out derivative analytics and portfolio management using R

DS5A-651: Strategic Management Credits: 3 (2-1-0)

COURSE OBJECTIVE:
The objective of this course is to enable students to integrate knowledge of various functional areas and other aspects of management, required for perceiving opportunities and threats for an organization in the long-run and second generation planning and implementation of suitable contingency strategies for seizing / facing these opportunities and threats.

Course Contents:

Unit-I:

Meaning, Need and Process of Strategic Management; Business Policy, Corporate Planning and Strategic Management; Single and Multiple SBU organizations; Strategic Decision–Making Processes –Rational–Analytical, Intuitive-Emotional, Political – Behavioural; Universality of Strategic Management; Strategists at Corporate Level and at SBU Level; Interpersonal, Informational and Decision Roles of a Manager.

Unit-II:

Mission, Business Definition and Objectives; Need, Formulation and changes in these three; Hierarchy of objectives, Specificity of Mission and Objectives. SWOT Analysis: General, Industry and International Environmental Factors; Analysis of Environment, Diagnosis of Environment – factors influencing it; Environmental Threat and Opportunity Profile (ETOP); Internal Strengths and Weaknesses; Factors affecting these; Techniques of Internal Analysis; Diagnosis of Strengths and Weaknesses; Strategic Advantage Profile (SAP).

Unit-III:

Strategy Alternatives: Grand Strategies and their sub strategies; Stability, Expansion, Retrenchment and Combination; Internal and External Alternatives; Related and Unrelated Alternatives, Horizontal and Vertical Alternatives; Active and Passive Alternatives; International Strategy Variations. Strategy Choice Making: Narrowing the choices; Managerial Choice Factors, Choice Processes – Strategic Gap Analysis, ETOP-SAP Matching, BCG Product – Portfolio Matrix, G.E. Nine Cell Planning Grid; Contingency Strategies; Prescriptions for choice of Business Strategy; Choosing International Strategies.

Unit-IV:

Strategy Implementation: Implementation Process; Resource Allocation; Organizational Implementation; Plan and Policy Implementation; Leadership Implementation; Implementing Strategy in International Setting. Strategy Evaluations and Control : Control and Evaluation Process; Motivation to Evaluate; Criteria for Evaluation; Measuring and Feedback; Evaluation and Corrective Action.

Text Books:

1. Lawrence R. Jauch and William F. Glueck, "Business Policy and Strategic Management", McGraw Hill Book Co., New York
2. Glen Boseman and Arvind Phatak, "Strategic Management: Text and Cases " , John Wiley and Sons, Singapore, 1989
3. Daniel J. McCarthy, Robert J. Minichiello, and Joseph R. Curran, "Business Policy and Strategy" Richard D. Irwin, AITBS, New Delhi, 1988
4. Roanld C. Christenesen,.Kenneth R. Andrews and Joseph L. Bower, "Business Policy – Text and Cases " , Richard D. Irwin, Inc., Illinois, 1978
5. Azha Kazmi, " Business Policy", Tata McGraw Hill, New Delhi, 1999.

Course Outcomes:

After successful completion of the course the students will be able to-

- understand the business's ability to establish its short, medium, and long-term plans in a highly dynamic industry.
- developing and over sighting the business's corporate strategies in order to support growth objectives while strengthening the business core to develop and maintain a competitive advantage.
- formulate the strategy, collaboration with both internal and external stakeholders and leading cross-functional teams in the development of business-wide operational strategies.

SCHOOL OF DATA SCIENCE AND FORECASTING

PROGRAM CODE: DS5B Batch: 2018-20

PROGRAM TITLE: MASTER OF SCIENCE (M.Sc.)

- DATA SCIENCE AND ANALYTICS

PROGRAM OUTCOMES:

- Understanding of the key technologies in data science and analytics: data mining, data visualization techniques, machine learning, statistics, and NLP.
- Getting knowledge on various theoretical and practical aspects of data science.
- Demonstrate use of team work, leadership skills, and decision making.
- Getting opportunities of higher studies in the area of data science.

PROGRAM SPECIFIC OUTCOMES:

- Apply data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results.
- Recognize and analyze ethical issues in business related to intellectual property, data security, integrity, and privacy.
- Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.
- Apply algorithms to build machine intelligence.
- Work with messy data, applying models, and understanding the business context.
- Work with unstructured data from various sources like video and social media.
- Use Data Visualization techniques.
- Write the programming codes in R and Python.

PROGRAM STRUCTURE:

First Semester:

Code	Title	Credits (L T P)
CORE COURSES		
DS5B-501	Database Management	3 (2-0-2)
DS5B-503	Forecasting Methods-I	3 (2-1-0)
DS5B-505	Operations Research	4 (3-1-0)
DS5B-507	Probability and Statistics	3 (2-1-0)
DS5B-509	Python for Analytics	3 (2-0-2)
DS5B-511	Advanced Excel	2 (0-0-4)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
DS5B-521	Fundamentals of Algorithms	3 (2-0-2)
DS5B-523	Decision Analysis	3 (2-1-0)
ELECTIVE GENERIC: The students can choose following course or any other PG level generic		

course being run in this campus.		
DS5B-551	Communication Skills	3 (2-1-0)

Second Semester:

Code	Title	Credits (L T P)
CORE COURSES		
DS5B-502	Data Mining and Data Warehousing	3 (2-0-2)
DS5B-504	Machine Learning	3 (2-0-2)
DS5B-506	Linear Algebra and Advanced Calculus	3 (2-1-0)
DS5B-508	Forecasting Methods-II	3 (2-0-2)
DS5B-510	Big Data Technologies	3 (2-0-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
DS5B-522	Statistical Programming in R	3 (2-0-2)
DS5B-524	Scientific Computing	3 (2-1-0)
ELECTIVE GENERIC: The students can choose following course or any other PG level generic course being run in this campus.		
DS5B-552	Technical Communication	3 (2-1-0)

Third Semester:

Code	Title	Credits (L T P)
CORE COURSES		
DS5B-601	Cloud Computing	3 (2-1-0)
DS5B-603	Data Visualization	3 (2-0-2)
DS5B-605	Research Methodology	3 (2-1-0)
DS5B-607	Non Linear Optimization	3 (2-1-0)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
DS5B-621	Cluster Analysis	3 (2-1-0)
DS5B-623	Multivariate Analysis	3 (2-0-2)
ELECTIVE GENERIC: The students can choose following course or any other PG level generic course being run in this campus.		
DS5B-651	Numerical Methods	3 (2-1-0)

Fourth Semester:

Code	Title	Credits (L T P)
CORE COURSES		
DS5B-602	Deep Learning	3 (2-1-0)
DS5B-604	Internet of Things	3 (2-0-2)
DS5B-606	Web Mining	3 (2-0-2)
ELECTIVE COURSES (Any one) The students can choose any one course from following elective courses.		
DS5B-622	Natural Language Processing	4 (2-1-2)
DS5B-624	Social Network Analysis	4 (2-1-2)
Project		
DS5B-652	Project Dissertation	4 (0-0-8)

Note: The above course contents can be modified as per requirement from time to time in accordance with University Ordinance No. 14.

DETAILED SYLLABUS:

First Semester:

DS5B-501: Database Management Credits: 3 (2-0-2)

Objective: The purpose of this course is to provide fundamental knowledge of database management system and understanding of how to use and design a DBMS.

Unit I: DBMS Concepts, Comparison between Database approach and Traditional file accessing approach, Advantages of database systems, Schemas and instances, Data Dependency, Data Dictionary, and Meta Data. Data models, Types of Data models (Object Oriented, Record Based and Physical data models), E-R diagram, Relational Data models: Domains, Tuples, Attributes, Keys, Relational database, Schemas, Integrity constraints, Relational algebra and relational calculus.

Unit II: Database Design: Introduction to normalization, Normal forms (INF, 2NF, 3NF, BCNF), Functional dependency, Decomposition, Dependency preservation and lossless join, multi-valued dependencies. **Structured Query Language**: DDL, DML, DCL, TCL, SQL Functions, integrity constraints, various joins, sub-query, index, View, Sequence, and Clusters. PL/SQL: manipulating data using PL/SQL, Iteration, Exceptions, Cursors, Trigger. (Experiment on Oracle 11g)

Unit III: Transaction Processing and Concurrency Control: Transaction System, Serializability of schedules, conflict & view serializable schedule, Recovery from transaction failures, Log based recovery. Checkpoints dead lock handling, Concurrency Control, locking Techniques for concurrency control, time stamping protocols for concurrency control, validation based protocol, multiple granularity.

Unit IV: Advance Concepts: Introduction to Distributed databases, data mining, data warehousing, Basic Concepts of Object Oriented Database System, Comparative study of OODBMS V/s RDBMS. Introduction to Image and Multimedia databases and data structures, Web and mobile database, Spatial and Geographic Database, Accessing Database from front-end Application. Case Study: Oracle, MySql, DB2.

Reference Books:

1. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, fifth Edition McGraw-Hill.
2. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
3. Rob, Coronel, “Database Systems”, Seventh Edition, Cengage Learning.

4. Ramakrishnan: Database Management System , McGraw-Hill
5. Fred R.McFadden,Jeffrey A.Hoffer & Marry B.Prescott.?Modern Database Management, Fifth Edition,Pearson Education Asia,2001
6. Gray Jim and Reuter Address, “Transaction Processing: Concepts and Techniques”, Morgan Kauffman Publishers.

Course Outcomes:
- The student will learn the basics of database management.
- The student will be able to design database using ER diagram.
- The student will be able to optimize database using normalization.
- The student will be able to work on database software MYSQL/Oracle.
- The student will learn how to write SQL queries.

DS5B-503: Forecasting Methods-I Credits: 3 (2-1-0)

Objective: This subject is designed in such a way to provide the basic concepts of quantitative forecasting methods, risk and uncertainty in forecasting.

COURSE DESCRIPTION:

Unit I: Introduction:
Forecasting perspective, an overview of forecasting methods, basic steps in forecasting. Common time series pattern, graphical and numerical summaries. Measuring forecasting accuracy: Mean, Median, Mode, Error Standard Deviation, MAD, ME, MSE, MAE prediction intervals, transformations and adjustments.

Unit II: Time Series Decomposition:
Principles of decomposition, moving averages, local regression smoothing, classical decomposition, Census Bureau methods, STL decomposition, forecasting and decomposition. Correlation measurement, Auto correlation, ACF, Durbin-Watson statistics.

Unit III: Exponential Smoothing Methods:
Forecasting scenarios, Averaging methods: mean, moving averages; Exponential smoothing methods-single exponential smoothing, ARRSES, Holt’s linear method, Holt-Winter’s trend and seasonality method, comparison of methods, general aspects of smoothing methods.

Unit IV: Regression:
Simple regression, forecasting with simple regression, non-linear relationships. Regression with time series, regression and forecasting, econometric models for forecasting. Univariate ARIMA model: examining stationary, ARIMA models, forecasting with ARIMA models, ARIMA application.

Text Books:
1. Spyros Makridakis: Forecasting Method’s and application Wiley
2. N.P. Nagpal: Forecasting Techniques, RBSA

3. Stephen A. Delurgio: Forecasting Principals and Application,McGraw Hill

Course Outcomes:

- Discuss the key factors which affect the success of forecasting procedures.
- Use Basic Statistical Techniques and statistical Graphics to forecast values.
- Find different sets of Smoothed or Average values to be used when forecasting.
- Understand the key concepts needed to use the Linear Regression model when forecasting.
- Model and Forecast the Seasonal component of a set of values.
- Model the different types of cyclical behaviour observed in different sets of values.
- Understand and use the Box-Jenkins or ARMA Procedure.

DS5B-505: Operations Research Credits: 4 (3-1-0)

COURSE OBJECTIVE:

This course exposes the students in mathematical modelling, solving and analysing business and industrial problems using operations research methods.

COURSE DESCRIPTION:

Unit -I:

Introduction, History, Development of Operations Research, Characteristics of Operations Research, Models in Operations Research, Principles of Modelling. Pre-modelling-Need Recognition, Problem Formulation. Modelling-Model development, Data collection, Model solution, Model validation, and sensitivity analysis. Post-modelling-Interpretation of results and implications, Decision making, Implementation, and Control.

Unit-II:

Linear Programming, Formulation of Linear programming Problems. Solution Methods-Graphical, Simplex, M-Technique, Two-Phase. Special cases of LP problems. Duality, Primal-dual relationships, Dual simplex method. Sensitivity analysis. Solving LP problems using computer software.

Unit-III:

Transportation Model-Formulating the model, Initial Feasible Solution-North-West Method, Least Cost Method, Vogel's Approximation Method. Optimum Solution-MODI method, Stepping Stone Method. Special issues of transportation problems. Assignment Model: Formulating the model, Solving the assignment problem using Hungarian method. Special issues of assignment problems.

Integer programming: Types of integer programming problems, Formulating the model, Solution using Branch and bound method. Dynamic Programming.

Solving the problems using computer software.

Unit-IV:

Network models: Minimal spanning tree algorithm, Shortest-route problem, Maximal flow model, Minimum –cost capacitated flow problem. Project Scheduling: CPM and PERT.

Inventory models: Functions of inventory, information requirements for inventory management-demand, lead time, inventory costs, and quantity on hand. Objectives of inventory management. Economic Order Quantity Models-Economic order size, economic production run, quantity discounts. Determining the reorder point. Material Requirement Planning.

Queuing Models: Goals, elements and characteristics of queuing systems, Measures of system performance, Waiting line models-single channel, multiple channel. Cost considerations.

TEXT BOOKS
Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
William J. Stevenson: Introduction to Management Science, IRWIN.

Course Outcomes:

- Understand the verbal description of the real system and accordingly identify and development of operational research models.
- Understand the mathematical tools that are needed to solve optimisation problems.
- Use of mathematical software to solve the OR models developed.
- Develop a technical report that describes the model, solving technique, results analysis and recommendations.

DS5B-507: Probability and Statistics Credits: 3 (2-1-0)

Objective: The main objective of this course is to provide students fundamental knowledge of probability and statistics.

COURSE DESCRIPTION:
UNIT I: Probability Theory: Set Theory, Random Experiments and Outcomes, Measure of Probability of Events, Independence Events, Conditional Probability, Some Basic Rules/Theorems of Probability; Counting Techniques and Application to Problems; Random Variables and Probability Distributions: Discrete distributions: degenerate, Bernoulli, Binomial, Poisson, Geometric, Negative binomial, hyper-geometric, uniform, Multinomial distribution and its marginal and conditional distributions. Continuous distributions: Uniform, Normal, Lognormal, Exponential, Laplace, Pareto, Beta, Gamma, Cauchy.

UNIT II:
General Introduction, including the Uses and Applications of Statistics, Types of Data and their Collection Methods, Stages of Statistical Investigation; Descriptive Analysis of Data including Exploratory Data Analysis; Central Tendency: mean, mode, median, percentile,

moments, Kurtosis, and Skewness, measures of dispersion: mean deviation, standard deviation, variance.

UNIT III:
Correlation: correlation coefficient and its properties, Correlation ratio, Correlation Index, Intra class correlation; Rank correlation: Spearman's and Kendall's measures; Concept of Regression: Principles of least squares, Fitting of polynomial and exponential curves; ANOVA, Design of Experiment.

UNIT IV:
Introduction to Sampling Techniques and Sampling Distributions of Sample Means, Hypothesis Testing: Basic Concepts, Significance Tests for Parameters including Analysis of Variance; Non-Parametric Tests: Chi-square Tests, Tests for Independent and Paired Samples; Type I and Type II Errors and Power Function, Neyman-Pearson Lemma and Likelihood Ratio Test for Most Powerful Critical Region.

Text Books:

1. Chung K.L. "Elementary Probability Theory with Stochastic Process", Springer / Narosa
2. Feller W. "An Introduction to Probability Theory & its Applications", John Wiley
3. Goon A.M., Gupta M. K., Dasgupta B., "Fundamentals of Statistics (V-1)",World Press
4. Yule G.U & Kendall M.G., "An Introduction to the Theory of Statistics", C.Griffin
5. Snedecor & Cochran "Statistical Methods" 6th edition, Iowa State Univ. Press.

Course Outcomes:

1. Learn about data driven decision making under probabilistic framework.
2. Translate a business problem into a statistical inference problem.
3. Identify an appropriate statistical method to solve the problem.
4. Perform statistical analysis and draw conclusions from the analysis to solve the business problem.

DS5B-509: Python for Analytics Credits: 3 (2-0-2)

Objective: The main objective is to help students to understand the fundamentals of python. Student will learn how to analysis data using Python.

COURSE DESCRIPTION:
UNIT I: Introduction to Python: Python versus Java, Python Interpreter and it's Environment, Python installation, Python basics: variables, operators, Strings, Conditional and Control Statements, loops; Data structures: lists and dictionaries; functions: global functions, local functions, lambda functions and methods.

UNIT II: Object Oriented Programming Concepts: Class, object, constructor, destructor and inheritance; Modules & Packages, File Input and Output, Catching exceptions to deal with bad data, Multithreading, Database Connectivity.

UNIT III: Numpy: Creating Arrays, Arrays Operations, Multidimensional ArraysArrays transformation, Array Concatenation, Array Math Operations, Multidimensional Array and its Operations, Vector and Matrix. **Visualization:** Visualization with matplotlib, Figures and subplots, Labeling and arranging figures, Outputting graphics.

UNIT IV: Pandas: Manipulating data from CSV, Excel, HDF5, and SQL databases, Data analysis and modelling with Pandas, Time-series analysis with Pandas, Using Pandas, the Python data analysis library, Series and Data Frames, Grouping, aggregating and applying, Merging and joining.

Text Books:

1. McKinney Wes, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.
2. Hauck Trent, "Instant Data Intensive Apps with Pandas How-To", Packt Publishing Ltd, 2013.
3. Beazley David M.,"Advanced Python Programming", Pearson Education,2009.
4. Chun Wesley , Core Python Programming, 3rd Edition,Prentice Hall Professional, 2012.
5. Telles Matt "Python Power!: The Comprehensive Guide", Cengage Learning, 2008.
6. McKinney Wes & PyData Development Team, "pandas: powerful Python data analysis toolkit", Release 0.13.1, Feb 2014.
7. https://docs.python.org/3.4/tutorial/
8. http://www.tutorialspoint.com/python/python_quick_guide.htm

Course Outcomes:

- The student will learn core data types of python.
- The student will learn conditional and looping operations in python.
- The student will be able to work with Object-oriented concepts and Database connectivity in python.
- The student will be able to analyze data using Pandas and Numpy.
- The student will be able to visualize the data using seaborn and matplotlib.

DS5B-511: Advanced Excel Credits: 2 (0-0-4)

Objective: The main objective of this course is to learn analysis of data using MS Excel, resulting in less time and better understands what the data means.

COURSE DESCRIPTION:

Unit I: Introduction to Excel User Interface**,** Application, Workbook, Worksheets & its Components, Named Ranges; Formatting: Cell Color, Font Color, Indents, Alignments, Number Formats, Custom Formats, Editing commands; Data Sorting: Built-in Sort, Sorting Levels, Custom Sort; Data Filtering: Auto Filter – Filter By Color, Filter by Icono Advanced Filter, Remove Duplicates; Data Subtotal – Built-In Subtotal (Nested Subtotal).

Unit II: Data Validation: Based on cell values (text length, whole no Based on Formulas, List Dropdown, Circle Invalid Data, Input & Error Messages; Data Grouping: Grouping Rows, Grouping Columns. Data Tables: Conditional Formatting, Formatting based on Cell values, Formatting based on Formulas, Icon Sets (bars, scales, icons), Freezing Panes, Text-to-Columns, Delimited, Fixed Length; Data Consolidation (from multiple files), Getting External Data into Excel, From MS Access, From Text files, From Web, Other Data Sources.

Unit III: Formulas, TEXT Functions, IF, ERROR Functions, LOGICAL Functions, VLOOKUP, HLOOKUP, COUNTIF, SUMIF, SUMPRODUCT, DATE & TIME FUNCTIONS, FORMULA TEXT, Information Functions (ISNA, ISEVEN, ISERR…).

Unit IV: Charts: Chart Types, Chart Components, Primary Vs Secondary Axis, Chart Formatting, Sparkline (2010 and above); Pivot Tables: Introduction & Creation, Slicer, TimeLine, Pivot Charts, Calculated Fields, Calculated Items, Grouping, Formatting – Number/Conditional, PowerPivot, PowerView.

Assignment: Dashboard design

Text Books:

1. John Walkenbac, “Excel 2016 Bible”, John Willey & sons.
2. Jordan Goldmeier , “Advanced Excel Essentials”, Apress Publisher.
3. Conrad George Carlberg , “Business Analysis with Microsoft Excel”, Que Publishers.
4. Bernd Held, ”Microsoft Excel Functions & Formulas”, Wordware publishing, Inc.
5. Steven Roman ,”Writing Excel Macros with VBA” O’Reilly Media.

Course Outcomes:

- The student will be able to perform basic operations in Excel.
- The student will be able to summarize data using Grouping and pivot table.
- The student will be able to write conditional statements and perform LOOKUP operations.
- The student will be able to create charts in Excel.
- The student will be able to create a dashboard in Excel.

DS5B-521: Fundamentals of Algorithms Credits: 3 (2-0-2)

Objective: The main object of this course is to provide an introduction to create analytical skills, to enable the students to design algorithms for various applications, and to analyse the algorithms.

COURSE DESCRIPTION:

Unit I: Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation- Big oh notation, Omega notation, Theta notation and Little oh notation

Unit II: Divide and conquer: General method, applications-Binary search, Quick sort, Merge sort, Strassen's matrix multiplication.

Unit III: Greedy method: General method, applications-Job sequencing with deadlines, 0/1 knapsack problem, Minimum cost spanning trees, Single source shortest path problem. Dynamic Programming: General method, applications-Matrix chain multiplication, Optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem, Travelling sales person problem.

Unit IV: Backtracking: General method, applications-n-queen problem, sum of subsets problem, graph colouring, Hamiltonian cycles. Branch and Bound, NP-Hard and NP-Complete problems: Basic concepts, non-deterministic algorithms, NP - Hard and NP Complete classes, Cook's theorem.

TEXT BOOKS

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithm", Pearson Education Asia, 2003.
2. T.H.Cormen,C.E.Leiserson, R.L.Rivest,and C.Stein "Introduction to Algorithms", second edition, ,PHI Pvt. Ltd./ Pearson Education
3. R.C.T.Lee, S.S.Tseng, R.C.Chang and T.Tsai, "Introduction to Design and Analysis of Algorithms A strategic approach", Mc Graw Hill.
4. Ellis Horowitz,Satraj Sahni and Rajasekharam," Fundamentals of Computer Algorithms",Galgotia publications pvt. Ltd.
5. Parag Himanshu Dave, Himanshu Bhalchandra, " Design and Analysis Algorithms", Dave Publisher: Pearson

Course Outcomes:

- The student will be able to understand the basics of algorithms.
- The student will be able to work with the divide and conquer method.
- The student will be able to work with Greedy methods.
- The student will be able to work with backtracking algorithms.
- The student will be able to understand NP-Hard and NP-Complete Problem.

DS5B-523: Decision Analysis Credits: 3 (2-1-0)

OBJECTIVE:

This course introduces and applies advanced modelling techniques to decision problems with the objective of enhancing the decision-making skills as well as the spreadsheet knowledge base.

COURSE DESCRIPTION:

Unit-I: Game Theory: Introduction, definitions, two-person zero sum game. Game with pure strategies, saddle point, game value. Game with mixed strategies, solution methods- algebraic method, graphical method, dominance, linear programming method.

Unit-II: Decision Theory: Structuring the decision problem-payoff tables, decision trees. Decision making under certainty. Decision making under uncertainty: Optimistic, Conservative, Minimax regret. Decision making under risk: Expected value criterion, expected value of perfect information. Sensitivity analysis. Decision making with sample information, expected value of sample information, efficiency of sample information. Computing branch probabilities. Utility and decision making: meaning of utility, developing utilities and payoffs, the expected utility approach.

Unit-III: Multi-criteria Decision Making: Multi-criteria decision making: Goal programming, Scoring models, Analytical Hierarchy Process.

Unit-IV: Markov Analysis: Transition probabilities, system behaviour. Methods of Analysis: Tree diagram, Matrix multiplication, Algebraic solution. Cyclical and absorbing states, Market share analysis, Accounts receivable analysis.

TEXTBOOKS

1. Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
2. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
3. William J. Stevenson: Introduction to Management Science, IRWIN.

Course Outcomes:

1. Learn basics of decision making and uncertainty analysis under a risky situation.
2. To understand concepts in Strategic Game Theory.
3. To learn how to model and solve real life cases using Game Theory.

DS5B-551: Communication Skills Credits: 3 (2-1-0)

OBJECTIVE

To make use of the opportunities and meet the challenges of the modern world, students need to develop effective communication skills. This is a skill that is most often quoted as lacking in engineers and IT professionals. Proper communication skills are also extremely important in interpersonal relationships. This course will help students in becoming confident and effective communicators, who can project themselves positively to others.

COURSE DESCRIPTION:

Unit I: Introduction to Communication: Need for Effective Communication. The Process of Communication: Levels of communication; Flow of communication; Use of language in communication; Communication networks; Significance of technical communication. Barriers to Communication: Types of barriers; miscommunication; noise; overcoming measures.

Unit II: Listening Skills: Listening as an active skill; Types of Listeners; Listening for general content; Listening to fill up information; Intensive Listening; Listening for specific information; Developing effective listening skills; Barriers to effective listening skills.

Reading Skills: Previewing techniques; Skimming; Scanning; Understanding the gist of an argument;
Identifying the topic sentence; Inferring lexical and contextual meaning; recognizing coherence and sequencing of sentences; Improving comprehension skills.

Writing Skills: Sentence formation; Use of appropriate diction; Paragraph and Essay Writing; Coherence and Cohesion.

Unit III: Letter Writing: Formal, informal and demi-official letters; business letters. Job Application: Cover letter, Differences between bio-data, CV and Resume. Report Writing: Basics of Report Writing; Structure of a report; Types of reports. Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language.

Unit IV: Interview Skills: Types of Interviews; Ensuring success in job interviews; Appropriate use of non-verbal communication. Group Discussion: Differences between group discussion and debate; Ensuring success in group discussions. Presentation Skills: Oral presentation and public speaking skills; business presentations. Technology-based Communication: Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software.

Text Books:

Spoken English & Effective Communication (With 2 CDs): Mind Power Spoken English Institute by by Prof. Sharad Srivastava and Dr Amita Singhvi; Franklin International; New edition (2015)
Communication Skills by Sanjay Kumar and Pushp Lata; Oxford University Press India; (2015)
El Dorado: A Textbook of Communication Skills by R. Pushkala and P.A.Sarada; Orient Blackswan; (2013)

Course Outcomes:

At the end of the course the students will be able-

1. To make communication with the parties concerned.
2. To write memorandum, circulars, notices, business letters, and business reports.
3. To write resume and job application.
4. To participate in group discussion and interviews.

Second Semester:

DS5B-502: Data Mining and Data Warehousing Credits: 3 (2-0-2)

Course Objective The main objective of this course is to provide understanding of data warehouse fundamentals and data mining techniques for business applications.

COURSE DESCRIPTION:

UNIT I: Data Warehousing: Introduction data warehousing, Data Mart, Data Warehouse Architecture; Star, Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning. ETL Concepts. OLAP technology: Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, indexing data.

UNIT II: Data Mining: Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining; Introduction to Web Mining, Text Mining. Data Processing: Data Cleaning, Data Integration and Transformation; Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Data Discretization and Concept hierarchy generation for numerical and categorical data.

UNIT III: Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, FP-Growth Algorithm, latest trends in association rules mining.

UNIT IV: Classification methods: Decision tree, Bayesian Classification, Rule based; clustering methods: Partitioning methods (K-Means, K-Mediods) and Hierarchical Clustering (Agglomerative and Divisive Clustering, Multi-phase method) Prediction: Linear and non-linear regression.

Text Books:

1. P.Ponnian, “Data Warehousing Fundamentals”, John Wiley.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.
3. P. N. Tan, M. Steinbach, Vipin Kumar, “Introduction to Data Mining”, Pearson Education.
4. G. Shmueli, N.R. Patel, P.C. Bruce, “Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner”, Wiley India.
5. Michael Berry and Gordon Linoff “Data Mining Techniques”, Wiley Publications.
6. M.H.Dunham, “Data Mining Introductory & Advanced Topics”, Pearson Education.

Course Outcomes:

- The student will learn basics of Data Warehouse.
- The student will learn basics of Data Mining.

- The student will be able to Pre process the data.
- The student will be able to perform Market Basket analysis.
- The student will be able to work with Classification Algorithms.
- The student will be able to cluster the data.

DS5B-504: Machine Learning Credits: 3 (2-0-2)

Objective: The main objective is to help students to understand the fundamental concepts of machine learning.

COURSE DESCRIPTION:

UNIT I: Introduction to Machine Learning, History and Overview of machine learning, Applications, Types of Machine Learning, Basic Concepts. Concept Learning and candidate elimination learning Algorithm.

UNIT II: Artificial Neural Network: biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervise & Unsupervised) and activation function. Supervised Learning: Perceptron learning, Single layer/multilayer, linear Separability, Adaline, Madaline, Back propagation network, RBFN.

UNIT III: Bayesian Learning, Bayes Theorem, Naïve Bayesian classifier, Bayesian belief, EM Algorithm. Dimensionality Reduction: Factor Analysis, Principal Component Analysis, Linear Discriminant Analysis.

UNIT IV: Markov and Hidden Markov Models, PAC Learning, Support Vector Machine, Evolutionary Learning: Genetic Algorithm, generating offspring, applications and genetic programming.

Text Books:

1. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
2. Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
4. Ethem Alpaydin, “Introduction to Machine Learning”, Prentice Hall of India, 2005.
5. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2006.
6. Sanjeev Kulkarni, Gilbert Harman, “An Elementary Introduction to Statistical Learning Theory”, 2011.
7. N. Shivnandam, “Principle of soft computing”, Wiley.

Course Outcomes:

- The student will be able to understand the basics of machine learning.
- The student will be able to understand Regression analysis.

- The student will be able to work on classification problems.
- The student will be able to work with unsupervised learning approaches.
- The student will be able to perform machine learning operations in scikit-learn.

DS5B-506: Linear Algebra and Advanced Calculus Credits: 3 (2-1-0)

Objective: The main objective is to students will learn to solve many types of data science problems using Linear Algebra and Calculus.

Course Description:

Unit I: Vector spaces over fields, subspaces, bases and dimension. Systems of linear equations, matrices, rank, Gaussian elimination. Linear transformations, representation of linear transformations by matrices, rank-nullity theorem, duality and transpose.

Unit II: Determinants, cofactors, adjoint, Cramer's Rule. Eigen values and Eigen vectors, characteristic polynomials, minimal polynomials, Cayley-Hamilton Theorem, triangulation, diagonalization, rational canonical form, Jordan canonical form.

Unit III: Inner product spaces, Gram-Schmidt orthonormalization, orthogonal projections, linear functionals and adjoints, Hermitian, self-adjoint, unitary and normal operators, Spectral Theorem for normal operators, Rayleigh quotient, Min-Max Principle.

Unit IV: Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor’s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange’s method of undetermined multipliers. Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

Text Books:

1. K. Hoffman and R. Kunze, Linear Algebra, Pearson Education (India), 2003. Prentice-Hall of India, 1991.
2. S. Lang, Linear Algebra, Undergraduate Texts in Mathematics, Springer-Verlag, New York, 1989.
3. P. Lax, Linear Algebra, John Wiley & Sons, New York,. Indian Ed. 1997
4. H.E. Rose, Linear Algebra, Birkhauser, 2002.
5. Hildebrand, Francis. Advanced Calculus for Applications. 2nd ed. Englewood Cliffs: Prentice Hall, March 31, 1976.
6. Kaplan W., “Advanced Calculus”, Addison Wesley (Pearson Education, Inc.), 5 th Edition, 2003
7. Grewal. B.S, “Higher Engineering Mathematics”, 41st Edition, Khanna Publications, Delhi, (2011).

Course Outcomes:

After successful completion of this course students will be able to:

1) demonstrate competence with the basic ideas of linear algebra including concepts of vector spaces, linear systems, independence, theory of matrices, linear transformations, bases and dimension, eigenvalues, eigenvectors and diagonalization;
2) describe and apply the key concepts advance calculus;

3) communicate and understand mathematical statements, ideas and results, both verbally and in writing.

DS5B-508: Forecasting Method-II Credits: 3 (2-0-2)

Objective: This subject is designed in such a way to provide the advance concepts of forecasting models based on quantitative and qualitative analysis. Risk and uncertainty in forecasting and also see the cause effect relationship in given scenario and forecast the best possible outcomes.

Unit I:

Technology forecasting: Its meaning and need, alternatives to forecasting, stages of innovation. Delphi: advantages and disadvantages of committees, Delphi procedure, conducting a Delphi based study. Forecasting by analogy. Growth curves-substitution curves, Pearl curve, Gompertz curve, Fisher-Pry curve, selection of proper growth curve, estimation of upper limit.

Unit II:

Trend extrapolation- exponential trends, non-exponential growth, qualitative trends etc. Measures of technology-scoring models, Causal models-technology only models, techno-economic model. Normative methods-relevance trees, morphological models, mission flow diagrams.

Unit III:

Basic concept of model, regression model, regression with ARIMA error, dynamic regression model intervention analysis, multivariate autoregressive models, state space model.

Unit IV:

Uses of forecasting methods in practice, advantages and limitation of forecasting.

Text Books:

Spyros Makridakis ,Forecasting Methods and Application Wiley publication

Joseph P. Martino,Technology forecasting for decision making, McGraw-Hill engineering and technology management series

Stephen A. Delurgio, Forecasting principals and applications, Irwin McGraw-Hill

Course Outcomes:

- Understand the ways of forecasting in the new immerging field of technology.
- Model and Forecast the different possible Trend, growth and seasonal components of a set of values
- Use EViews to perform the key operations needed to obtain Descriptive Statistics and Regression Analysis.
- To understand the different causing variables affecting forecast and model them.
- Combine the Trend, Seasonal and Cyclical components to produce a more accurate forecast of a set of values.

DS5B-510: Big Data Technologies Credits: 3 (2-0-2)

Course Objective: The main objective of this course is to introduce big data technologies such as Hadoop, spark and analyzing big datasets in spark using python.

COURSE DESCRIPTION:

UNIT I: Introduction
Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting – Modern Data Analytic Tools. Big Data Analytics Process, Big Data Analytics for Business. Identifying problem and solving problem in Big Data environment. Analyzing Unstructured vs. Structured Data, Databases.

UNIT II: Hadoop and MapReduce
Introduction to Hadoop, Hadoop architecture, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases; Hadoop Distributed File system: Design of HDFS, HDFS Concepts. Introduction to MapReduce: MapReduce Basic Concepts, Understanding the Map Reduce architecture, Writing MapReduce Programs. understanding Map phase, shuffling, sorting, and reducing phase.

UNIT III: Spark
Introduction to Spark, Resilient Distributed Dataset (RDD), RDD Operations: actions and transforamtion funtions. Spark Dataframes, operations on Dataframes: Join, groupby, aggregate, handling missing data.

UNIT IV: SparkSQL and MLLib
SparkSQL and its basic operations. MLLib: Data types, Basic statistics, Classification(Logistic regression, Decision tree classifier)and linear regression model generation, Model Evaluation, Collaborative filtering, and Clustering.

Text Books:

1. Arvind Sathi, "Big Data Analytics: Disruptive Technologies for Changing theGame", 1st Edition, IBM Corporation, 2012.
2. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", 1st Edition, Wiley and SAS Business Series, 2012.
3. Tom White,"Hadoop: The Definitive Guide", 3rd Edition, O'Reilly Media, 2012.
4. Donald Miner, Adam Shook, Eric Sammer, "Hadoop Operation", O'Reilly 2012.
5. Donald Miner, Adam Shook "MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems", O'Reilly 2012.
6. Chuck Lam, "Hadoop in Action", Manning Publications, 2010.
7. https://spark.apache.org/docs/2.0.0/programming-guide.html

Course Outcomes:
- The student will be able to understand core concepts of Hadoop.
- The student will know the HDFS and MapReduce.
- The student will be able to work with Big Data tool such as Spark.
- The student will be able to analyze big data sets.
- The student will be able to create machine learning models for Big data.

DS5B-522: Statistical Programming in R Credits: 3 (2-0-2)

Objective: This course is an introduction to R, a powerful and flexible statistical language and environment that also provides more flexible graphics capabilities than other popular statistical packages. After taking this course, students will be able to –

1. Use R for statistical programming, computation, graphics, and modeling,
2. Write functions and use R in an efficient way,
3. Fit some basic types of statistical models,
4. Use R in their own research,
5. Be able to expand their knowledge of R on their own

COURSE DESCRIPTION:

Unit I: Introduction to R programming language: Getting R, Managing R, Arithmetic and Matrix Operations, Introduction to Functions, Control Structures. Working with Objects and Data: Introduction to Objects, Manipulating Objects, Constructing Data Objects, types of Data items, Structure of Data items, Reading and Getting Data, Manipulating Data, Storing Data.

Unit II: Data Distribution and Statistical Testing: Types of Data distribution, Normal distribution, Poisson distribution, Random number generation, Chi-Square Testing, Student's t-test, F-test, Monte Carlo Simulation.

Unit III: Graphical Analysis using R: Basic Plotting, Manipulating the plotting window, Box-Whisker Plots, Scatter Plots, Pair Plots, Pie Charts, Bar Charts.

Unit IV: Advanced R: Statistical models in R, Correlation and regression analysis, Analysis of Variance (ANOVA), creating data for complex analysis, Summarizing data, and case studies.

Text Books:

1. Mark Gardener: Beginning R: The Statistical Programming Language, Willey publications
2. Norman Matloff: The Art of R Programming: A Tour of Statistical Software Design, OREILLY & Associates Inc.

Course Outcomes:

- Data manipulation - acquiring skills in flexible matrix manipulation
- Access online resources for R and import new function packages into the R workspace
- Scripting in such a way that the script can be used with minimal effort for similar datasets and analyses and for especially large datasets
- Explore data-sets to create testable hypotheses and identify appropriate statistical tests
- Perform appropriate statistical tests using R
- Learn how to create high-quality figures, especially associated with more complex analyses (e.g. three dimensional scatter plots, animated chart Trellis displays, etc.).

DS5B-524: Scientific Computing Credits: 3 (2-1-0)

Objective:

The course provides an appreciation of the need for numerical methods for solving different types of problems, and discusses basic approaches. It develops the understanding of numerical mathematics or scientific computing - whether in mathematics, the sciences, engineering, or economics.

COURSE DESCRIPTION:

Unit I: Foundation of Scientific Computing, Quantum computing, Wentzel-Kramer-Brillouin Method, Runge-Kutta method, Trapezoidal method.

Unit II: Quasi-linear, Laplace equation, wave packets, Pressure fluctuation, wave phenomena, linearized shallow water wave equation, 1D convection equation, Upwinding, Numerical amplification factor, Stiff differential equation.

UNIT III: Numerical amplification factor, Heat equation, Parabolic partial differential equation, Tridiagonal matrices, Error propagation, Elliptic partial differential equations, Ordinary differential equation, Convergence properties, General elliptic equation, Multigrid method.

Unit IV: Spectral analysis of explicit and implicit, Highlight the scientific and high performance, Taylor series analysis, Buffer domain technique, Aliasing error, Accuracy compact schemes, CCD scheme Stabilizing effects of filters, Properties of filters, Scientific elements of a FEM, Lagrange and hermite interpolations, Elliptic equation with linear basis function.

Text Books:

1. Scientific Computing by Michael T Heath, Mc Graw Hill, 2001
2. Numerical Recipes: The Art of Scientific Computing, Cambridge University Press, 2007
3. Guide to Scientific Computing by Peter R Turner, CRC Press, 2001

Course Outcomes:

After successful completion of the course the students will be able to-

- transform scientific problems into generic computational models;
- have an overview of advanced algorithms for solving a wide range of problems;
- solve mathematical problems by using elementary algorithms, and compute solutions using a structured computer program.
- display and analyse data appropriately, including the results of numerical calculations.
- plan and develop efficient numerical programs.

DS5B-552: Technical Communication Credits: 3 (2-1-0)

Objective:

This course is designed to help the students to develop skills that will enable them to produce clear and effective scientific and technical documents.

Unit I:

Technical writing: Definition, Similarities to other writings, Unique features, importance, technical writing as profession, qualifications for technical writing. Identifying audience. Problems involving content, words and phrases, punctuation, unity, coherence, logic, etc. Being concise.

Unit II:

Techniques of Technical Communication. Analysing-Division, Classification, Partition. Defining-Formal, informal, expanded. Describing-subjective versus objective, spatial description, description of mechanism, process, selected details. Illustrating-Tables, graphs, charts, pictorials. Researching-Basic types of research, original research, searching the literature. Abstracting of your own reports, the works of others, precautions. Oral communication-one to one reporting, participation in conferences, speaking to large audiences, organising the speech.

Unit III:

Basic forms of Technical Writings. The memorandum, The business letter, Formal report.

Unit IV:

Technical reports. Justification reports and proposals, the progress reports, periodic reports, status reports, trip reports. Laboratory reports, Feasibility reports, State-of-the-Art reports. Instructions and manuals.

Text Books:

1. James Sherlock: A Guide to Technical Communication

Course Outcome:

After completion of this course student will be able to-

- Document the knowledge about products, services, technology, or concepts into well-crafted and organised information collateral.
- Write technical reports, memorandum, business letters, manuals, proposals, progress reports etc.
- Develop document involving spatial description, description of mechanism, process, illustrations, etc.

Third Semester:

DS5B-601: Cloud Computing Credits: 3 (2-1-0)

Objective: The main objective of this subject is to help student to understand Cloud and It's Services, Architecture, Deployment, Core Issues, Strengths and limitations of cloud computing.

UNIT I Introduction to Cloud Computing: Overview of Cloud Computing, History of Cloud Computing, Importance of Cloud Computing, advantages and disadvantages of Cloud Computing, Applications, Cloud computing vs. Cluster computing vs. Grid computing, Future of Cloud Computing; Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Cloud Service Models(XaaS), Deployment Models (Public cloud, Private cloud, Hybrid cloud).

Unit II: Cloud Service Models and Virtualization: Infrastructure as a Service (IaaS): Introduction, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Virtual Machine(VM), Resource Virtualization(Server, Storage, Network),VMware vSphere, Machine Image ,Porting Applications Case study on Amazon EC2;Platform as a Service(PaaS): Introduction to PaaS, advantages and disadvantages of PaaS, case study on Microsoft Azure; Software as a Service(SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS; Development Services and Tools : Amazon Ec2, Google App Engine, IBM Clouds.

UNIT III: Capacity Planning: Defining Baseline and Metrics, Baseline measurements, System metrics, Load testing, Resource ceilings, Server and instance types, Network Capacity, Scaling. Understanding Service Oriented Architecture, Moving Applications to the Cloud, Working with Cloud-Based Storage, Working with Productivity Software.

UNIT IV: Managing the Cloud: Administrating the Clouds, Cloud Management Products; Cloud Security: Security Overview, Cloud Security Challenges and Risks, Security Governance, Risk Management: Security Monitoring, Security Architecture Design, Data Security, Application Security, Virtual Machine Security, Identity Management and Access Control, Authentication in cloud computing, Client access in cloud, Cloud contracting Model. Using the Mobile Cloud: Working with Mobile Devices and Working with Mobile Web Services;

Case Studies on Various Clouds: Google Web Services, Amazon Web Services, Microsoft Cloud Services, IBM Clouds, Eucalyptus.

Text Books:

1. Kris A Jamsa: Cloud computing : SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More 2013Jones & Bartlett Learning ISBN-13: 9781449647391.
2. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH, 2009.
4. Sosinsky B., "Cloud Computing Bible", Wiley India
5. Cloud Computing: Principles and Paradigms, Editors: Raj kumar Buyya, James Broberg, Andrzej M. Goscinski, Wiley, 2011.
6. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.

Course Outcomes:

- The student will be able to understand the basics of Cloud Computing.
- The student will be able to understand Cloud Computing Models.
- The student will be able to work with AWS Cloud Platform.
- The student will be able to manage cloud platform.
- The student will be able to understand various cloud services.

DS5B-603: Data Visualization Credits: 3 (2-0-2)

Objective: This course will help the student to understand data visualization and how data scientists/ analysts use visualization technique to represent results.

COURSE DESCRIPTION:

UNIT I Introduction to Data Visualization, characteristics, goals, need of data visualization, comparison of data science and data visualization, Types of Data, Operations on datatypes, Data Dimensions, Designing Visuals, Visual attributes, Designing Visuals, Mackinlay Design Criteria, Retinal Variables: Size, texture, shape, orientation, color, color Saturation, color hue; Where to use which variable? Bertin's visual attributes, Seven Stages of Visualizing Data.

UNIT II Types of visualization chart: Scatter, line, pie, bar, histogram, Bubble, stacked area chart, pair plot, Heatmaps. Smart Charts: List, Process, Cycle, Hierarchy, Relationships, matrix, pyramid, pictures. Text Visualization.

UNIT III Dashboard, Characteristics, Types of dashboards, best practices and design issues, visual perception, limits of short-term memory, visual encoding data, Gestalt principles, principles of visual perception. Case studies: sales dashboard, CIO dashboard, Telesales dashboard, marketing analysis dashboard.

UNIT IV: Tableau Data Visualization Tools: Data loading, Connecting with Databases, Data Prep with Text and Excel Files, Drill Down and Hierarchies, Sorting, Grouping, Filters, Filtering for Top and Top N, Parameters Formatting; Tableau's Mapping, Custom Geocoding, Polygon Maps, WMS; Dashboards and Stories, Dashboard Layouts and Formatting

Text Books:

1. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.
2. Stephen Few, "Information dashboard design: The effective visual communication of data",O'Reilly, 2006.
3. Edward R. Tufte, "The visual display of quantitative information", Second Edition, GraphicsPress, 2001.
4. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
5. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment",O'Reilly, 2008.
6. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.

Course Outcomes:

- The student will learn basic principles of data visualization.
- The student will learn various types of charts to visualize data.
- The student will understand Dashboard concepts.
- The student will be able to use data visualization tools Tableau/Qlik view.
- The student will be able to tell stories using the dashboard and visualization.

DS5B-605: Research Methodology Credits: 3 (2-1-0)

COURSE OBJECTIVE:

The objective of teaching this course is to enable students to conduct research.

COURSE DESCRIPTION:

Unit-I:

Introduction to research, Need, Importance and Characteristics of research, Types of research – An overview, Quantitative and qualitative research, Review of literature. Identification, Definition and Statement of Problem, Variables, Role of variables in research, Research Questions and Objectives.

Unit-II:

Hypotheses, Hypotheses Testing, Population and Sample, Probability Sampling Techniques, Non - Probability Sampling Techniques, Error, types of error.

Unit-III:

Research Design – An Overview, Philosophical and Historical, Survey, Case Studies, Experimental Designs, Research Tools. Process of Research Tools Designing, Questionnaire Designing, Test Designing, Scale Designing, Scaling Techniques. Process of Standardising Research Tools, Data Analysis Overview.

Unit-IV:

Frequency Distribution, Statistical Tools: Measures of Central Tendency, Measure of Variability, Comparing Means: Independent Sample t-test, Paired Sample t-test, One Way ANOVA, Factorial Design ANOVA, ANCOVA, Factor Analysis and Non-parametric Statistical Techniques.

Report Writing, IPR and Plagiarism, Statistical Software and Research Paper Writing.

Text Books:

1. Kerlinger, F.N: Foundations of Behavioral Research, Surjeet Publication, New Delhi, 1983.
2. Sterling, T. and Pollack, S: Introduction to Statistical Data Processing, Prentice Hall, 1968.
3. Campbell, W: Forms and style in Thesis Writing, 3rd ed., Boston., Houghton, Mifflim, 1969.
4. McNemar, Orinn: Psychological Statistics, John Wiely and Sons, 1960.
5. Molstad, John A.: Selective Review of Research Studies Showing Media Effectiveness: A Primer for Media Director. AV communication review vol.22, 1974.
6. S.P. Gupta, Statistical Methods, S.Chand
7. C.K.Kothari, Research Methodology, New Age Publications.

Course Outcomes:

- To be able to understand the basic concept of research and data collection.
- To be able to formulate research questions and develop a sufficiently coherent research design
- To be able apply advanced knowledge in statistics to experimental and applied research
- To be able to critically evaluate the methodological designs and select appropriate analytical strategies for their research projects.
- To understand the interpretation and appropriate reporting requirements for research and thesis writing.
- To be able to use statistical packages required quantitative analysis (e.g., R, SPSS and Excel).

DS5B-607: Nonlinear Optimization Credits: 3 (2-1-0)

COURSE OBJECTIVE:

- To introduce the analysis of nonlinear optimization problems.
- To present the classical methods for solving nonlinear optimization problems with and without constraints, and nonlinear equations.

COURSE DESCRIPTION:

Unit-I:

Basics of Computer Arithmetic, Numerical Analysis, and Real Analysis.

Unit-II:

Convex analysis, Newton's Method, Unconstrained smooth optimization – optimality conditions – Newton's method for optimization – line-search methods – trust-region methods.

Unit-III:

Large-scale unconstrained optimization – linear conjugate gradient method – limited-memory quasi-Newton method. Linear and nonlinear least-squares problems. Nonlinear equations.

Unit-IV:

Basics of stochastic optimization, Structured non-smooth unconstrained optimization – cutting plane methods – gradient sampling.

Text Books:

1. J. Nocedal and S. Wright, Numerical Optimization, Second Edition, Springer, (2006)
2. A. R. Conn, N.I.M Gould, and Ph. L. Toint, Trust Region Methods, SIAM, Philadelphia, PA, (2000)
3. R. Fletcher, Practical Methods of Optimization, 2nd Edition, Wiley, Chichester & New York, (1987)

4. D. P. Bertsekas, Nonlinear Programming, Second Edition, Athena Scientific, Belmont, MA, (1999)
5. A. Ruszczynski, Nonlinear Optimization, Princeton University press, (2006)
6. S. Boyd and L. Vandenberghe, Convex Optimization, Cambridge University Press, (2004)

Course Outcomes:

- Students will learn the basic mechanisms that drive convergence of optimization algorithms.
- Students will learn the basic theory that underpins the theory for each algorithm.
- Students will learn to implement optimization algorithms.
- Students will learn the scientific tools that are relevant for different classes of optimization problems and different problem sizes.
- Students will gain intuition into the strategies and techniques that drive the most successful methods.

DS5B-621: Cluster Analysis **Credits: 3 (2-1-0)**

Objective: The purpose of this course is to provide fundamental knowledge of Clustering Methods, and develop skill for reporting analysis studies.

UNIT I Introduction to Classification and Clustering, Requirements for Cluster Analysis, Overview of Basic Clustering Methods, Concept of Similarity, Similarity Measures Basic Clustering Methods: Iterative Partition Clustering: k-means, K-Modes, k-medoids algorithms, CLARA, CLARANS;

UNIT II Hierarchical Clustering: Agglomerative, Divisive and Multi-Phase: BIRCH, Chameleon; Density Based Clustering Method: DBSCAN, OPTICS, DENCLUE; Grid-Based Methods: STING, CLIQUE;

UNIT III Advanced Clustering Methods: Probabilistic Model-Based Clustering: Fuzzy Cluster, Probabilistic Model-Based Clusters, Expectation-Maximization Algorithm; Validation Techniques: Cophenetic Correlation, Significance Tests on Variables Used to Create Clusters, Replication, Significance Tests on External Variables, Monte Carlo Procedures.

UNIT IV

Determining the Number of Clusters: Elbow criterion; Measuring Cluster Quality and Robustness; Displaying cluster solutions graphically. Cluster Analysis Software, Statistical Packages Containing Clustering Software, Reporting Cluster Analysis Studies.

Text Books:

1. Charles Romesburg,"Cluster Analysis for Researchers", LULU Press, 2004.
2. Mark S. Aldenderfer, Roger K. Blashfield, "Cluster analysis", Sage Publications, 01-Nov-1984.
3. Brian S. Everitt, Sabine Landau, Morven Leese, Daniel Stahl, "Cluster Analysis", John Wiley & Sons, 14-Jan-2011.
4. Brian S. Everitt, Graham Dunn," Applied Multivariate Data Analysis", Wiley, 28-Jun-2010
5. Bryan F.J. Manly, "Multivariate Statistical Methods: A Primer, Third Edition", CRC Press, 06-Jul-2004.
6. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.

Course Outcomes:
- The student will be able to understand basics of clustering.
- The student will be able to understand hierarchical clustering.
- The student will be able to understand advanced clustering approaches.
- The student will be able to assess the clustering performance.
- The student will be able to perform clustering operations in R/Python.

DS5B-623: Multivariate Analysis Credits: 3 (2-0-2)

Objective:
1. To understand the main features of multivariate data.
2. To be able to use exploratory and confirmatory multivariate statistical methods properly.
3. To be able to carry out multivariate statistical techniques and methods efficiently and effectively.

COURSE DESCRIPTION:

UNIT I: Analysis of categorical data. Loglinear models for two- and higher-dimensional contingency tables, Characterizing and Displaying Multivariate Data, Tests on one or two mean vectors.

UNIT II: Multivariate Analysis of Variance, Aspects of multivariate analysis, random vectors, sample geometry and random sampling, multivariate normal distribution, inferences about the mean vector, MANOVA.

UNIT III: Classification and grouping techniques: discrimination and classification, clustering. Logistic regression models.

UNIT IV: Analysis of covariance structures, Principal Component Analysis (PCA), Factor Analysis, Cluster Analysis. Use of statistical computer packages.

Text Books:

1. Applied Multivariate Statistical Analysis, by Richard A. Johnson and Dean W.Wichern (6th edition), Prentice Hall.
2. Characterizing and Displaying Multivariate Data, by A.C.Rencher, John Wiley and Sons.
3. Multivariate Data Analysis, by Joseph F.Hair, William, Babin and Anderson.
4. Cluster Analysis, by Brian S.Everitt, Sabine Landau, Morven Leese. Wiley

Course Outcomes:

- To be able to understand the concept of analysing multivariate data.
- To be familiar with a basic minimum level of matrix competency and with general aspects of handling multivariate data.
- Perform exploratory analysis of multivariate data, such as plot multivariate data, calculating descriptive statistics, testing for multivariate normality;
- Conduct statistical inference about multivariate means including hypothesis testing, confidence ellipsoid calculation and different types of confidence intervals estimation;
- Undertake statistical analyses using appropriate multivariate techniques, which includes principal component, factor analysis, discriminate and clustering analysis
- Analyse multivariate data using the statistical software package.

DS5B 651: Numerical Methods Credits: 3(2-1-0)

Objective:
The Objective of this course is to help student to understand basic concepts in numerical methods and able to solve engineering as well as social problems.

COURSE DESCRIPTION:

UNIT I: Introduction to Numerical solutions of algebraic and transcendental equations
Newton-Raphson and Regula-Falsi methods. Solution of linear simultaneous equations: Gauss elimination and Gauss Jordon methods. Iterative methods: Gauss Jacobi and Gauss-Seidel methods. Definition of Eigen values and Eigen vectors of a square matrix. Computation of largest Eigen value and the corresponding Eigen vector by Rayleigh's power method.

UNIT II: Interpolation and Approximation
Finite differences (Forward and Backward differences) Interpolation, Newton's forward and backward interpolation formulae. Newton's divided difference formula. Lagrange's interpolation and inverse interpolation formulae.

UNIT III: Numerical differentiation and Numerical Integration
Numerical differentiation using Newton's forward and backward interpolation formulae. Numerical Integration: Simpson's one third and three eighth's value, Boole's rule, Weddle's rule, Romberg's method, two and three point Gaussian quadrature formulae, Double integrals using trapezoidal and Simpson's rules.

UNIT IV: Ordinary Differential Equations

Single-step explicit methods: Taylor series method, Euler and modified Euler methods, Solution of first order and simultaneous equations by Euler's and Picard's method, Fourth order Runge Kutta method for solving first and second order equations, single-step implicit methods, multistep linear methods, Milne's and Adam's predictor and corrector methods.

Text Books:

1. Balagurusamy, E., "Numerical Methods", Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 1999.
2. S.S. Sastry, "Introductory Methods of Numerical Analysis", PHI learning Pvt Ltd.
3. Curtis F. Gerald and Patrick O.Wheatley, "Applied Numerical Analysis", Pearson Education Ltd
4. Gerald, C.F, and Wheatley, P.O, "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2002.
5. Higher Engineering Mathematics by Dr. B.S. Grewal, 36th Edition, Khanna Publishers.
6. S.C. Chapra and R.P. Canale, "Numerical Methods for Engineers with Programming and Software Applications", McGraw-Hill, Newyork – 1998
7. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., "Numerical Methods", S.Chand Co. Ltd., New Delhi, 2003.
8. Burden, R.L and Faires, T.D., "Numerical Analysis", Seventh Edition, Thomson Asia Pvt. Ltd., Singapore, 2002.

Course Outcomes:

After successful completion of the course the students will be able to-

- Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
- Apply numerical methods to obtain approximate solutions to mathematical problems.
- Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
- Analyse and evaluate the accuracy of common numerical methods.

Fourth Semester:

DS5B-602: Deep Learning Credits: 3 (2-1-0)

OBJECTIVE:

This course aims to present the mathematical, statistical and computational challenges of building stable representations for high-dimensional data, such as images, text and data. We will delve into selected topics of Deep Learning, discussing recent models from both supervised and unsupervised learning. Special emphasis will be on convolutional architectures, invariance learning, unsupervised learning and non-convex optimization.

COURSE DESCRIPTION:

Unit-I:

Introduction: Feed forward Neural networks. Gradient descent and the backpropagation algorithm. Unit saturation, aka the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad local minima. Heuristics for faster training. Nestors accelerated gradient descent. Regularization. Dropout. Convolutional Neural Networks: Architectures, convolution / pooling layers. Recurrent Neural Networks: LSTM, GRU, Encoder Decoder architectures.

Unit-II:

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

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

Unit-III:

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

Unit-IV:

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

TEXTBOOKS

Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." MIT Press, (2015).

Bengio, Yoshua. "Learning deep architectures for AI." Foundations and trends in Machine Learning 2.1 (2009): 1127.

Hochreiter, Sepp, and Jargen Schmidhuber. "Long short-term memory." Neural computation 9.8 (1997): 17351780.

Course Outcomes:

After completing the study of the course the students are expected to:

- understand complexity of Deep Learning algorithms and their limitations;
- understand modern notions in data analysis oriented computing;
- be capable of confidently applying common Deep Learning algorithms in practice and implementing their own;
- be capable of performing distributed computations;
- be capable of performing experiments in Deep Learning using real-world data.

DS5B-604: Internet of Things Credits: 3 (2-0-2)

COURSE OBJECTIVE:

1. Vision and Introduction to IoT.
2. Understand IoT Market perspective.
3. Data and Knowledge Management and use of Devices in IoT Technology.
4. Understand State of the Art – IoT Architecture.
5. Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

COURSE DESCRIPTION:

Unit-I:

M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics.
M2M to IoT – A Market Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.

Unit-II:

M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.
M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management.

Unit-III:

IoT Architecture-State of the Art – Introduction, State of the art, **Architecture Reference Model-** Introduction, Reference Model and architecture, IoT reference Model. **IoT Reference Architecture-** Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. **Real-World Design Constraints-** Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

Unit-IV:

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

<u>Text books:</u>

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
2. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
3. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013.

Course Outcomes:

At the end of the course the student will be able to:

1. Understand the vision of IoT from a global context.
2. Determine the Market perspective of IoT.
3. Use of Devices, Gateways and Data Management in IoT.
4. Building state of the art architecture in IoT.
5. Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.

DS5B-606: Web Mining Credits: 3 (2-0-2)

Objective: The main objective of this course s to student will learn how to apply web mining to derive data driven results.

COURSE DESCRIPTION:

UNIT I: Introduction to Web Mining: Web content, web usage mining and web structure mining. Web crawling: Crawling Basics; Indexing, Text analysis and classification.

UNIT II: Similarity and Clustering/community algorithms: Partitioning Approaches, Geometric Embedding Approaches, and Probabilistic Approaches; Topical locality,

UNIT III: Supervised Text Learining: Evaluating Text Classifiers, Nearest Neighbor Learners, Greedy Inclusion Algorithms, Truncation Algorithms, Exploiting Hierarchy among Topics, Discriminative Classification, Regression, Support Vector Machines, Hypertext Classification. SEMISUPERVISED LEARNING: Expectation Maximization, Labeling Hypertext Graphs.

UNIT IV: Link analysis: PageRank and HITS ranking methods, Ranking algorithms; Web search and retrieval, Web growth models, Web traffic models;Social tagging, Social networks and social media, Information diffusion.Applications of Web mining in Recommendtion system.

Text Books:

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008.
2. Michael Berry and Gordon Linoff, “Data Mining Techniques for Marketing, Sales, and Customer Relationship Management”, Third Edition, John Wiley, 2011.
3. Soumen Chakrabarti,"Mining the Web: Discovering Knowledge from Hypertext Data",Morgan Kaufmann, 2003.
4. Bing Liu “Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data”,2011 edition, Springer.
5. Anthony Scime,"Web Mining: Applications and Techniques", Idea Group Inc (IGI), 2005.

Course Outcomes:

At the end of the course the student will be able to:

- understand basics of web mining.
- scrap the web content.
- analyzing web content.
- create NLP models to analyzing the web content.
- understand link analysis and page rank.

DS5B-622: Natural Language Processing Credits: 3 (2-0-2)

Objective: The main object of this course is to provide an introduction to the field of computational linguistics, and natural language processing (NLP).

COURSE DESCRIPTION:

UNIT I: Introduction to NLP, NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field.

UNIT II: The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Lexical syntax. Hidden Markov Models. Maximum Entropy Models. Conditional Random Fields.

UNIT III: Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing.

UNIT IV: Named entity recognition and relation extraction. IE using sequence labeling. Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars. Web 2.0 Applications : Sentiment Analysis; Text Entailment.

Text Books:

1. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
2. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
3. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
4. Steven Bird, Ewan Klein, and Edward Loper, "Natural Language Processing with Python - Analyzing Text with the Natural Language Toolkit", O'Reilly Media, 2009.
5. Ian H. Witten and Eibe Frank. "Data Mining: Practical Machine Learning Tools and Techniques" , 3rd edition, Morgan Kaufmann, 2005.
6. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

Course Outcomes:

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

1. Broad understanding of the field of Natural Language Processing.
2. Understand mathematical concepts for NLP algorithms.

3. Understanding the capabilities and limitations of NLP technologies.
4. Apply the fundamental knowledge of various types of basic NLP techniques to analyze, design, formulate and implement solutions for any real time situation.
5. Understand the theoretical concepts of NLP in formal language theory.

DS5B -624 Social Network Analysis Credits 3 (2-1-0)

Objective: The course is designed to develop the skills that will involve strategic cross-functional decision-making.

UNIT I: Introductions: Each student will describe their interests and possible uses of SNA in their research. Overview of SNA: history and resources. Mathematical foundations: matrices and graph theory. Whole versus personal networks, one-mode versus two-mode network data.

UNIT II: Basic network metrics and definitions, Centrality and centralization, Key players, Two-mode networks. Sociocentric and egocentric research designs, Collecting network data. Collecting network data: Informant accuracy, Network visualizations.

UNIT III: Cohesive subgroups, bottom-up and top-down approaches, Core/periphery structures, Cohesive subgroups, bottom-up and top-down approaches, Core/periphery structures. Social capital, notions and measures. Structural holes, Burt's measures. Position generators. Egocentric SNA, design and applications.

UNIT IV: Network Scale-Up Method, Qualitative approaches and mixed methods in SNA;Is SNA theory or methodology? Network theories and theories of networks, SNA and social theory, Using network metrics in regression models, QAP and hypothesis testing, missing data ExponentialRandomGraphModels(ERGMs), Siena.

Introduction to Software Packages for network analysis: UCINET, Pajek, PNet, the statnet and other related packages in R, and Network Workbench.

Text Books:

1. Wasserman, Stanley and Katherine Faust. 1994. Social Network Analysis: Methods and Applications. New York: Cambridge University Press.
2. Carrington, Peter J., John Scott and Stanley Wasserman (eds). 2005. Models and Methods in Social Network Analysis. New York: Cambridge University Press.
3. Carrington and Scott (eds). 2011. The SAGE Handbook on Social Network Analysis. SAGE.
4. De Nooy, Mrvar and Batagelj. 2011. Exploratory Social Network Analysis with Pajek. Cambridge University Press.
5. Kadushin. 2011. Understanding Social Networks: Theories, Concepts, and Findings. Oxford University Press.
6. Knoke and Yang. 2008. Social Network Analysis: SAGE.

Course Outcomes:

After completion of this role student will be able to make strategies after:

- Identifying those (individuals and groups) playing central roles (thought leaders, key knowledge brokers, information managers, etc).

- Identifying bottlenecks and those isolated.
- Spotting opportunities to improve knowledge flow.
- Targeting those where better knowledge sharing will have the most impact.
- Raising awareness of the significance of informal networks.

SCHOOL OF DATA SCIENCE AND FORECASTING

PROGRAM CODE: DS7B BATCH: 2018-20

PROGRAM TITLE: MASTER OF TECHNOLOGY (M.Tech.)
- BIG DATA ANALYTICS

PROGRAM OUTCOMES:

- Developing the analytical skills for dealing with Big data.
- Opportunities of higher studies in the area of Big Data Science.
- Knowledge on various theoretical and practical aspects of data science.
- Demonstrate use of team work, leadership skills, and decision making.

PROGRAM SPECIFIC OUTCOMES:

- Work with Big data using cutting edge tools and technologies to analyze Big Data.
- Understanding of the key Big Data Technologies Hadoop, Spark, data mining, data visualization, machine learning.
- Use Data Visualization techniques, machine learning and Deep learning.
- Write the programming codes in R and Python.

PROGRAM STRUCTURE (2018-20):

First Semester:

Code	Title	Credits (L-T-P)
CORE COURSES		
DS7B-701	Statistical Computing	3 (2-1-0)
DS7B-703	Linear Algebra and Advanced Calculus	3 (2-1-0)
DS7B-705	Data Mining and Data Warehousing	3 (2-0-2)
DS7B-707	Next Generation Databases	3 (2-0-2)
DS7B-709	Python for Analytics	3 (2-0-2)
DS7B-711	Advanced Excel	3 (0-0-6)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
DS7B-721	Statistical Programming in R	3 (2-0-2)
DS7B-723	Multivariate Analysis	3 (2-0-2)
ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus.		
DS7B-751	Communication Skills	3 (2-1-0)

Second Semester:

Code	Title	Credits (L T P)
CORE COURSES		
DS7B-702	Forecasting Methods	3 (2-1-0)

DS7B-704	Big Data Technologies	3 (2-0-2)
DS7B-706	Machine Learning	3 (2-0-2)
DS7B-708	Java	3 (2-0-2)
DS7B-710	Data Visualization	3 (2-0-2)
DS7B-712	Web Mining	3 (2-0-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One)		
DS7B-722	Functional Programming	3 (2-0-2)
DS7B-724	Natural Language Processing	3 (2-0-2)
ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus.		
DS7B-752	Technical Communication	3 (2-1-0)

Third Semester:

Code	Title	Credits (L T P)
CORE COURSES		
DS7B-801	Operations Research	4 (3-1-0)
DS7B-803	Algorithms for Data Analytics	3 (2-0-2)
DS7B-805	Cloud Computing	3 (2-1-0)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two)		
DS7B-821	Pattern Recognition	3 (2-0-2)
DS7B-823	Predictive Analytics	3 (2-0-2)
DS7B-825	Internet of Things	3 (2-0-2)
DS7B-827	Virtual Realty	3 (2-0-2)
ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus.		
DS7B-851	Minor Project	4 (0-0-8)

Fourth Semester:

Code	Title	Credits
DS7B-802	M.Tech. Dissertation	12

Note: The above course contents can be modified as per requirement from time to time in accordance with University Ordinance No. 14.

DETAILED SYLLABUS:

First Semester:

DS7B-701: Statistical Computing Credits: 3 (2-1-0)

Objective: The main objective is to train the students in computational methods for statistical analysis.

Course Description:

Unit-I:

Review of simulation techniques for various probability models, and resampling.

Unit-II:

Computational problems and techniques for

i. robust linear regression
ii. nonlinear and generalized linear regression problem
iii. tree-structured regression and classification
iv. cluster analysis
v. smoothing and function estimation
vi. robust multivariate analysis

Unit-III:

Analysis of incomplete data: EM algorithm, single and multiple imputations. Markov Chain, Monte Carlo and annealing techniques.

Unit-IV:

Neural Networks, Association Rules and learning algorithms.

Text Books:

S. M. Ross, Simulation, Second edition.
R. A. Thisted, Elements of Statistical Computing.
W. N. Venables and B. D. Ripley, Modern Applied Statistics with S-Plus, Third Edition.
Peter J. Rousseeuw and Annick M. Leroy, Robust Regression and Outlier Detection.
P. McCullagh and J. A. Nelder, Generalized Linear Models.
L. Breiman, Classification and Regression Trees.
Brian Everitt, Cluster Analysis.
R. J. A. Little, D. B. Rubin, Statistical Analysis with Missing Data.
T. Hastie, R. Tibshirani and J. Friedman, The Elements of Statistical Learning: Data Mining, Inference and Prediction.

Course Outcomes:

Students will be able to:

- Implement statistical analysis techniques for solving practical problems.
- Perform statistical analysis on variety of data.
- Perform appropriate statistical tests and visualize the outcome.

DS7B-703: Linear Algebra and Advanced Calculus Credits: 3 (2-1-0)

Objective: The main objective is to students will learn to solve many types of data science problems using Linear Algebra and Calculus.

Course Description:

Unit I: Vector spaces over fields, subspaces, bases and dimension. Systems of linear equations, matrices, rank, Gaussian elimination. Linear transformations, representation of linear transformations by matrices, rank-nullity theorem, duality and transpose.

Unit II: Determinants, cofactors, adjoint, Cramer's Rule. Eigen values and Eigen vectors, characteristic polynomials, minimal polynomials, Cayley-Hamilton Theorem, triangulation, diagonalization, rational canonical form, Jordan canonical form.

Unit III: Inner product spaces, Gram-Schmidt orthonormalization, orthogonal projections, linear functionals and adjoints, Hermitian, self-adjoint, unitary and normal operators, Spectral Theorem for normal operators, Rayleigh quotient, Min-Max Principle.

Unit IV: Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers. Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

Text Books:

1. K. Hoffman and R. Kunze, Linear Algebra, Pearson Education (India), 2003. Prentice-Hall of India, 1991.
2. S. Lang, Linear Algebra, Undergraduate Texts in Mathematics, Springer-Verlag, New York, 1989.
3. P. Lax, Linear Algebra, John Wiley & Sons, New York,. Indian Ed. 1997
4. H.E. Rose, Linear Algebra, Birkhauser, 2002.
5. Hildebrand, Francis. Advanced Calculus for Applications. 2nd ed. Englewood Cliffs: Prentice Hall, March 31, 1976.
6. Kaplan W., "Advanced Calculus", Addison Wesley (Pearson Education, Inc.), 5 th Edition, 2003
7. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, (2011).

Course Outcomes:

After successful completion of this course students will be able to:

1) demonstrate competence with the basic ideas of linear algebra including concepts of vector spaces, linear systems, independence, theory of matrices, linear transformations, bases and dimension, eigenvalues, eigenvectors and diagonalization;
2) describe and apply the key concepts advance calculus;
3) communicate and understand mathematical statements, ideas and results, both verbally and in writing.

DS7B-705: Data Mining and Data Warehousing Credits: 3 (2-0-2)

Course Objective The main objective of this course is to provide understanding of data warehouse fundamentals and data mining techniques for business applications.

COURSE DESCRIPTION:

UNIT I: Data Warehousing: Introduction data warehousing, Data Mart, Data Warehouse Architecture; Star, Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning. ETL Concepts. OLAP technology: Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, indexing data.

UNIT II: Data Mining: Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining; Introduction to Web Mining, Text Mining. Data Processing: Data Cleaning, Data Integration and Transformation; Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Data Discretization and Concept hierarchy generation for numerical and categorical data.

UNIT III: Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, FP-Growth Algorithm, latest trends in association rules mining.

UNIT IV: Classification methods: Decision tree, Bayesian Classification, Rule based; clustering methods: Partitioning methods (K-Means, K-Mediods) and Hierarchical Clustering (Agglomerative and Divisive Clustering, Multi-phase method) Prediction: Linear and non-linear regression.

Text Books:

1. P.Ponnian, “Data Warehousing Fundamentals”, John Wiley.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.
3. P. N. Tan, M. Steinbach, Vipin Kumar, “Introduction to Data Mining”, Pearson Education.
4. G. Shmueli, N.R. Patel, P.C. Bruce, “Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner”, Wiley India.
5. Michael Berry and Gordon Linoff “Data Mining Techniques”, Wiley Publications.
6. M.H.Dunham, “Data Mining Introductory & Advanced Topics”, Pearson Education.

Course Outcomes:

- The student will learn basics of Data Warehouse.
- The student will learn basics of Data Mining.
- The student will be able to Pre process the data.
- The student will be able to perform Market Basket analysis.
- The student will be able to work with Classification Algorithms.
- The student will be able to cluster the data.

DS7B-707: Next Generation Databases Credits: 3 (2-0-2)

Objective:

To explore the concepts of NoSQL Databases.
To understand and use columnar and distributed database patterns.
To learn to use various Data models for a variety of databases.

Course Description:

Unit-I:

Database Revolutions- System Architecture- Relational Database- Database Design-Data Storage- Transaction Management- Data warehouse and Data Mining- Information Retrieval. Big Data Revolution- CAP Theorem- Birth of NoSQL- Document Database—XML Databases- JSON Document Databases- Graph Databases.

Unit-II:

Column Databases— Data Warehousing Schemes- Columnar Alternative- Sybase IQ- C-Store and Vertica- Column Database Architectures- SSD and In-Memory Databases— In-Memory Databases- Berkeley Analytics Data Stack and Spark.

Unit-III:

Distributed Database Patterns-Distributed Relational Databases-Non-relational. Distributed Databases- MongoDB - Sharing and Replication- HBase- Cassandra-Consistency Models—Types of Consistency- Consistency MongoDB- HBase Consistency- Cassandra Consistency.

Unit-IV:

Data Models and Storage- SQL- NoSQL APIs- Return SQL- Advance Databases— PostgreSQL-Riak- CouchDB- NEO4J- Redis- Future Databases— Revolution Revisited-Counter revolutionaries- Oracle HQ- Other Convergent Databases- Disruptive Database Technologies.

TEXT BOOKS:

Abraham Silberschatz, Henry F. Korth, S. Sudarshan, “Database System Concepts”, Sixth Edition, McGrawHill.
Guy Harrison, “Next Generation Databases”, Apress, 2015.
Eric Redmond, Jim R Wilson, “Seven Databases in Seven Weeks”, LLC. 2012.
Dan Sullivan, “NoSQL for Mere Mortals”, Addison-Wesley, 2015.
Adam Fowler, “NoSQL for Dummies “, John Wiley & Sons, 2015.

Course Outcomes:

Students will be able to:

- Explore the relationship between Big Data and NoSQL databases
- Work with NoSQL databases to analyze the big data for usefulbusiness applications.

- Work with different data models to suit various data representation and storage needs.

DS7B-709: Python for Analytics Credits: 3 (2-0-2)

Objective: The main objective is to help students to understand the fundamentals of python. Student will learn how to analysis data using Python.

COURSE DESCRIPTION:

UNIT I: Introduction to Python: Python versus Java, Python Interpreter and it's Environment, Python installation, Python basics: variables, operators, Strings, Conditional and Control Statements, loops; Data structures: lists and dictionaries; functions: global functions, local functions, lambda functions and methods.

UNIT II: Object Oriented Programming Concepts: Class, object, constructor, destructor and inheritance; Modules & Packages, File Input and Output, Catching exceptions to deal with bad data, Multithreading, Database Connectivity.

UNIT III: Numpy: Creating Arrays, Arrays Operations, Multidimensional ArraysArrays transformation, Array Concatenation, Array Math Operations, Multidimensional Array and its Operations, Vector and Matrix. **Visualization:** Visualization with matplotlib, Figures and subplots, Labeling and arranging figures, Outputting graphics.

UNIT IV: Pandas: Manipulating data from CSV, Excel, HDF5, and SQL databases, Data analysis and modelling with Pandas, Time-series analysis with Pandas, Using Pandas, the Python data analysis library, Series and Data Frames, Grouping, aggregating and applying, Merging and joining.

Text Books:

1. McKinney Wes, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.
2. Hauck Trent, "Instant Data Intensive Apps with Pandas How-To", Packt Publishing Ltd, 2013.
3. Beazley David M.,"Advanced Python Programming", Pearson Education,2009.
4. Chun Wesley , Core Python Programming, 3rd Edition,Prentice Hall Professional, 2012.
5. Telles Matt "Python Power!: The Comprehensive Guide", Cengage Learning, 2008.
6. McKinney Wes & PyData Development Team, "pandas: powerful Python data analysis toolkit", Release 0.13.1, Feb 2014.
7. https://docs.python.org/3.4/tutorial/
8. http://www.tutorialspoint.com/python/python_quick_guide.htm

Course Outcomes:

- The student will learn core data types of python.

- The student will learn conditional and looping operations in python.
- The student will be able to work with Object-oriented concepts and Database connectivity in python.
- The student will be able to analyze data using Pandas and Numpy.
- The student will be able to visualize the data using seaborn and matplotlib.

DS7B-511: Advanced Excel Credits: 2 (0-0-4)

Objective: The main objective of this course is to learn analysis of data using MS Excel, resulting in less time and better understands what the data means.

COURSE DESCRIPTION:

Unit I: Introduction to Excel User Interface**,** Application, Workbook, Worksheets & its Components, Named Ranges; Formatting: Cell Color, Font Color, Indents, Alignments, Number Formats, Custom Formats, Editing commands; Data Sorting: Built-in Sort, Sorting Levels, Custom Sort; Data Filtering: Auto Filter – Filter By Color, Filter by Icono Advanced Filter, Remove Duplicates; Data Subtotal – Built-In Subtotal (Nested Subtotal).

Unit II: Data Validation: Based on cell values (text length, whole no Based on Formulas, List Dropdown, Circle Invalid Data, Input & Error Messages; Data Grouping: Grouping Rows, Grouping Columns. Data Tables: Conditional Formatting, Formatting based on Cell values, Formatting based on Formulas, Icon Sets (bars, scales, icons), Freezing Panes, Text-to-Columns, Delimited, Fixed Length; Data Consolidation (from multiple files), Getting External Data into Excel, From MS Access, From Text files, From Web, Other Data Sources.

Unit III: Formulas, TEXT Functions, IF, ERROR Functions, LOGICAL Functions, VLOOKUP, HLOOKUP, COUNTIF, SUMIF, SUMPRODUCT, DATE & TIME FUNCTIONS, FORMULA TEXT, Information Functions (ISNA, ISEVEN, ISERR…).

Unit IV: Charts: Chart Types, Chart Components, Primary Vs Secondary Axis, Chart Formatting, Sparkline (2010 and above); Pivot Tables: Introduction & Creation, Slicer, TimeLine, Pivot Charts, Calculated Fields, Calculated Items, Grouping, Formatting – Number/Conditional, PowerPivot, PowerView.

Assignment: Dashboard design

Text Books:

1. John Walkenbac, “Excel 2016 Bible”, John Willey & sons.
2. Jordan Goldmeier , “Advanced Excel Essentials”, Apress Publisher.
3. Conrad George Carlberg , “Business Analysis with Microsoft Excel”, Que Publishers.
4. Bernd Held, ”Microsoft Excel Functions & Formulas”, Wordware publishing, Inc.
5. Steven Roman ,”Writing Excel Macros with VBA” O’Reilly Media.

Course Outcomes:
- The student will be able to perform basic operations in Excel.
- The student will be able to summarize data using Grouping and pivot table.
- The student will be able to write conditional statements and perform LOOKUP operations.
- The student will be able to create charts in Excel.
- The student will be able to create a dashboard in Excel.

DS7B-721: Statistical Programming in R Credits: 3 (2-0-2)

Objective: This course is an introduction to R, a powerful and flexible statistical language and environment that also provides more flexible graphics capabilities than other popular statistical packages. After taking this course, students will be able to –

1. Use R for statistical programming, computation, graphics, and modeling,
2. Write functions and use R in an efficient way,
3. Fit some basic types of statistical models,
4. Use R in their own research,
5. Be able to expand their knowledge of R on their own

COURSE DESCRIPTION:

Unit I: Introduction to R programming language: Getting R, Managing R, Arithmetic and Matrix Operations, Introduction to Functions, Control Structures. Working with Objects and Data: Introduction to Objects, Manipulating Objects, Constructing Data Objects, types of Data items, Structure of Data items, Reading and Getting Data, Manipulating Data, Storing Data.

Unit II: Data Distribution and Statistical Testing: Types of Data distribution, Normal distribution, Poisson distribution, Random number generation, Chi-Square Testing, Student's t-test, F-test, Monte Carlo Simulation.

Unit III: Graphical Analysis using R: Basic Plotting, Manipulating the plotting window, Box-Whisker Plots, Scatter Plots, Pair Plots, Pie Charts, Bar Charts.

Unit IV: Advanced R: Statistical models in R, Correlation and regression analysis, Analysis of Variance (ANOVA), creating data for complex analysis, Summarizing data, and case studies.

Text Books:

1. Mark Gardener: Beginning R: The Statistical Programming Language, Willey publications
2. Norman Matloff: The Art of R Programming: A Tour of Statistical Software Design, OREILLY & Associates Inc.

Course Outcomes:

- Data manipulation - acquiring skills in flexible matrix manipulation
- Access online resources for R and import new function packages into the R workspace
- Scripting in such a way that the script can be used with minimal effort for similar datasets and analyses and for especially large datasets
- Explore data-sets to create testable hypotheses and identify appropriate statistical tests
- Perform appropriate statistical tests using R
- Learn how to create high-quality figures, especially associated with more complex analyses (e.g. three dimensional scatter plots, animated chart Trellis displays, etc.).

DS7B-723: Multivariate Analysis Credits: 3 (2-0-2)

Objective:

1. To understand the main features of multivariate data.
2. To be able to use exploratory and confirmatory multivariate statistical methods properly.
3. To be able to carry out multivariate statistical techniques and methods efficiently and effectively.

COURSE DESCRIPTION:

UNIT I: Analysis of categorical data. Loglinear models for two- and higher-dimensional contingency tables, Characterizing and Displaying Multivariate Data, Tests on one or two mean vectors.

UNIT II: Multivariate Analysis of Variance, Aspects of multivariate analysis, random vectors, sample geometry and random sampling, multivariate normal distribution, inferences about the mean vector, MANOVA.

UNIT III: Classification and grouping techniques: discrimination and classification, clustering. Logistic regression models.

UNIT IV: Analysis of covariance structures, Principal Component Analysis (PCA), Factor Analysis, Cluster Analysis. Use of statistical computer packages.

Text Books:

1. Applied Multivariate Statistical Analysis, by Richard A. Johnson and Dean W.Wichern (6^{th} edition), Prentice Hall.
2. Characterizing and Displaying Multivariate Data, by A.C.Rencher, John Wiley and Sons.
3. Multivariate Data Analysis, by Joseph F.Hair, William, Babin and Anderson.
4. Cluster Analysis, by Brian S.Everitt, Sabine Landau, Morven Leese. Wiley

Course Outcomes:

- To be able to understand the concept of analysing multivariate data.

- To be familiar with a basic minimum level of matrix competency and with general aspects of handling multivariate data.
- Perform exploratory analysis of multivariate data, such as plot multivariate data, calculating descriptive statistics, testing for multivariate normality;
- Conduct statistical inference about multivariate means including hypothesis testing, confidence ellipsoid calculation and different types of confidence intervals estimation;
- Undertake statistical analyses using appropriate multivariate techniques, which includes principal component, factor analysis, discriminate and clustering analysis
- Analyse multivariate data using the statistical software package.

DS7B-751: Communication Skills Credits: 3 (2-1-0)

OBJECTIVE

To make use of the opportunities and meet the challenges of the modern world, students need to develop effective communication skills. This is a skill that is most often quoted as lacking in engineers and IT professionals. Proper communication skills are also extremely important in interpersonal relationships. This course will help students in becoming confident and effective communicators, who can project themselves positively to others.

COURSE DESCRIPTION:

Unit I: Introduction to Communication: Need for Effective Communication. The Process of Communication: Levels of communication; Flow of communication; Use of language in communication; Communication networks; Significance of technical communication. Barriers to Communication: Types of barriers; miscommunication; noise; overcoming measures.

Unit II: Listening Skills: Listening as an active skill; Types of Listeners; Listening for general content; Listening to fill up information; Intensive Listening; Listening for specific information; Developing effective listening skills; Barriers to effective listening skills.

Reading Skills: Previewing techniques; Skimming; Scanning; Understanding the gist of an argument;
Identifying the topic sentence; Inferring lexical and contextual meaning; recognizing coherence and sequencing of sentences; Improving comprehension skills.

Writing Skills: Sentence formation; Use of appropriate diction; Paragraph and Essay Writing; Coherence and Cohesion.

Unit III: Letter Writing: Formal, informal and demi-official letters; business letters. Job Application: Cover letter, Differences between bio-data, CV and Resume. Report Writing: Basics of Report Writing; Structure of a report; Types of reports. Non-verbal Communication and Body Language: Forms of non-verbal communication; Interpreting body-language cues; Kinesics; Proxemics; Chronemics; Effective use of body language.

Unit IV: Interview Skills: Types of Interviews; Ensuring success in job interviews; Appropriate use of non-verbal communication. Group Discussion: Differences between group discussion and debate; Ensuring success in group discussions. Presentation Skills: Oral presentation and public speaking skills; business presentations. Technology-based Communication: Netiquettes: effective e-mail messages; power-point presentation; enhancing editing skills using computer software.

Text Books:

Spoken English & Effective Communication (With 2 CDs): Mind Power Spoken English Institute by by Prof. Sharad Srivastava and Dr Amita Singhvi; Franklin International; New edition (2015)
Communication Skills by Sanjay Kumar and Pushp Lata; Oxford University Press India; (2015)
El Dorado: A Textbook of Communication Skills by R. Pushkala and P.A.Sarada; Orient Blackswan; (2013)

Course Outcomes:

At the end of the course the students will be able-

1. To make communication with the parties concerned.
2. To write memorandum, circulars, notices, business letters, and business reports.
3. To write resume and job application.
4. To participate in group discussion and interviews.

Second Semester:

DS7B-702: Forecasting Methods Credits: 4 (2-1-2)

COURSE OBJECTIVE

This subject is designed in such a way to provide the basic concepts of forecasting models based on quantitative analysis. Risk and uncertainty in forecasting and it is generally considered good practice to indicate the degree of uncertainty attaching to forecasts.

COURSE DESCRIPTION:

Unit I: Introduction: Fo**re**casting perspective, an overview of forecasting methods, basic steps in forecasting. Basic forecasting tools: time series and cross-sectional data, graphical and numerical summaries, forecasting accuracy, prediction intervals, transformations and adjustments.

Unit II: Time series: Decomposition, principles of decomposition, moving averages, classical decomposition, census bureau methods, forecasting and decomposition.

Unit III: Exponential smoothing: averaging methods, Singleexponential smoothing methods, ARRSES, Double exponential soothing methodcomparison of methods, general aspects of smoothing methods.

Unit IV: Regression: Simple regression, forecasting with simple regression, non-linear relationships. Multiple regressions. Box-Jenkins methods: examining correlations in time series data, examining stationary, ARIMA models, forecasting with ARIMA models.

Text Book(s):

1. Spyros Makridakis :Forecasting Method's and application Wiley
2. N.P. Nagpal :Forecasting Techniques ,RBSA
3. Stephen A. Delurgio: Forecasting Principals and Application,McGraw Hill

Course Outcomes:

- Discuss the key factors which affect the success of forecasting procedures.
- Use Basic Statistical Techniques and statistical Graphics to forecast values.
- Find different sets of Smoothed or Average values to be used when forecasting.
- Understand the key concepts needed to use the Linear Regression model when forecasting.
- Model and Forecast the Seasonal component of a set of values.
- Model the different types of cyclical behaviour observed in different sets of values.
- Understand and use the Box-Jenkins or ARMA Procedure.

DS7B-704: Big Data Technologies Credits: 3 (2-0-2)

Course Objective: The main objective of this course is to introduce big data technologies such as Hadoop, spark and analyzing big datasets in spark using python.

COURSE DESCRIPTION:

UNIT I: Introduction
Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting – Modern Data Analytic Tools. Big Data Analytics Process, Big Data Analytics for Business. Identifying problem and solving problem in Big Data environment. Analyzing Unstructured vs. Structured Data, Databases.

UNIT II: Hadoop and MapReduce
Introduction to Hadoop, Hadoop architecture, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases; Hadoop Distributed File system: Design of HDFS, HDFS Concepts. Introduction to MapReduce: MapReduce Basic Concepts, Understanding the Map Reduce architecture, Writing MapReduce Programs. understanding Map phase, shuffling, sorting, and reducing phase.

UNIT III: Spark
Introduction to Spark, Resilient Distributed Dataset (RDD), RDD Operations: actions and transforamtion funtions. Spark Dataframes, operations on Dataframes: Join, groupby, aggregate, handling missing data.

UNIT IV: SparkSQL and MLLib
SparkSQL and its basic operations. MLLib: Data types, Basic statistics, Classification(Logistic regression, Decision tree classifier)and linear regression model generation, Model Evaluation, Collaborative filtering, and Clustering.

Text Books:

1. Arvind Sathi, "Big Data Analytics: Disruptive Technologies for Changing theGame", 1st Edition, IBM Corporation, 2012.

2. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, 1st Edition, Wiley and SAS Business Series, 2012.
3. Tom White,"Hadoop: The Definitive Guide", 3rd Edition, O'Reilly Media, 2012.
4. Donald Miner, Adam Shook, Eric Sammer, “Hadoop Operation”, O’Reilly 2012.
5. Donald Miner, Adam Shook “MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems”, O’Reilly 2012.
6. Chuck Lam, "Hadoop in Action", Manning Publications, 2010.
7. https://spark.apache.org/docs/2.0.0/programming-guide.html

Course Outcomes:

- The student will be able to understand core concepts of Hadoop.
- The student will know the HDFS and MapReduce.
- The student will be able to work with Big Data tool such as Spark.
- The student will be able to analyze big data sets.
- The student will be able to create machine learning models for Big data.

DS7B-706: Machine Learning Credits: 3 (2-0-2)

Objective: The main objective is to help students to understand the fundamental concepts of machine learning.

COURSE DESCRIPTION:

UNIT I: Introduction to Machine Learning, History and Overview of machine learning, Applications, Types of Machine Learning, Basic Concepts. Concept Learning and candidate elimination learning Algorithm.

UNIT II: Artificial Neural Network: biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervise & Unsupervised) and activation function. Supervised Learning: Perceptron learning, Single layer/multilayer, linear Separability, Adaline, Madaline, Back propagation network, RBFN.

UNIT III: Bayesian Learning, Bayes Theorem, Naïve Bayesian classifier, Bayesian belief, EM Algorithm. Dimensionality Reduction: Factor Analysis, Principal Component Analysis, Linear Discriminant Analysis.

UNIT IV: Markov and Hidden Markov Models, PAC Learning, Support Vector Machine, Evolutionary Learning: Genetic Algorithm, generating offspring, applications and genetic programming.

Text Books:

1. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
2. Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012

4. Ethem Alpaydin, “Introduction to Machine Learning”, Prentice Hall of India, 2005.
5. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2006.
6. Sanjeev Kulkarni, Gilbert Harman, “An Elementary Introduction to Statistical Learning Theory”, 2011.
7. N. Shivnandam, “Principle of soft computing”, Wiley.

Course Outcomes:

- The student will be able to understand the basics of machine learning.
- The student will be able to understand Regression analysis.
- The student will be able to work on classification problems.
- The student will be able to work with unsupervised learning approaches.
- The student will be able to perform machine learning operations in scikit-learn.

DS7B-708: Java Programming Credits: 3 (2-0-2)

Objective: The main objective of course is to student able to work with basics of Java language and advance concepts such as Servlets and JSP.

UNIT-I: Introduction

Introduction to Java, Java Designing Goal, Role of Java Programmer, Features of Java Language, Java Virtual Machine. Java Bytecode. Variables and data types, Conditional and looping constructs. Arrays and Multi–Dimensional Array, Operations on Array; Strings: Operations, Mutable & Immutable String. Decision Control Structure: if, if-else, if else if, switch; Repetition Control Structure: while, do-while, for.

UNIT-II: Object-oriented programming

Java Classes and Objects, Constructors, Polymorphism: Overloading methods, Overriding methods, Polymorphism, Inheritance, Types of Inheritance in Java, final classes and final methods, Abstract classes and methods. Interfaces, Nested classes, Garbage Collection, Packages, Access modifier and Making JAR Files.

UNIT-III:

Multi-Threaded Programming: Thread Life-Cycle, Thread priorities, Synchronizing Threads, Inter Process Communication, Deadlock; Input Output Streams; Exception handling: try, throw, catch, and finally block; Database Connectivity: Introduction to JDBC, JDBC Drivers & Architecture, CURD operation Using JDBC, Connecting to NoSQL Databases.

UNIT-IV: Advance Java Concepts

Introduction to servlet, Servlet life cycle, Developing and Deploying Servlets. Java Server Pages(JSP), Advantages of JSP over Java Servlet Architecture and Life Cycle of a JSP Page, JSP Basic Tags, Implicit Objects and action Tags; JSTL, JavaBeans, MVC Architecture; Introducing Struts and Hibernate.

Text Books:

1. Herbert Schildt, “Java The Complete Reference”, 8th Edition, McGraw-Hill Osborne Media, 2011.
2. Cay S. Horstmann and Gary Cornell, “Core Java™, Volume I – Fundamentals” 8th Edition, Prentice Hall, 2007.
3. Cay S. Horstmann and Gary Cornell, “Core Java, Vol. 2: Advanced Features”, 8th Edition, Prentice Hall, 2008.
4. K. Arnold and J. Gosling, “The JAVA programming language”, Third edition, Pearson Education, 2000.
5. Timothy Budd, “Understanding Object-oriented programming with Java”, Updated Edition, Pearson Education, 2000.

6. C. Thomas Wu, “An introduction to Object-oriented programming with Java”, Fourth Edition, Tata McGraw-Hill Publishing company Ltd., 2006.
7. Black Book “Java server programming” J2EE, 1st ed., Dream Tech Publishers, 2008. Kathy walrath ”
8. Complete Reference J2EE by James Keogh McGraw publication
9. Professional Java Server Programming by Subrahmanyam Allamaraju, Cedric Buest, Wiley

Course Outcomes:

After successfully completing the course the students will be able to-

- work with core java concepts
- update and retrieve the data from the databases using JDBC-ODBC.
- develop server side programs using Servlets.
- develop Java Server Pages applications using JSP Tags.

DS7B-710: Data Visualization Credits: 3 (2-0-2)

Objective: This course will help the student to understand data visualization and how data scientists/ analysts use visualization technique to represent results.

COURSE DESCRIPTION:

UNIT I Introduction to Data Visualization, characteristics, goals, need of data visualization, comparison of data science and data visualization, Types of Data, Operations on datatypes, Data Dimensions, Designing Visuals, Visual attributes, Designing Visuals, Mackinlay Design Criteria, Retinal Variables: Size, texture, shape, orientation, color, color Saturation, color hue; Where to use which variable? Bertin's visual attributes, Seven Stages of Visualizing Data.

UNIT II Types of visualization chart: Scatter, line, pie, bar, histogram, Bubble, stacked area chart, pair plot, Heatmaps. Smart Charts: List, Process, Cycle, Hierarchy, Relationships, matrix, pyramid, pictures. Text Visualization.

UNIT III Dashboard, Characteristics, Types of dashboards, best practices and design issues, visual perception, limits of short-term memory, visual encoding data, Gestalt principles, principles of visual perception. Case studies: sales dashboard, CIO dashboard, Telesales dashboard, marketing analysis dashboard.

UNIT IV: Tableau Data Visualization Tools: Data loading, Connecting with Databases, Data Prep with Text and Excel Files, Drill Down and Hierarchies, Sorting, Grouping, Filters, Filtering for Top and Top N, Parameters Formatting; Tableau's Mapping, Custom Geocoding, Polygon Maps, WMS; Dashboards and Stories, Dashboard Layouts and Formatting

Text Books:

1. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.
2. Stephen Few, "Information dashboard design: The effective visual communication of data",O'Reilly, 2006.
3. Edward R. Tufte, "The visual display of quantitative information", Second Edition, GraphicsPress, 2001.
4. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
5. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment",O'Reilly, 2008.
6. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.

Course Outcomes:

- The student will learn basic principles of data visualization.
- The student will learn various types of charts to visualize data.
- The student will understand Dashboard concepts.
- The student will be able to use data visualization tools Tableau/Qlik view.
- The student will be able to tell stories using the dashboard and visualization.

DS7B-712: Web Mining Credits: 3 (2-0-2)

Objective: The main objective of this course s to student will learn how to apply web mining to derive data driven results.

COURSE DESCRIPTION:

UNIT I: Introduction to Web Mining: Web content, web usage mining and web structure mining. Web crawling: Crawling Basics; Indexing, Text analysis and classification.

UNIT II: Similarity and Clustering/community algorithms: Partitioning Approaches, Geometric Embedding Approaches, and Probabilistic Approaches; Topical locality,

UNIT III: Supervised Text Learining: Evaluating Text Classifiers, Nearest Neighbor Learners, Greedy Inclusion Algorithms, Truncation Algorithms, Exploiting Hierarchy among Topics, Discriminative Classification, Regression, Support Vector Machines, Hypertext Classification. SEMISUPERVISED LEARNING: Expectation Maximization, Labeling Hypertext Graphs.

UNIT IV: Link analysis: PageRank and HITS ranking methods, Ranking algorithms; Web search and retrieval, Web growth models, Web traffic models;Social tagging, Social networks and social media, Information diffusion.Applications of Web mining in Recommendtion system.

Text Books:

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008.
2. Michael Berry and Gordon Linoff, “Data Mining Techniques for Marketing, Sales, and Customer Relationship Management”, Third Edition, John Wiley, 2011.
3. Soumen Chakrabarti,"Mining the Web: Discovering Knowledge from Hypertext Data",Morgan Kaufmann, 2003.
4. Bing Liu “Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data”,2011 edition, Springer.
5. Anthony Scime,"Web Mining: Applications and Techniques", Idea Group Inc (IGI), 2005.

Course Outcomes:

At the end of the course the student will be able to:

- understand basics of web mining.
- scrap the web content.
- analyzing web content.
- create NLP models to analyzing the web content.
- understand link analysis and page rank.

DS7B-722: Functional Programming Credits: 3 (2-0-2)

Objective:

Functional programming is a style of programming in which functions are basic building blocks of programs. It treats computing as mathematics functions and applies the function to parameters. This paradigm is getting popular because of reduced side effects and supports parallel code. This course aims at applying functional programming to problems using Scala.

Course Description:

Unit-I:

Functional & Non- Functional – Benefits of Functional Programming in Scala – Referential Transparency, Purity and Substitution Model – Running a scala functional program – Modules, Objects, Namespaces – Higher order functions – Polymorphic functions – Following types to implementations.

Unit-II:

Defining functional data structures – Pattern matching – Data Sharing – Recursion over lists – Generalizing to higher order functions – Trees – Alternative to exceptions – Option data type – Either data type.

Strict and non-strict functions – Lazy Lists Example – Infinite Steams and corecursion – Making stateful APIS pure – Data Types for parallel computations – Combining parallel computations – Explicit forking – Refining API - Algebra of API – Refining combinators.

Unit-III:

Parser Combinators: Design Algebra – Handle context sensitivity – Error Reporting – Implementing algebra **Monoids**: Folding Lists with monoids - Associativity and Parallelism - Foldable Data Structures – Composing Monoids **Monads:** Functors – Monads – Monadic Combinators – Monad Laws.

Unit-IV:

Generalizing monads – Applicative trait – Monads vs Applicative functors – Traversable functors –
Uses of Traverse - Factoring Effects – Simple IO type – Avoiding Stack Overflow – Non blocking and asynchronous – General purpose IO type.

TEXT BOOKS:

1. Paul Chiusano and Rúnar Bjarnason, "Functional Programming in Scala", Manning Publishers, 2014.
2. Dean Wampler, Alex Payne, "Programming Scala", O'Reilly Media, 2009.
3. Scala by Example www.**scala**-lang.org/docu/files/**ScalaByExample**.pdf
4. Martin Odersky, "Scala Language Specification", 2008, http://www.scala-lang.org/docu/files/ScalaReference.pdf
5. Scala Library Documentation : http://www.scala-lang.org/docu/files/api/index.html

Course Outcomes:

1. Functional programming makes it easier to write parallel code for today's and tomorrow's multiprocessors by replacing mutable variables and loops with powerful ways to define and compose functions.
2. To provide a powerful paradigm in which to tackle complex, real-world programming tasks.
3. Able to understand the elements of the functional programming and learn how to apply them usefully in daily programming tasks.

DS7B-724: Natural Language Processing Credits: 3 (2-0-2)

Objective: The main object of this course is to provide an introduction to the field of computational linguistics, and natural language processing (NLP).

COURSE DESCRIPTION:

UNIT I: Introduction to NLP, NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field.

UNIT II: The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Lexical syntax. Hidden Markov Models. Maximum Entropy Models. Conditional Random Fields.

UNIT III: Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing.

UNIT IV: Named entity recognition and relation extraction. IE using sequence labeling. Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars. Web 2.0 Applications : Sentiment Analysis; Text Entailment.

Text Books:

1. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
2. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
3. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
4. Steven Bird, Ewan Klein, and Edward Loper, ”Natural Language Processing with Python - Analyzing Text with the Natural Language Toolkit”, O'Reilly Media, 2009.
5. Ian H. Witten and Eibe Frank. “Data Mining: Practical Machine Learning Tools and Techniques” , 3rd edition, Morgan Kaufmann, 2005.
6. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

Course Outcomes:

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

1. Broad understanding of the field of Natural Language Processing.
2. Understand mathematical concepts for NLP algorithms.
3. Understanding the capabilities and limitations of NLP technologies.
4. Apply the fundamental knowledge of various types of basic NLP techniques to analyze, design, formulate and implement solutions for any real time situation.
5. Understand the theoretical concepts of NLP in formal language theory.

DS7B-752: Technical Communication Credits: 3 (2-1-0)

Objective:

This course is designed to help the students to develop skills that will enable them to produce clear and effective scientific and technical documents.

Unit I:

Technical writing: Definition, Similarities to other writings, Unique features, importance, technical writing as profession, qualifications for technical writing. Identifying audience. Problems involving content, words and phrases, punctuation, unity, coherence, logic, etc. Being concise.

Unit II:

Techniques of Technical Communication. Analysing-Division, Classification, Partition. Defining-Formal, informal, expanded. Describing-subjective versus objective, spatial description, description of mechanism, process, selected details. Illustrating-Tables, graphs, charts, pictorials. Researching-Basic types of research, original research, searching the literature. Abstracting of your own reports, the works of others, precautions. Oral communication-one to one reporting, participation in conferences, speaking to large audiences, organising the speech.

Unit III:

Basic forms of Technical Writings. The memorandum, The business letter, Formal report.

Unit IV:

Technical reports. Justification reports and proposals, the progress reports, periodic reports, status reports, trip reports. Laboratory reports, Feasibility reports, State-of-the-Art reports. Instructions and manuals.

Text Books:

1. James Sherlock: A Guide to Technical Communication

Course Outcome:

After completion of this course student will be able to-

- Document the knowledge about products, services, technology, or concepts into well-crafted and organised information collateral.
- Write technical reports, memorandum, business letters, manuals, proposals, progress reports etc.
- Develop document involving spatial description, description of mechanism, process, illustrations, etc.

Third Semester:

DS7B-801: Operations Research Credits: 4 (3-1-0)

COURSE OBJECTIVE:

This course exposes the students in mathematical modelling, solving and analysing business and industrial problems using operations research methods.

COURSE DESCRIPTION:

Unit -I:

Introduction, History, Development of Operations Research, Characteristics of Operations Research, Models in Operations Research, Principles of Modelling. Pre-modelling-Need Recognition, Problem Formulation. Modelling-Model development, Data collection, Model solution, Model validation, and sensitivity analysis. Post-modelling-Interpretation of results and implications, Decision making, Implementation, and Control.

Unit-II:
Linear Programming, Formulation of Linear programming Problems. Solution Methods-Graphical, Simplex, M-Technique, Two-Phase. Special cases of LP problems. Duality, Primal-dual relationships, Dual simplex method. Sensitivity analysis. Solving LP problems using computer software.

Unit-III:
Transportation Model-Formulating the model, Initial Feasible Solution-North-West Method, Least Cost Method, Vogel's Approximation Method. Optimum Solution-MODI method, Stepping Stone Method. Special issues of transportation problems. Assignment Model: Formulating the model, Solving the assignment problem using Hungarian method. Special issues of assignment problems.

Integer programming: Types of integer programming problems, Formulating the model, Solution using Branch and bound method. Dynamic Programming.

Solving the problems using computer software.

Unit-IV:
Network models: Minimal spanning tree algorithm, Shortest-route problem, Maximal flow model, Minimum –cost capacitated flow problem. Project Scheduling: CPM and PERT.

Inventory models: Functions of inventory, information requirements for inventory management-demand, lead time, inventory costs, and quantity on hand. Objectives of inventory management. Economic Order Quantity Models-Economic order size, economic production run, quantity discounts. Determining the reorder point. Material Requirement Planning.

Queuing Models: Goals, elements and characteristics of queuing systems, Measures of system performance, Waiting line models-single channel, multiple channel. Cost considerations.

TEXT BOOKS
Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
William J. Stevenson: Introduction to Management Science, IRWIN.

Course Outcomes:

- Understand the verbal description of the real system and accordingly identify and development of operational research models.
- Understand the mathematical tools that are needed to solve optimisation problems.
- Use of mathematical software to solve the OR models developed.

- Develop a technical report that describes the model, solving technique, results analysis and recommendations.

DS7B-803: Algorithms for Data Analytics Credits: 3 (2-0-2)

COURSE OBJECTIVE:

The objective of this course is to provide comprehensive coverage of algorithms specially meant for analyzing big data at an in-depth level. Decision trees, support vector machines and neural networks are considered to be highly effective in analyzing complex data.

COURSE DESCRIPTION:

UNIT-I: CLASSIFICATION ALGORITHMS:

Issues regarding classification and prediction, Bayesian Classification, Classification by back propagation, Classification based on concepts from association rule mining, Other Classification Methods, Classification accuracy.

UNIT-II: DECISION TREES & TEXT ANALYTICS:

Introduction to Decision trees - Classification by decision tree induction – Various types of pruning methods – Comparison of pruning methods – Issues in decision trees – Decision Tree Inducers – Decision Tree extensions.

Introduction, Core text mining operations, Preprocessing techniques, Categorization, Clustering, Information extraction, Probabilistic models for information extraction, Text mining applications.

UNIT-III: SUPPORT VECTOR MACHINES:

Learning and Soft Computing: Rationale, Motivations, Needs, Basics: Examples of Applications in Diverse Fields, Basic Tools of Soft Computing: Neural Networks, Fuzzy Logic Systems, and Support Vector Machines, Basic Mathematics of Soft Computing, Learning and Statistical Approaches to Regression and Classification - Support Vector Machines - Risk Minimization Principles and the Concept of Uniform Convergence, The VC Dimension, Structural Risk Minimization, Support Vector Machine Algorithms.

UNIT-IV: NEURAL NETWORKS:

Single-Layer Networks: The Perceptron, The Adaptive Linear Neuron (Adaline) and the Least Mean Square Algorithm - Multilayer Perceptrons: The Error Back-propagation Algorithm – The Generalized Delta Rule, Heuristics or Practical Aspects of the Error Back-propagation Algorithm.

TEXT BOOKS

1. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 3rd ed, 2010.
2. Lior Rokach and Oded Maimon, "Data Mining and Knowledge Discovery Handbook", Springer, 2nd edition, 2010.
3. Ronen Feldman and James Sanger, "The Text Mining Handbook: Advanced Approaches

in Analyzing Unstructured Data", Cambridge University Press, 2006.
4. Vojislav Kecman, "Learning and Soft Computing", MIT Press, 2010.
5. Jared Dean, "Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners", Wiley India Private Limited, 2014.

Course Outcomes:

After completing the course the students will-

1. Learn concepts and techniques and how to find useful knowledge.
2. Understand of the topics that can create an ideal analytic environment that is better suited to the challenges of today's analytics demands.
3. Harness the power of high performance computing architectures and data mining, text analytics, and machine learning algorithms.

DS7B-805: Cloud Computing Credits: 3 (2-1-0)

Objective: The main objective of this subject is to help student to understand Cloud and It's Services, Architecture, Deployment, Core Issues, Strengths and limitations of cloud computing.

UNIT I Introduction to Cloud Computing: Overview of Cloud Computing, History of Cloud Computing, Importance of Cloud Computing, advantages and disadvantages of Cloud Computing, Applications, Cloud computing vs. Cluster computing vs. Grid computing, Future of Cloud Computing; Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Cloud Service Models(XaaS), Deployment Models (Public cloud, Private cloud, Hybrid cloud).

Unit II: Cloud Service Models and Virtualization: Infrastructure as a Service (IaaS): Introduction, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Virtual Machine(VM), Resource Virtualization(Server, Storage, Network),VMware vSphere, Machine Image ,Porting Applications Case study on Amazon EC2;Platform as a Service(PaaS): Introduction to PaaS, advantages and disadvantages of PaaS, case study on Microsoft Azure; Software as a Service(SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS; Development Services and Tools : Amazon Ec2, Google App Engine, IBM Clouds.

UNIT III: Capacity Planning: Defining Baseline and Metrics, Baseline measurements, System metrics, Load testing, Resource ceilings, Server and instance types, Network Capacity, Scaling. Understanding Service Oriented Architecture, Moving Applications to the Cloud, Working with Cloud-Based Storage, Working with Productivity Software.

UNIT IV: Managing the Cloud: Administrating the Clouds, Cloud Management Products; Cloud Security: Security Overview, Cloud Security Challenges and Risks, Security Governance, Risk Management: Security Monitoring, Security Architecture Design, Data Security, Application Security, Virtual Machine Security, Identity Management and Access Control, Authentication in cloud computing, Client access in cloud, Cloud contracting Model. Using the Mobile Cloud: Working with Mobile Devices and Working with Mobile Web Services;

Case Studies on Various Clouds: Google Web Services, Amazon Web Services, Microsoft Cloud Services, IBM Clouds, Eucalyptus.

Text Books:

1. Kris A Jamsa: Cloud computing : SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More 2013Jones & Bartlett Learning ISBN-13: 9781449647391.
2. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", TMH, 2009.
4. Sosinsky B., "Cloud Computing Bible", Wiley India
5. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011.
6. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.

Course Outcomes:

- The student will be able to understand the basics of Cloud Computing.
- The student will be able to understand Cloud Computing Models.
- The student will be able to work with AWS Cloud Platform.
- The student will be able to manage cloud platform.
- The student will be able to understand various cloud services.

DS7B-821: Pattern Recognition Credits: 3 (2-0-2)

COURSE OBJECTIVE:

The objective of this course is to understand pattern recognition techniques and its applications.

COURSE DESCRIPTION:

Unit -I:

Pattern recognition, Classification and Description—Patterns and feature extraction with Examples—Training and Learning in PR systems—Pattern recognition Approaches.

Unit-II:

Introduction to statistical Pattern Recognition—supervised Learning using Parametric and Non Parametric Approaches.

Linear Discriminant Functions, Discrete and binary Classification problems, Techniques to directly obtain linear classifiers, formulation of Unsupervised Learning Problems, Clustering for unsupervised learning and classification.

Unit-III:

Overview of Syntactic Pattern Recognition—Syntactic recognition via parsing and other grammars– Graphical Approaches to syntactic pattern recognition—Learning via grammatical inference.

Unit-IV:

Introduction to Neural networks—Feedforward Networks and training by Back Propagation— Content Addressable Memory Approaches and Unsupervised Learning in Neural PR.

TEXT BOOKS

1. Robert Schalkoff, "Pattern Recognition: Statistical Structural and Neural Approaches", John wiley & sons , Inc,1992.
2. Earl Gose, Richard johnson baugh, Steve Jost, "Pattern Recognition andImage Analysis", Prentice Hall of India,.Pvt Ltd, New Delhi, 1996.
3. Duda R.O., P.E.Hart & D.G Stork, " Pattern Classification", 2nd Edition, J.Wiley Inc 2001.
4. Duda R.O.& Hart P.E., "Pattern Classification and Scene Analysis", J.wiley Inc, 1973.
5. Bishop C.M., "Neural Networks for Pattern Recognition", Oxford University Press, 1995.

Course Outcomes:

After successfully completing the course the students will-

- learn the fundamentals of Pattern Recognition techniques
- learn the various Statistical Pattern recognition techniques
- learn the various Syntactical Pattern recognition techniques
- learn the Neural Pattern recognition techniques

DS7B-823: Predictive Analytics Credits: 3 (2-0-2)

COURSE OBJECTIVE:

To develop a rigorous understanding of how data is used to support the practice of management and strong data-based reasoning and computational thinking skills.

COURSE DESCRIPTION:

Unit-I

Overview of Predictive Analytics: Supervised and Unsupervised learning, Parametric and non-parametric models, Business Intelligence, Data mining, etc. Problem identification: Predictive analytics processing steps, business understanding, defining data for analytics, defining target variable, measures of success. Data Understanding: Single variable summaries-mean, standard deviation, Normal distribution, Uniform distribution, Data understanding with simple statistics. Data visualisation in one dimension, Multiple variables summaries-Correlation, etc. Data visualisation in multiple dimensions.

Unit-II

Data preparation-Variable cleaning, feature creation. Itemsets and association rules-terminology, parameter settings, measures of interesting rules, deploying association rules, problems, with association rules, building classification and association rules. Descriptive modelling-principal component analysis, Clustering algorithms. Interpreting Descriptive models.

Unit-III

Predictive modelling-Decision tress, Logistic regression, neural networks, K-nearest neighbour, Naïve Bayes, Regression models, Linear regression. Assessing Predictive Models.

Unit-IV

Model ensembles, Text mining, Model deployment. Case studies.

TEXT BOOKS

1. Dean Abbott , Applied Predictive Analytics, WILEY, 2014
2. Eric Siegel , Predictive Analytics, WILEY, 2016
3. Anasse Bari, Mohamed Chaouchi, and Tommy Jung, Predictive Analytics For Dummies, WILEY, 2016
4. Max Kuhn, Kjell Johnson, Applied Predictive Modeling, Springer Science & Business Media, 2013.

Course Outcomes:

Upon successful completion of the course, students will be able to:

- Understand how predictive analytics is used to forecast uncertain quantities and events.
- Understand how to source, cleanse and manage data sets.
- Use selected data analytics tools to manipulate and visualise data and also to develop predictive analytics models.

DS7B-825: Internet of Things Credits: 3 (2-0-2)

COURSE OBJECTIVE:

1. Vision and Introduction to IoT.
2. Understand IoT Market perspective.
3. Data and Knowledge Management and use of Devices in IoT Technology.
4. Understand State of the Art – IoT Architecture.
5. Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

COURSE DESCRIPTION:

Unit-I:

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

M2M to IoT – A Market Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.

Unit-II:

M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.
M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management.

Unit-III:
IoT Architecture-State of the Art – Introduction, State of the art, **Architecture Reference Model-** Introduction, Reference Model and architecture, IoT reference Model. **IoT Reference Architecture-** Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. **Real-World Design Constraints-** Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

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

Text books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
3. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

Course Outcomes:

At the end of the course the student will be able to:

1. Understand the vision of IoT from a global context.
2. Determine the Market perspective of IoT.
3. Use of Devices, Gateways and Data Management in IoT.
4. Building state of the art architecture in IoT.
5. Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.

DS7B-827: Virtual Reality Credits: 3 (2-0-2)

COURSE OBJECTIVE:

- To make students understand the basic concept and framework of Virtual Reality.
- To teach students the technology for multimodal user interaction and perception in Virtual Reality.
- To provide students the hands on experience on VR development tools like Unity.

COURSE DESCRIPTION:

Unit -I:
Introduction to Virtual Reality: Fundamental Concept and Components of Virtual Reality, Primary Features and Present Development on Virtual Reality.

Visual Computation in Virtual Reality: Fundamentals of Computer Graphics; Real time rendering technology; Principles of Stereoscopic Display; Software and Hardware Technology on Stereoscopic Display.

Unit-II:
Virtual Reality Environment: Multiple Modals of Input and Output Interface in Virtual Reality, Environment Modeling in Virtual Reality, Geometric Modeling; Behavior Simulation; Physically Based Simulation.

Unit-III:
3D Concepts: Three dimensional Geometric transformation: Translation - Rotation - Scaling –Reflection– Shearing – Composite Transformation – Parallel and Perspective projections.
Game Engine interface and essentials: Scene view – Game view – Windows – Game objects and components – Prefabs – Tags and Layers – Scripting basics – Creating a game layout case study.

Unit-IV:
Augmented Reality: System Structure of Augmented Reality; Key Technology in AR; General solution for calculating geometric & illumination consistency in the augmented environment.
VR Development Tools: Frameworks of Software Development Tools in VR; Modeling Tools for VR; X3D Standard; Vega, MultiGen, Virtools etc. Hands-on Practice on Unity.

TEXT BOOKS

1. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2006.
2. Sherman, William R. and Alan B. Craig. Understanding Virtual Reality – Interface, Application, and Design, Morgan Kaufmann, 2002.
3. Donald D. Hearn, M. Pauline Baker and Warren Carithers, “Computer Graphics with
4. OpenGL”, Fourth Edition, Pearson Education, 2010.
5. Joe Hocking, “Unity in Action: Multiplatform Game Development in C# with Unity 5”, Manning Publications, 2015.

Course Outcomes:
At the end of the course, students should able to

- Understand the basic concepts of Virtual Reality and its application areas.
- Identify and setup the correct virtual environment as per the problem domain.
- Understand the key features and objects in VR Environment.

- Setup and Program the basic VR Applications.

SCHOOL OF DATA SCIENCE AND FORECASTING

PROGRAM CODE: DS7E BATCH: 2018-20
PROGRAM TITLE: MASTER OF TECHNOLOGY (M.Tech.)
- DATA SCIENCE (FOR WORKING EXECUTIVES)

PROGRAM OUTCOMES:

- Training to the working executives in a flexible mode.
- Knowledge on various theoretical and practical aspects of data science.
- Demonstrate knowledge of mathematical and statistical skills.
- Demonstrate use of team work, leadership skills, and decision making.
- Opportunities of higher studies in the area of Data Science.

PROGRAM SPECIFIC OUTCOMES:

- Work with messy data, applying models, and understanding the business context.
- Work with unstructured data from various sources like video and social media.
- Understanding of the key technologies in data science such as database management, data mining, data visualization techniques, Machine Learning, Hadoop, R, forecasting methods, and statistics.
- Use Data Visualization techniques.
- Write the programming codes in R and Python.
- Employ cutting edge tools and technologies to analyze Big Data.

PROGRAM STRUCTURE (2018-20):

First Semester:

Code	Title	Credits (L-T-P)
CORE COURSES		
DS7E-701	RDBMS and NOSQL	3 (2-0-2)
DS7E-703	Statistical Research Methods	4 (3-1-0)
DS7E-705	Python for Analytics	4 (3-1-0)
DS7E-707	Advanced Excel	2 (0-0-4)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One) through Online		
DS7E-721	Data Mining and Data Warehousing	3 (2-0-2)
DS7E-723	Multivariate Analysis	3 (2-0-2)
ELECTIVE GENERIC:		
DS7E-751	Minor Project-I	4 (0-0-8)

Second Semester:

Code	Title	Credits (L-T-P)
CORE COURSES		
DS7E-702	Operations Research	4 (3-1-0)
DS7E-704	Statistical Programming in R	3 (2-0-2)
DS7E-706	Linear Algebra and Advanced Calculus	3 (2-1-0)
DS7E-708	Machine Learning	3 (2-0-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One) through Online		
DS7E-722	Cloud Computing	3 (2-1-0)
DS7E-724	Web Mining	3 (2-0-2)
ELECTIVE GENERIC:		
DS7E-752	Minor Project-II	4 (0-0-8)

Third Semester:

Code	Title	Credits (L-T-P)
CORE COURSES		
DS7E-801	Forecasting Methods	4 (3-1-0)
DS7E-803	Data Visualization	3 (2-0-2)
DS7E-805	Decision Analysis	3 (2-1-0)
DS7E-807	Data Security	3 (2-0-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One) through Online		
DS7E-821	Deep Learning	3 (2-1-0)
DS7E-823	Technical Communication	3 (2-1-0)
ELECTIVE GENERIC:		
DS7E-851	Minor Project-III	4 (0-0-8)

Fourth Semester:

Code	Title	Credits (L T P)
CORE COURSES		
DS7E-802	Modelling and Simulation	4 (2-1-2)
DS7E-804	Big Data Technologies	3 (2-0-2)
DS7E-806	Scientific Computing	3 (2-1-0)
DS7E-808	Internet of Things (IOT)	3 (2-0-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any One) through Online		
DS7E-822	Natural Language Processing	3 (2-0-2)
DS7E-824	Social Network Analysis	3 (2-0-2)
ELECTIVE GENERIC:		
DS7E-852	Minor Project-IV	4 (0-0-8)

Note: The above course contents can be modified as per requirement from time to time in accordance with University Ordinance No. 14.

DETAILED SYLLABUS:

First Semester:

DS7E-701: RDBMS and NOSQL Credits: 3 (2-0-2)

Objective: The purpose of this course is to provide fundamental knowledge of relational database management system and SQL to students. Student will also learn new mechanism of storage and retrieval of data, NoSQL.

COURSE DESCRIPTION:

UNIT I: Overview of DBMS: Comparison between Database approach and Traditional file accessing approach, Advantages of database systems, Schemas and instances, Data Dependency, Data Dictionary, and Meta Data. Data models, Types of Data models (Object Oriented, Record Based and Physical data models), E-R Modelling.

UNIT II: Relational Data model: Domains, Tuples, Attributes, Keys, Relational database, Schemas, Integrity constraints, Relational algebra and relational calculus; Normalization: Normal forms (INF, 2NF, 3NF, BCNF), Functional dependency, Decomposition, Dependency preservation and lossless join.

UNIT III: Structured Query Language: DDL, DML, DCL, TCL, SQL Functions, integrity constraints, various joins, sub-query, index, View, Sequence, and Clusters.

UNIT IV: NoSQL: Nosql Basics, Storage Architecture, Operations, Query Model, Modifying Data Stores and Managing Evolution, Indexing and Ordering Data Sets, Managing Transactions and Data Integrity. Using NoSQL in the Cloud, Scalable Parallel Processing with Mapreduce, Analyzing Big Data with Hive, Surveying Database Internals

Text Books:

1. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, fifth Edition McGraw-Hill.
2. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
3. Rob, Coronel, “Database Systems”, Seventh Edition, Cengage Learning.
4. Fred R.McFadden,Jeffrey A.Hoffer & Marry B.Prescott.?Modern Database Management, Fifth Edition,Pearson Education Asia,2001.
5. Bayross Ivan, "SQL, PL/SQL: The Programming Language Of Oracle", 4th Revised Edition, BPB Publications, 2010.
6. Tiwari Shashank, "Professional Nosql", Wiley India Pvt Ltd, 2011.

Course Outcomes:

- The student will learn the basics of database management.
- The student will be able to design database using ER diagram.
- The student will be able to optimize database using normalization.
- The student will be able to work on database software MYSQL/Oracle.
- The student will learn how to write SQL query.
- The student will be able to understand NoSQL concepts.

DS7E-703: Statistical Research Methods Credits: 4 (3-1-0)

Objective:

This course will familiarize students with the rudiments of statistical theory and ready them for effective academic and professional practice in the field of research process of industrial, system and social science.

COURSE DESCRIPTION:

Unit I: Introduction to Research Methods and Measures of central tendency

Meaning and Objectives of Research, Significance of Research, Arithmetic Mean, Geometric Mean, Harmonic Mean, Median, Mode. Mean deviation, Standard deviation, Variance, Co-efficient of variation.

Unit II: Probability and Statistical Distribution

Binomial distribution, Poison distribution and Normal distributions, Fitting of Normal Curve. Concept of Probability, Theorems of Probability, Conditional Probability, Baye's Theorem, Random Variable and Probability distribution.

Unit III: **Correlation and Regression Analysis**

Types of correlation, Methods of Correlation, Co-efficient of correlation, Properties of correlation, Rank Correlation. Difference between correlation and regression, Regression Lines, Regression Equations.

Unit IV: Testing of Hypothesis

Procedure of Testing Hypothesis, Standard Error and Sampling distribution, Estimation, Student's t-distribution, Chi-Square test and goodness of fit, F-test and analysis of variance.

Text Books:

S.P. Gupta: Statistical Method, S. Chand
C.K. Kothari: Research Methodology, New Age International

Course Outcomes:

- To be able to understand the basic concept of statistics and data collection.
- To be able apply advanced knowledge in statistics to experimental and applied research
- To be able to understand the concepts of validity and probability as they apply to different set of data.
- To be able to critically evaluate the methodological designs and select appropriate analytical strategies for their research projects.
- To understand the interpretation and appropriate reporting requirements for statistical and data analysis.
- To be able to use statistical packages required quantitative analysis (e.g., R, SPSS and Excel).

DS7E-705: Python for Analytics Credits: 4 (3-1-0)

Objective: The main objective is to help students to understand the fundamentals of python. Student will learn how to analysis data using Python.

COURSE DESCRIPTION:

UNIT I: Introduction to Python: Python versus Java, Python Interpreter and it's Environment, Python installation, Python basics: variables, operators, Strings, Conditional and Control Statements, loops; Data structures: lists and dictionaries; functions: global functions, local functions, lambda functions and methods.

UNIT II: Object Oriented Programming Concepts: Class, object, constructor, destructor and inheritance; Modules & Packages, File Input and Output, Catching exceptions to deal with bad data, Multithreading, Database Connectivity.

UNIT III: Numpy: Creating Arrays, Arrays Operations, Multidimensional ArraysArrays transformation, Array Concatenation, Array Math Operations, Multidimensional Array and its Operations, Vector and Matrix. **Visualization:** Visualization with matplotlib, Figures and subplots, Labeling and arranging figures, Outputting graphics.

UNIT IV: Pandas: Manipulating data from CSV, Excel, HDF5, and SQL databases, Data analysis and modelling with Pandas, Time-series analysis with Pandas, Using Pandas, the Python data analysis library, Series and Data Frames, Grouping, aggregating and applying, Merging and joining.

Text Books:

1. McKinney Wes, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.
2. Hauck Trent, "Instant Data Intensive Apps with Pandas How-To", Packt Publishing Ltd, 2013.
3. Beazley David M.,"Advanced Python Programming", Pearson Education,2009.
4. Chun Wesley , Core Python Programming, 3rd Edition,Prentice Hall Professional, 2012.
5. Telles Matt "Python Power!: The Comprehensive Guide", Cengage Learning, 2008.
6. McKinney Wes & PyData Development Team, "pandas: powerful Python data analysis toolkit", Release 0.13.1, Feb 2014.
7. https://docs.python.org/3.4/tutorial/
8. http://www.tutorialspoint.com/python/python_quick_guide.htm

Course Outcomes:

- The student will learn core data types of python.
- The student will learn conditional and looping operations in python.
- The student will be able to work with Object-oriented concepts and Database connectivity in python.

- The student will be able to analyze data using Pandas and Numpy.
- The student will be able to visualize the data using seaborn and matplotlib.

DS7E-707: Advanced Excel Credits: 2 (0-0-4)

Objective: The main objective of this course is to learn analysis of data using MS Excel, resulting in less time and better understands what the data means.

COURSE DESCRIPTION:

Unit I: Introduction to Excel User Interface**,** Application, Workbook, Worksheets & its Components, Named Ranges; Formatting: Cell Color, Font Color, Indents, Alignments, Number Formats, Custom Formats, Editing commands; Data Sorting: Built-in Sort, Sorting Levels, Custom Sort; Data Filtering: Auto Filter – Filter By Color, Filter by Icono Advanced Filter, Remove Duplicates; Data Subtotal – Built-In Subtotal (Nested Subtotal).

Unit II: Data Validation: Based on cell values (text length, whole no Based on Formulas, List Dropdown, Circle Invalid Data, Input & Error Messages; Data Grouping: Grouping Rows, Grouping Columns. Data Tables: Conditional Formatting, Formatting based on Cell values, Formatting based on Formulas, Icon Sets (bars, scales, icons), Freezing Panes, Text-to-Columns, Delimited, Fixed Length; Data Consolidation (from multiple files), Getting External Data into Excel, From MS Access, From Text files, From Web, Other Data Sources.

Unit III: Formulas, TEXT Functions, IF, ERROR Functions, LOGICAL Functions, VLOOKUP, HLOOKUP, COUNTIF, SUMIF, SUMPRODUCT, DATE & TIME FUNCTIONS, FORMULA TEXT, Information Functions (ISNA, ISEVEN, ISERR…).

Unit IV: Charts: Chart Types, Chart Components, Primary Vs Secondary Axis, Chart Formatting, Sparkline (2010 and above); Pivot Tables: Introduction & Creation, Slicer, TimeLine, Pivot Charts, Calculated Fields, Calculated Items, Grouping, Formatting – Number/Conditional, PowerPivot, PowerView.

Text Books:

1. John Walkenbac, “Excel 2016 Bible”, John Willey & sons.
2. Jordan Goldmeier , “Advanced Excel Essentials”, Apress Publisher.
3. Conrad George Carlberg , “Business Analysis with Microsoft Excel”, Que Publishers.
4. Bernd Held, ”Microsoft Excel Functions & Formulas”, Wordware publishing, Inc.
5. Steven Roman ,”Writing Excel Macros with VBA” O’Reilly Media.

Course Outcomes:
- The student will be able to perform basic operations in Excel.
- The student will be able to summarize data using Grouping and pivot table.
- The student will be able to write conditional statements and perform LOOKUP operations.
- The student will be able to create charts in excel.

- The student will be able to create a dashboard in excel.

DS7E-721: Data Mining and Data Warehousing Credits: 3 (2-0-2)

Course Objective The main objective of this course is to provide understanding of data warehouse fundamentals and data mining techniques for business applications.

COURSE DESCRIPTION:

UNIT I: Data Warehousing: Introduction data warehousing, Data Mart, Data Warehouse Architecture; Star, Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning. ETL Concepts. OLAP technology: Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, indexing data.

UNIT II: Data Mining: Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining; Introduction to Web Mining, Text Mining. Data Processing: Data Cleaning, Data Integration and Transformation; Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Data Discretization and Concept hierarchy generation for numerical and categorical data.

UNIT III: Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, FP-Growth Algorithm, latest trends in association rules mining.

UNIT IV: Classification methods: Decision tree, Bayesian Classification, Rule based; clustering methods: Partitioning methods (K-Means, K-Mediods) and Hierarchical Clustering (Agglomerative and Divisive Clustering, Multi-phase method) Prediction: Linear and non-linear regression.

Text Books:

1. P. Ponnian, “Data Warehousing Fundamentals”, John Wiley.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.
3. P. N. Tan, M. Steinbach, Vipin Kumar, “Introduction to Data Mining”, Pearson Education.
4. G. Shmueli, N.R. Patel, P.C. Bruce, “Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner”, Wiley India.
5. Michael Berry and Gordon Linoff “Data Mining Techniques”, Wiley Publications.
6. M.H.Dunham, “Data Mining Introductory & Advanced Topics”, Pearson Education.

Course Outcomes:

- The Student will learn basics of Data Warehouse.
- The student will learn basics of Data Mining.

- The student will be able to Pre process the data.
- The student will be able to perform Market Basket Analysis.
- The student will be able to work with Classification Algorithms.
- The student will be able to cluster the data.

DS7E-723: Multivariate Analysis Credits: 3 (2-0-2)

Objective:

1. To understand the main features of multivariate data.
2. To be able to use exploratory and confirmatory multivariate statistical methods properly.
3. To be able to carry out multivariate statistical techniques and methods efficiently and effectively.

COURSE DESCRIPTION:

UNIT I: Analysis of categorical data. Loglinear models for two- and higher-dimensional contingency tables, Characterizing and Displaying Multivariate Data, Tests on one or two mean vectors.

UNIT II: Multivariate Analysis of Variance, Aspects of multivariate analysis, random vectors, sample geometry and random sampling, multivariate normal distribution, inferences about the mean vector, MANOVA.

UNIT III: Classification and grouping techniques: discrimination and classification, clustering. Logistic regression models.

UNIT IV: Analysis of covariance structures, Principal Component Analysis (PCA), Factor Analysis, Cluster Analysis. Use of statistical computer packages.

Text Books:

1. Applied Multivariate Statistical Analysis, by Richard A. Johnson and Dean W.Wichern (6^{th} edition), Prentice Hall.
2. Characterizing and Displaying Multivariate Data, by A.C.Rencher, John Wiley and Sons.
3. Multivariate Data Analysis, by Joseph F.Hair, William, Babin and Anderson.
4. Cluster Analysis, by Brian S.Everitt, Sabine Landau, Morven Leese. Wiley

Course Outcomes:

- To be able to understand the concept of analysing multivariate data.
- To be familiar with a basic minimum level of matrix competency and with general aspects of handling multivariate data.
- Perform exploratory analysis of multivariate data, such as plot multivariate data, calculating descriptive statistics, testing for multivariate normality;

- Conduct statistical inference about multivariate means including hypothesis testing, confidence ellipsoid calculation and different types of confidence intervals estimation;
- Undertake statistical analyses using appropriate multivariate techniques, which includes principal component, factor analysis, discriminate and clustering analysis
- Analyse multivariate data using the statistical software package.

Second Semester:

DS7E-702: Operations Research Credits: 4 (3-1-0)

COURSE OBJECTIVE:

This course exposes the students in mathematical modelling, solving and analysing business and industrial problems using operations research methods.

COURSE DESCRIPTION:

Unit -I:

Introduction, History, Development of Operations Research, Characteristics of Operations Research, Models in Operations Research, Principles of Modelling. Pre-modelling-Need Recognition, Problem Formulation. Modelling-Model development, Data collection, Model solution, Model validation, and sensitivity analysis. Post-modelling-Interpretation of results and implications, Decision making, Implementation, and Control.

Unit-II:

Linear Programming, Formulation of Linear programming Problems. Solution Methods-Graphical, Simplex, M-Technique, Two-Phase. Special cases of LP problems. Duality, Primal-dual relationships, Dual simplex method. Sensitivity analysis. Solving LP problems using computer software.

Unit-III:

Transportation Model-Formulating the model, Initial Feasible Solution-North-West Method, Least Cost Method, Vogel's Approximation Method. Optimum Solution-MODI method, Stepping Stone Method. Special issues of transportation problems. Assignment Model: Formulating the model, Solving the assignment problem using Hungarian method. Special issues of assignment problems.

Integer programming: Types of integer programming problems, Formulating the model, Solution using Branch and bound method. Dynamic Programming.

Solving the problems using computer software.

Unit-IV:

Network models: Minimal spanning tree algorithm, Shortest-route problem, Maximal flow model, Minimum –cost capacitated flow problem. Project Scheduling: CPM and PERT.

Inventory models: Functions of inventory, information requirements for inventory management-demand, lead time, inventory costs, and quantity on hand. Objectives of inventory management. Economic Order Quantity Models-Economic order size, economic production run, quantity discounts. Determining the reorder point. Material Requirement Planning.

Queuing Models: Goals, elements and characteristics of queuing systems, Measures of system performance, Waiting line models-single channel, multiple channel. Cost considerations.

TEXT BOOKS

Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall

David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.

William J. Stevenson: Introduction to Management Science, IRWIN.

Course Outcomes:

- Understand the verbal description of the real system and accordingly identify and development of operational research models.
- Understand the mathematical tools that are needed to solve optimisation problems.
- Use of mathematical software to solve the OR models developed.
- Develop a technical report that describes the model, solving technique, results analysis and recommendations.

DS7E-704: Statistical Programming in R Credits: 3 (2-0-2)

Objective: This course is an introduction to R, a powerful and flexible statistical language and environment that also provides more flexible graphics capabilities than other popular statistical packages. After taking this course, students will be able to –

1. Use R for statistical programming, computation, graphics, and modeling,
2. Write functions and use R in an efficient way,
3. Fit some basic types of statistical models,
4. Use R in their own research,
5. Be able to expand their knowledge of R on their own

COURSE DESCRIPTION:

Unit I: Introduction to R programming language: Getting R, Managing R, Arithmetic and Matrix Operations, Introduction to Functions, Control Structures. Working with Objects and Data: Introduction to Objects, Manipulating Objects, Constructing Data Objects, types of Data items, Structure of Data items, Reading and Getting Data, Manipulating Data, Storing Data.

Unit II: Data Distribution and Statistical Testing: Types of Data distribution, Normal distribution, Poisson distribution, Random number generation, Chi-Square Testing, Student's t-test, F-test, Monte Carlo Simulation.

Unit III: Graphical Analysis using R: Basic Plotting, Manipulating the plotting window, Box-Whisker Plots, Scatter Plots, Pair Plots, Pie Charts, Bar Charts.

Unit IV: Advanced R: Statistical models in R, Correlation and regression analysis, Analysis of Variance (ANOVA), creating data for complex analysis, Summarizing data, and case studies.

Text Books:

1. Mark Gardener: Beginning R: The Statistical Programming Language, Willey publications
2. Norman Matloff: The Art of R Programming: A Tour of Statistical Software Design, OREILLY & Associates Inc.

Course Outcomes:

- Data manipulation - acquiring skills in flexible matrix manipulation
- Access online resources for R and import new function packages into the R workspace
- Scripting in such a way that the script can be used with minimal effort for similar datasets and analyses and for especially large datasets
- Explore data-sets to create testable hypotheses and identify appropriate statistical tests
- Perform appropriate statistical tests using R
- Learn how to create high-quality figures, especially associated with more complex analyses (e.g. three dimensional scatter plots, animated chart Trellis displays, etc.).

DS7E-706: Linear Algebra and Advanced Calculus Credits: 3 (2-1-0)

Objective: The main objective is to students will learn to solve many types of data science problems using Linear Algebra and Calculus.

Course Description:

Unit I: Vector spaces over fields, subspaces, bases and dimension. Systems of linear equations, matrices, rank, Gaussian elimination. Linear transformations, representation of linear transformations by matrices, rank-nullity theorem, duality and transpose.

Unit II: Determinants, cofactors, adjoint, Cramer's Rule. Eigenvalues and eigenvectors, characteristic polynomials, minimal polynomials, Cayley-Hamilton Theorem, triangulation, diagonalization, rational canonical form, Jordan canonical form.

Unit III: Inner product spaces, Gram-Schmidt orthonormalization, orthogonal projections, linear functionals and adjoints, Hermitian, self-adjoint, unitary and normal operators, Spectral Theorem for normal operators, Rayleigh quotient, Min-Max Principle.

Unit IV: Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers. Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

Text Books:

1. K. Hoffman and R. Kunze, Linear Algebra, Pearson Education (India), 2003. Prentice-Hall of India, 1991.
2. S. Lang, Linear Algebra, Undergraduate Texts in Mathematics, Springer-Verlag, New York, 1989.
3. P. Lax, Linear Algebra, John Wiley & Sons, New York,. Indian Ed. 1997
4. H.E. Rose, Linear Algebra, Birkhauser, 2002.
5. Hildebrand, Francis. Advanced Calculus for Applications. 2nd ed. Englewood Cliffs: Prentice Hall, March 31, 1976.
6. Kaplan W., "Advanced Calculus", Addison Wesley (Pearson Education, Inc.), 5 th Edition, 2003
7. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, (2011).

Course Outcomes:

After successful completion of this course students will be able to:

1) demonstrate competence with the basic ideas of linear algebra including concepts of vector spaces, linear systems, independence, theory of matrices, linear transformations, bases and dimension, eigenvalues, eigenvectors and diagonalization;
2) describe and apply the key concepts advance calculus;
3) communicate and understand mathematical statements, ideas and results, both verbally and in writing.

DS7E-708: Machine Learning Credits: 3 (2-0-2)

Objective: The main objective is to help students to understand the fundamental concepts of machine learning.

COURSE DESCRIPTION:

UNIT I: Introduction to Machine Learning, History and Overview of machine learning, Applications, Types of Machine Learning, Basic Concepts. Concept Learning and candidate elimination learning Algorithm.

UNIT II: Artificial Neural Network: biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervise & Unsupervised) and activation function. Supervised Learning: Perceptron learning, Single layer/multilayer, linear Separability, Adaline, Madaline, Back propagation network, RBFN.

UNIT III: Bayesian Learning, Bayes Theorem, Naïve Bayesian classifier, Bayesian belief, EM Algorithm. Dimensionality Reduction: Factor Analysis, Principal Component Analysis, Linear Discriminant Analysis.

UNIT IV: Markov and Hidden Markov Models, PAC Learning, Support Vector Machine, Evolutionary Learning: Genetic Algorithm, generating offspring, applications and genetic programming.

Text Books:

1. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
2. Stephen Marsland, “Machine Learning –An Algorithmic Perspective”, CRC Press, 2009.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
4. Ethem Alpaydin, “Introduction to Machine Learning”, Prentice Hall of India, 2005.
5. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2006.
6. Sanjeev Kulkarni, Gilbert Harman, “An Elementary Introduction to Statistical Learning Theory”, 2011.
7. N. Shivnandam, “Principle of soft computing”, Wiley.

Course Outcomes:

- The student will be able to understand the basics of machine learning.
- The student will be able to understand Regression analysis.
- The student will be able to work on classification problems.
- The student will be able to work with unsupervised learning approaches.
- The student will be able to perform machine learning operations in scikit-learn.

DS7E-722: Cloud Computing Credits: 3 (2-1-0)

Objective: The main objective of this subject is to help student to understand Cloud and It’s Services, Architecture, Deployment, Core Issues, Strengths and limitations of cloud computing.

UNIT I Introduction to Cloud Computing: Overview of Cloud Computing, History of Cloud Computing, Importance of Cloud Computing, advantages and disadvantages of Cloud Computing, Applications, Cloud computing vs. Cluster computing vs. Grid computing, Future of Cloud Computing; Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Cloud Service Models(XaaS), Deployment Models (Public cloud, Private cloud, Hybrid cloud).

Unit II: Cloud Service Models and Virtualization: Infrastructure as a Service (IaaS): Introduction, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Virtual Machine(VM), Resource Virtualization(Server, Storage, Network),VMware vSphere, Machine Image ,Porting Applications Case study on Amazon EC2;Platform as a Service(PaaS): Introduction to PaaS, advantages and disadvantages of PaaS, case study on Microsoft Azure; Software as a Service(SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS; Development Services and Tools : Amazon Ec2, Google App Engine, IBM Clouds.

UNIT III: Capacity Planning: Defining Baseline and Metrics, Baseline measurements, System metrics, Load testing, Resource ceilings, Server and instance types, Network Capacity, Scaling. Understanding Service Oriented Architecture, Moving Applications to the Cloud, Working with Cloud-Based Storage, Working with Productivity Software.

UNIT IV: Managing the Cloud: Administrating the Clouds, Cloud Management Products; Cloud Security: Security Overview, Cloud Security Challenges and Risks, Security Governance, Risk Management: Security Monitoring, Security Architecture Design, Data Security, Application Security, Virtual Machine Security, Identity Management and Access Control, Authentication in cloud computing, Client access in cloud, Cloud contracting Model. Using the Mobile Cloud: Working with Mobile Devices and Working with Mobile Web Services;

Case Studies on Various Clouds: Google Web Services, Amazon Web Services, Microsoft Cloud Services, IBM Clouds, Eucalyptus.

Text Books:

1. Kris A Jamsa: Cloud computing : SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More 2013Jones & Bartlett Learning ISBN-13: 9781449647391.
2. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach”, TMH, 2009.
4. Sosinsky B., “Cloud Computing Bible”, Wiley India
5. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011.
6. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.

Course Outcomes:

- The student will be able to understand the basics of Cloud Computing.
- The student will be able to understand Cloud Computing Models.
- The student will be able to work with AWS Cloud Platform.
- The student will be able to manage cloud platform.
- The student will be able to understand various cloud services.

DS7E-724: Web Mining Credits: 3 (2-0-2)

Objective: The main objective of this course s to student will learn how to apply web mining to derive data driven results.

COURSE DESCRIPTION:

UNIT I: Introduction to Web Mining: Web content, web usage mining and web structure mining. Web crawling: Crawling Basics; Indexing, Text analysis and classification.

UNIT II: Similarity and Clustering/community algorithms: Partitioning Approaches, Geometric Embedding Approaches, and Probabilistic Approaches; Topical locality,

UNIT III: Supervised Text Learining: Evaluating Text Classifiers, Nearest Neighbor Learners, Greedy Inclusion Algorithms, Truncation Algorithms, Exploiting Hierarchy among Topics, Discriminative Classification, Regression, Support Vector Machines, Hypertext Classification. SEMISUPERVISED LEARNING: Expectation Maximization, Labeling Hypertext Graphs.

UNIT IV: Link analysis: PageRank and HITS ranking methods, Ranking algorithms; Web search and retrieval, Web growth models, Web traffic models;Social tagging, Social networks and social media, Information diffusion.Applications of Web mining in Recommendtion system.

Text Books:

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008.
2. Michael Berry and Gordon Linoff, “Data Mining Techniques for Marketing, Sales, and Customer Relationship Management”, Third Edition, John Wiley, 2011.
3. Soumen Chakrabarti,"Mining the Web: Discovering Knowledge from Hypertext Data",Morgan Kaufmann, 2003.
4. Bing Liu “Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data”,2011 edition, Springer.
5. Anthony Scime,"Web Mining: Applications and Techniques", Idea Group Inc (IGI), 2005.

Course Outcomes:

- The student will be able to understand basics of web mining.
- The student will be able to scrap the web content.
- The student will be able to Analyzing web content.
- The student will be able to create NLP models to analyzing the web content.
- The student will be able to understand link analysis and page rank.

Third Semester:

DS7E-801: Forecasting Methods Credits: 4 (3-1-0)

COURSE OBJECTIVE

This subject is designed in such a way to provide the basic concepts of forecasting models based on quantitative analysis. Risk and uncertainty in forecasting and it is generally considered good practice to indicate the degree of uncertainty attaching to forecasts.

COURSE DESCRIPTION:

Unit I: Introduction: Fo**re**casting perspective, an overview of forecasting methods, basic steps in forecasting. Basic forecasting tools: time series and cross-sectional data, graphical and numerical summaries, forecasting accuracy, prediction intervals, transformations and adjustments.

Unit II: Time series: Decomposition, principles of decomposition, moving averages, classical decomposition, census bureau methods, forecasting and decomposition.

Unit III: Exponential smoothing: averaging methods, Singleexponential smoothing methods, ARRSES, Double exponential soothing methodcomparison of methods, general aspects of smoothing methods.

Unit IV: Regression: Simple regression, forecasting with simple regression, non-linear relationships. Multiple regressions. Box-Jenkins methods: examining correlations in time series data, examining stationary, ARIMA models, forecasting with ARIMA models.

Text Book(s):

1. Spyros Makridakis :Forecasting Method's and application Wiley
2. N.P. Nagpal :Forecasting Techniques ,RBSA
3. Stephen A. Delurgio: Forecasting Principals and Application,McGraw Hill

Course Outcomes:

- Discuss the key factors which affect the success of forecasting procedures.
- Use Basic Statistical Techniques and statistical Graphics to forecast values.
- Find different sets of Smoothed or Average values to be used when forecasting.
- Understand the key concepts needed to use the Linear Regression model when forecasting.
- Model and Forecast the Seasonal component of a set of values.
- Model the different types of cyclical behaviour observed in different sets of values.
- Understand and use the Box-Jenkins or ARMA Procedure.

DS7E-803: Data Visualization Credits: 3 (2-0-2)

Objective: This course will help the student to understand data visualization and how data scientists/ analysts use visualization technique to represent results.

COURSE DESCRIPTION:

UNIT I Introduction to Data Visualization, characteristics, goals, need of data visualization, comparison of data science and data visualization, Types of Data, Operations on datatypes, Data Dimensions, Designing Visuals, Visual attributes, Designing Visuals, Mackinlay Design Criteria, Retinal Variables: Size, texture, shape, orientation, color, color Saturation, color hue; Where to use which variable? Bertin's visual attributes, Seven Stages of Visualizing Data.

UNIT II Types of visualization chart: Scatter, line, pie, bar, histogram, Bubble, stacked area chart, pair plot, Heatmaps. Smart Charts: List, Process, Cycle, Hierarchy, Relationships, matrix, pyramid, pictures. Text Visualization.

UNIT III Dashboard, Characteristics, Types of dashboards, best practices and design issues, visual perception, limits of short-term memory, visual encoding data, Gestalt principles, principles of visual perception. Case studies: sales dashboard, CIO dashboard, Telesales dashboard, marketing analysis dashboard.

UNIT IV: Tableau Data Visualization Tools: Data loading, Connecting with Databases, Data Prep with Text and Excel Files, Drill Down and Hierarchies, Sorting, Grouping, Filters, Filtering for Top and Top N, Parameters Formatting; Tableau's Mapping, Custom Geocoding, Polygon Maps, WMS; Dashboards and Stories, Dashboard Layouts and Formatting

Text Books:

1. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.

2. Stephen Few, "Information dashboard design: The effective visual communication of data",O'Reilly, 2006.

3. Edward R. Tufte, "The visual display of quantitative information", Second Edition, GraphicsPress, 2001.

4. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.

5. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment",O'Reilly, 2008.

6. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.

Course Outcomes:

- The student will learn basic principles of data visualization.
- The student will learn various types of charts to visualize data.
- The student will understand Dashboard concepts.
- The student will be able to use data visualization tools Tableau/Qlik view.
- The student will be able to tell stories using the dashboard and visualization.

DS7E-805: Decision Analysis Credits: 3 (2-1-0)

OBJECTIVE:

This course introduces and applies advanced modelling techniques to decision problems with the objective of enhancing the decision-making skills as well as the spreadsheet knowledge base.

COURSE DESCRIPTION:

Unit-I: Game Theory: Introduction, definitions, two-person zero sum game. Game with pure strategies, saddle point, game value. Game with mixed strategies, solution methods-algebraic method, graphical method, dominance, linear programming method.

Unit-II: Decision Theory: Structuring the decision problem-payoff tables, decision trees. Decision making under certainty. Decision making under uncertainty: Optimistic, Conservative, Minimax regret. Decision making under risk: Expected value criterion, expected value of perfect information. Sensitivity analysis. Decision making with sample information, expected value of sample information, efficiency of sample information. Computing branch probabilities. Utility and decision making: meaning of utility, developing utilities and payoffs, the expected utility approach.

Unit-III: Multi-criteria Decision Making: Multi-criteria decision making: Goal programming, Scoring models, Analytical Hierarchy Process.

Unit-IV: Markov Analysis: Transition probabilities, system behaviour. Methods of Analysis: Tree diagram, Matrix multiplication, Algebraic solution. Cyclical and absorbing states, Market share analysis, Accounts receivable analysis.

TEXTBOOKS

1. Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
2. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
3. William J. Stevenson: Introduction to Management Science, IRWIN.

Course Outcomes:

After completing the course the student will -

1. Learn basics of decision making and uncertainty analysis under a risky situation.
2. Understand concepts in Strategic Game Theory.
3. Learn how to model and solve real life cases using Game Theory.

DS7E-807: Data Security Credits: 3 (2-0-2)

OBJECTIVE:

The objective of the course is to train students in the organizing and the technical realization and security of data.

COURSE DESCRIPTION:

Unit-I:

What is Data Security? Why do you need it? – Basic Principles of Confidentiality, Integrity Availability Concepts Policies, procedures, Guidelines, Standards Administrative Measures and Technical Measures, People, Process, Technology

Unit-II:

Current Trends in information Security: benefits and Issues related to data security. Standards available for InfoSec: Cobit and ISO 27001.

Unit-III:

Vulnerability, Threat and Risk, Risk Assessment and Mitigation, Segregation and Separation of Duties & Roles and responsibilities, IT ACT 2000.

Unit-IV:

Basics of Cryptography - Preliminaries, Elementary Substitution Ciphers, Elementary Transport Ciphers, Other Cipher Properties, Secret Key Cryptography – Product Ciphers, DES Construction.

Public Key Cryptography and RSA – RSA Operations, Why Does RSA Work?, Performance, Applications, Practical Issues, Public Key Cryptography Standard
(PKCS), Cryptographic Hash - Introduction, Properties, Construction, Applications and Performance, Diffie-Hellman Key Exchange.

TEXTBOOKS

1. Cryptography and Network Security- Behrouz A Forouzan, Deb deep Mukhopadhyay, Mc-GrawHill, 3rd Edition, 2015
2. Cryptography and Network Security- William Stallings, Pearson Education, 7th Editio

Course Outcomes:

On successful completion of this course, the student will be able to:

1. define terms related to data and network security.
2. describe the ways in which the security of data can be endangered.
3. demonstrate competence in detecting potential security vulnerabilities, and demonstrate ways of recovering from the effects of attacks.
4. analyse the offered system, and point to the potential safety problems.
5. suggest the optimal way to organize data security system.
6. choose an appropriate engineering approach to problem solving.

DS7E-821: Deep Learning Credits: 3 (2-1-0)

OBJECTIVE:

This course aims to present the mathematical, statistical and computational challenges of building stable representations for high-dimensional data, such as images, text and data. We will delve into selected topics of Deep Learning, discussing recent models from both supervised and unsupervised learning. Special emphasis will be on convolutional architectures, invariance learning, unsupervised learning and non-convex optimization.

COURSE DESCRIPTION:

Unit-I:

Introduction: Feed forward Neural networks. Gradient descent and the backpropagation algorithm. Unit saturation, aka the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad local minima. Heuristics for faster training. Nestors accelerated gradient descent. Regularization. Dropout. Convolutional Neural Networks: Architectures, convolution / pooling layers. Recurrent Neural Networks: LSTM, GRU, Encoder Decoder architectures.

Unit-II:

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

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

Unit-III:

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

Unit-IV:

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

TEXTBOOKS

Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." MIT Press, (2015).
Bengio, Yoshua. "Learning deep architectures for AI." Foundations and trends in Machine Learning 2.1 (2009): 1127.
Hochreiter, Sepp, and Jargen Schmidhuber. "Long short-term memory." Neural computation 9.8 (1997): 17351780.

Course Outcomes:

After completing the study of the course the students are expected to:

- understand complexity of Deep Learning algorithms and their limitations;
- understand modern notions in data analysis oriented computing;
- be capable of confidently applying common Deep Learning algorithms in practice and implementing their own;
- be capable of performing distributed computations;
- be capable of performing experiments in Deep Learning using real-world data.

DS7E-823: Technical Communication Credits: 3 (2-1-0)

Objective:

This course is designed to help the students to develop skills that will enable them to produce clear and effective scientific and technical documents.

Unit I:

Technical writing: Definition, Similarities to other writings, Unique features, importance, technical writing as profession, qualifications for technical writing. Identifying audience. Problems involving content, words and phrases, punctuation, unity, coherence, logic, etc. Being concise.

Unit II:

Techniques of Technical Communication. Analysing-Division, Classification, Partition. Defining-Formal, informal, expanded. Describing-subjective versus objective, spatial description, description of mechanism, process, selected details. Illustrating-Tables, graphs, charts, pictorials. Researching-Basic types of research, original research, searching the literature. Abstracting of your own reports, the works of others, precautions. Oral communication-one to one reporting, participation in conferences, speaking to large audiences, organising the speech.

Unit III:

Basic forms of Technical Writings. The memorandum, The business letter, Formal report.

Unit IV:
Technical reports. Justification reports and proposals, the progress reports, periodic reports, status reports, trip reports. Laboratory reports, Feasibility reports, State-of-the-Art reports. Instructions and manuals.

Text Books:

1. James Sherlock: A Guide to Technical Communication

Course Outcome:

After completion of this course student will be able to-
- Document the knowledge about products, services, technology, or concepts into well-crafted and organised information collateral.
- Write technical reports, memorandum, business letters, manuals, proposals, progress reports etc.
- Develop document involving spatial description, description of mechanism, process, illustrations, etc.

Fourth Semester:

DS7E-802: Modelling and Simulation Credits: 4 (2-1-2)

COURSE OBJECTIVE
This course exposes the students in simulation modelling, solving and analysing business and industrial problems using simulation models.

COURSE DESCRIPTION:

Unit -I:
System modelling, classification of models, validation and verification. System simulation, simulation terminology, applications of simulation, Simulation steps, advantages and disadvantages of simulation. Monte Carlo (MC) simulation. An inventory simulation. A waiting line simulation.

Basic probability and statistics. Random variables and their properties, simulation output data and stochastic processes, estimation of means, variances, and correlations, confidence intervals, and hypothesis testing, Strong law of large numbers.

Unit-II:
Generation of Random Numbers: Pseudo random numbers: Pseudorandom numbers and algorithm for generating them-mid-square method, linear congruential method, additive congruential method, quadratic congruential method. Testing and validating of pseudo random sequences.

Generating random variants: inverse-transform method; generating continuous Random variates: uniform, exponential; generating discrete random variates: Binomial, Poisson.

Variance reduction techniques, Experimental design.

Unit-III:

Discrete-Event Simulation: Time advance mechanisms. Components and Organization of a discrete event simulation model. Simulation of a single-server queuing system. Simulation of an inventory system.

Simulation Languages: Comparison of simulation languages with general purpose languages. Classification of simulation software. Desirable software features. Simulation language – GPSS / SIMSCRIPT – II.5.

Unit-IV:
Building valid and credible simulation models, determining the level of model detailing, techniques for increasing model validity and credibility. Output data analysis.

TEXTBOOKS
Averill M. Law: Simulation Modeling & Analysis, Tata McGraw-Hill
Geoffrey Gordon: System Simulation, Prentice Hall of India
David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management

Course Outcomes:
After completion of this course the students will be able to-

- model deterministic systems and differentiate between nonlinear and linear models.
- numerically simulate linear and non-linear ordinary differential equations and deterministic systems.
- estimate and validate a model based upon input and output data.
- Generate and test random number variates and apply them to develop simulation models
- Analyze output data produced by a model and test validity of the model.

DS7E-804: Big Data Technologies Credits: 3 (2-0-2)

Course Objective: The main objective of this course is to introduce big data technologies such as Hadoop, spark and analyzing big datasets in spark using python.

COURSE DESCRIPTION:

UNIT I: Introduction
Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting – Modern Data Analytic Tools. Big Data Analytics Process, Big Data Analytics for Business. Identifying problem and solving problem in Big Data environment. Analyzing Unstructured vs. Structured Data, Databases.

UNIT II: Hadoop and MapReduce
Introduction to Hadoop, Hadoop architecture, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases; Hadoop Distributed File system: Design of HDFS, HDFS Concepts. Introduction to MapReduce: MapReduce Basic Concepts, Understanding the Map Reduce architecture, Writing MapReduce Programs. understanding Map phase, shuffling, sorting, and reducing phase.

UNIT III: Spark
Introduction to Spark, Resilient Distributed Dataset (RDD), RDD Operations: actions and

transforamtion funtions. Spark Dataframes, operations on Dataframes: Join, groupby, aggregate, handling missing data.

UNIT IV: SparkSQL and MLLib
SparkSQL and its basic operations. MLLib: Data types, Basic statistics, Classification(Logistic regression, Decision tree classifier)and linear regression model generation, Model Evaluation, Collaborative filtering, and Clustering.

Text Books:

1. Arvind Sathi, "Big Data Analytics: Disruptive Technologies for Changing theGame", 1st Edition, IBM Corporation, 2012.
2. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", 1st Edition, Wiley and SAS Business Series, 2012.
3. Tom White,"Hadoop: The Definitive Guide", 3rd Edition, O'Reilly Media, 2012.
4. Donald Miner, Adam Shook, Eric Sammer, "Hadoop Operation", O'Reilly 2012.
5. Donald Miner, Adam Shook "MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems", O'Reilly 2012.
6. Chuck Lam, "Hadoop in Action", Manning Publications, 2010.
7. https://spark.apache.org/docs/2.0.0/programming-guide.html

Course Outcomes:

- The student will be able to understand core concepts of Hadoop.
- The student will know the HDFS and MapReduce.
- The student will be able to work with Big Data tool such as Spark.
- The student will be able to analyze big data sets.
- The student will be able to create machine learning models for Big data.

DS7E-806: Scientific Computing Credits:3(2-1-0)

Objective:

The course provides an appreciation of the need for numerical methods for solving different types of problems, and discusses basic approaches. It develops the understanding of numerical mathematics or scientific computing - whether in mathematics, the sciences, engineering, or economics.

COURSE DESCRIPTION:

Unit I: Foundation of Scientific Computing, Quantum computing, Wentzel-Kramer-Brillouin Method, Runge-Kutta method, Trapezoidal method.

Unit II: Quasi-linear, Laplace equation, wave packets, Pressure fluctuation, wave phenomena, linearized shallow water wave equation, 1D convection equation, Upwinding, Numerical amplification factor, Stiff differential equation.

UNIT III: Numerical amplification factor, Heat equation, Parabolic partial differential equation, Tridiagonal matrices, Error propagation, Elliptic partial differential equations, Ordinary differential equation, Convergence properties, General elliptic equation, Multigrid method.

Unit IV: Spectral analysis of explicit and implicit, Highlight the scientific and high performance, Taylor series analysis, Buffer domain technique, Aliasing error, Accuracy compact schemes, CCD scheme Stabilizing effects of filters, Properties of filters, Scientific elements of a FEM, Lagrange and hermite interpolations, Elliptic equation with linear basis function.

Text Books:

1. Scientific Computing by Michael T Heath, Mc Graw Hill, 2001
2. Numerical Recipes: The Art of Scientific Computing, Cambridge University Press, 2007
3. Guide to Scientific Computing by Peter R Turner, CRC Press, 2001

Course Outcomes:

After successful completion of the course the students will be able to-

- transform scientific problems into generic computational models;
- have an overview of advanced algorithms for solving a wide range of problems;
- solve mathematical problems by using elementary algorithms, and compute solutions using a structured computer program.
- display and analyse data appropriately, including the results of numerical calculations.
- plan and develop efficient numerical programs.

DS7E-808: Internet of Things Credits: 3 (2-0-2)

COURSE OBJECTIVE:

1. Vision and Introduction to IoT.
2. Understand IoT Market perspective.
3. Data and Knowledge Management and use of Devices in IoT Technology.
4. Understand State of the Art – IoT Architecture.
5. Real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

COURSE DESCRIPTION:

Unit-I:

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

M2M to IoT – A Market Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.

Unit-II:

M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

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

Unit-III:

IoT Architecture-State of the Art – Introduction, State of the art, **Architecture Reference Model-** Introduction, Reference Model and architecture, IoT reference Model. **IoT Reference Architecture-** Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. **Real-World Design Constraints-** Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.

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

Text books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014.
3. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

Course Outcomes:

At the end of the course the student will be able to:

1. Understand the vision of IoT from a global context.
2. Determine the Market perspective of IoT.
3. Use of Devices, Gateways and Data Management in IoT.
4. Building state of the art architecture in IoT.
5. Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.

DS7E-822: Natural Language Processing Credits: 3 (2-0-2)

Objective: The main object of this course is to provide an introduction to the field of computational linguistics, and natural language processing (NLP).

COURSE DESCRIPTION:

UNIT I: Introduction to NLP, NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field.

UNIT II: The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Lexical syntax. Hidden Markov Models. Maximum Entropy Models. Conditional Random Fields.

UNIT III: Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing.

UNIT IV: Named entity recognition and relation extraction. IE using sequence labeling. Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars. Web 2.0 Applications: Sentiment Analysis; Text Entailment.

Text Books:

1. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
2. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
3. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
4. Steven Bird, Ewan Klein, and Edward Loper,"Natural Language Processing with Python - Analyzing Text with the Natural Language Toolkit", O'Reilly Media, 2009.
5. Ian H. Witten and Eibe Frank. "Data Mining: Practical Machine Learning Tools and Techniques" , 3rd edition, Morgan Kaufmann, 2005.
6. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

Learning Outcomes:

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

1. Broad understanding of the field of Natural Language Processing.
2. Understand mathematical concepts for NLP algorithms.
3. Understanding the capabilities and limitations of NLP technologies.
4. Apply the fundamental knowledge of various types of basic NLP techniques to analyze, design, formulate and implement solutions for any real time situation.
5. Understand the theoretical concepts of NLP in formal language theory.

DS7E -824 Social Network Analysis Credits 3 (2-1-0)

Objective: The course is designed to develop the skills that will involve strategic cross-functional decision-making.

UNIT I: Introductions: Each student will describe their interests and possible uses of SNA in their research. Overview of SNA: history and resources. Mathematical foundations: matrices and graph theory. Whole versus personal networks, one-mode versus two-mode network data.

UNIT II: Basic network metrics and definitions, Centrality and centralization, Key players, Two-mode networks. Sociocentric and egocentric research designs, Collecting network data. Collecting network data: Informant accuracy, Network visualizations.

UNIT III: Cohesive subgroups, bottom-up and top-down approaches, Core/periphery structures, Cohesive subgroups, bottom-up and top-down approaches, Core/periphery structures. Social capital, notions and measures. Structural holes, Burt's measures. Position generators. Egocentric SNA, design and applications.

UNIT IV: Network Scale-Up Method, Qualitative approaches and mixed methods in SNA;Is SNA theory or methodology? Network theories and theories of networks, SNA and social theory, Using network metrics in regression models, QAP and hypothesis testing, missing data Exponential Random Graph Models(ERGMs), Siena.

Introduction to Software Packages for network analysis: UCINET, Pajek, PNet, the statnet and other related packages in R, and Network Workbench.

Text Books:

1. Wasserman, Stanley and Katherine Faust. 1994. Social Network Analysis: Methods and Applications. New York: Cambridge University Press.
2. Carrington, Peter J., John Scott and Stanley Wasserman (eds). 2005. Models and Methods in Social Network Analysis. New York: Cambridge University Press.
3. Carrington and Scott (eds). 2011. The SAGE Handbook on Social Network Analysis. SAGE.
4. De Nooy, Mrvar and Batagelj. 2011. Exploratory Social Network Analysis with Pajek. Cambridge University Press.
5. Kadushin. 2011. Understanding Social Networks: Theories, Concepts, and Findings. Oxford University Press.
6. Knoke and Yang. 2008. Social Network Analysis: SAGE.

Course Outcomes:

After completion of this role student will be able to make strategies after:

- Identifying those (individuals and groups) playing central roles (thought leaders, key knowledge brokers, information managers, etc).
- Identifying bottlenecks and those isolated.
- Spotting opportunities to improve knowledge flow.
- Targeting those where better knowledge sharing will have the most impact.
- Raising awareness of the significance of informal networks.

SCHOOL OF DATA SCIENCE AND FORECASTING

PROGRAM CODE: DS7A BATCH: 2018-20

PROGRAM TITLE: MASTER OF TECHNOLOGY (M.Tech.)
- DATA SCIENCE

PROGRAM OUTCOMES:

- Understanding of the key technologies in data science such as database management, data mining, data visualization techniques, Machine Learning, Hadoop, R, forecasting methods, and statistics.
- Demonstrate knowledge of mathematical and statistical skills.
- Demonstrate use of team work, leadership skills, and decision making.
- Opportunities of higher studies in the area of Data Science.
- Knowledge on various theoretical and practical aspects of data science.

PROGRAM SPECIFIC OUTCOMES:

- Work with messy data, applying models, and understanding the business context.
- Work with unstructured data from various sources like video and social media.
- Use Data Visualization techniques.
- Write the programming codes in R and Python.
- Employ cutting edge tools and technologies to analyze Big Data.

PROGRAM STRUCTURE (2018-20):

First Semester:

Code	Title	Credits (L-T-P)
CORE COURSES		
DS7A-701	Operations Research	4 (3-1-0)
DS7A-703	Statistical Research Methods	4 (3-1-0)
DS7A-705	Data Visualization	3 (2-0-2)
DS7A-707	RDBMS and NOSQL	3 (2-0-2)
DS7A-709	Python for Analytics	3 (2-0-2)
DS7A-711	Laboratory-Advanced Excel	2 (0-0-4)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two)		
DS7A-721	Cloud Computing	3 (2-1-0)
DS7A-723	Statistical Programming in R	3 (2-0-2)
DS7A-725	Multivariate Analysis	3 (2-0-2)
ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus.		
DS7A-751	Fundamentals of Algorithms	3 (2-1-0)

Second Semester:

Code	Title	Credits (L T P)
CORE COURSES		
DS7A-702	Forecasting Methods	4 (2-1-2)
DS7A-704	Big Data Technologies	3 (2-0-2)
DS7A-706	Linear Algebra and Advanced Calculus	3 (2-1-0)
DS7A-708	Modelling and Simulation	3 (2-0-2)
DS7A-710	Machine Learning	3 (2-0-2)
DS7A-712	Data Mining and Data Warehousing	3 (2-0-2)
ELECTIVE COURSES-DISCIPLINE CENTRIC (Any Two)		
DS7A-722	Scientific Computing	3 (2-1-0)
DS7A-724	Natural Language Processing	3 (2-0-2)
DS7A-726	Web Mining	3 (2-0-2)
ELECTIVE GENERIC: The students can choose following course or any generic course being offered in other M.Tech. programmes being run in this campus.		
DS7A-752	Technical Communication	3 (2-1-0)

Third & Fourth Semesters:

Code	Title	Credits
DS7A-800	M.Tech. Dissertation	24

Note: The above course contents can be modified as per requirement from time to time in accordance with University Ordinance No. 14.

DETAILED SYLLABUS:

First Semester:

DS7A-701: Operations Research Credits: 4 (3-1-0)

COURSE OBJECTIVE:

This course exposes the students in mathematical modelling, solving and analysing business and industrial problems using operations research methods.

COURSE DESCRIPTION:

Unit -I:

Introduction, History, Development of Operations Research, Characteristics of Operations Research, Models in Operations Research, Principles of Modelling. Pre-modelling-Need Recognition, Problem Formulation. Modelling-Model development, Data collection, Model solution, Model validation, and sensitivity analysis. Post-modelling-Interpretation of results and implications, Decision making, Implementation, and Control.

Unit-II:

Linear Programming, Formulation of Linear programming Problems. Solution Methods-Graphical, Simplex, M-Technique, Two-Phase. Special cases of LP problems. Duality, Primal-dual relationships, Dual simplex method. Sensitivity analysis. Solving LP problems using computer software.

Unit-III:
Transportation Model-Formulating the model, Initial Feasible Solution-North-West Method, Least Cost Method, Vogel's Approximation Method. Optimum Solution-MODI method, Stepping Stone Method. Special issues of transportation problems. Assignment Model: Formulating the model, Solving the assignment problem using Hungarian method. Special issues of assignment problems.

Integer programming: Types of integer programming problems, Formulating the model, Solution using Branch and bound method. Dynamic Programming.

Solving the problems using computer software.

Unit-IV:
Network models: Minimal spanning tree algorithm, Shortest-route problem, Maximal flow model, Minimum –cost capacitated flow problem. Project Scheduling: CPM and PERT.

Inventory models: Functions of inventory, information requirements for inventory management-demand, lead time, inventory costs, and quantity on hand. Objectives of inventory management. Economic Order Quantity Models-Economic order size, economic production run, quantity discounts. Determining the reorder point. Material Requirement Planning.

Queuing Models: Goals, elements and characteristics of queuing systems, Measures of system performance, Waiting line models-single channel, multiple channel. Cost considerations.

TEXT BOOKS
Hamdy A. Taha: Operations Research: An introduction, Pearson Prentice Hall
David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management Science, South-Western College Publishing.
William J. Stevenson: Introduction to Management Science, IRWIN.

Course Outcomes:

- Understand the verbal description of the real system and accordingly identify and development of operational research models.
- Understand the mathematical tools that are needed to solve optimisation problems.
- Use of mathematical software to solve the OR models developed.
- Develop a technical report that describes the model, solving technique, results analysis and recommendations.

DS7A-703: Statistical Research Methods Credits: 4 (3-1-0)

Objective:

This course will familiarize students with the rudiments of statistical theory and ready them for effective academic and professional practice in the field of research process of industrial, system and social science.

COURSE DESCRIPTION:

Unit I: Introduction to Research Methods and Measures of central tendency
Meaning and Objectives of Research, Significance of Research, Arithmetic Mean, Geometric Mean, Harmonic Mean, Median, Mode. Mean deviation, Standard deviation, Variance, Co-efficient of variation.

Unit II: Probability and Statistical Distribution
Binomial distribution, Poison distribution and Normal distributions, Fitting of Normal Curve. Concept of Probability, Theorems of Probability, Conditional Probability, Baye's Theorem, Random Variable and Probability distribution.

Unit III: **Correlation and Regression Analysis**
Types of correlation, Methods of Correlation, Co-efficient of correlation, Properties of correlation, Rank Correlation. Difference between correlation and regression, Regression Lines, Regression Equations.

Unit IV: Testing of Hypothesis
Procedure of Testing Hypothesis, Standard Error and Sampling distribution, Estimation, Student's t-distribution, Chi-Square test and goodness of fit, F-test and analysis of variance.

Text Books:
S.P. Gupta: Statistical Method, S. Chand
C.K. Kothari: Research Methodology, New Age International

Course Outcomes:

- To be able to understand the basic concept of statistics and data collection.
- To be able apply advanced knowledge in statistics to experimental and applied research
- To be able to understand the concepts of validity and probability as they apply to different set of data.
- To be able to critically evaluate the methodological designs and select appropriate analytical strategies for their research projects.
- To understand the interpretation and appropriate reporting requirements for statistical and data analysis.
- To be able to use statistical packages required quantitative analysis (e.g., R, SPSS and Excel).

DS7A-705: Data Visualization Credits: 3 (2-0-2)

Objective: This course will help the student to understand data visualization and how data scientists/ analysts use visualization technique to represent results.

COURSE DESCRIPTION:

UNIT I Introduction to Data Visualization, characteristics, goals, need of data visualization, comparison of data science and data visualization, Types of Data, Operations on datatypes, Data Dimensions, Designing Visuals, Visual attributes, Designing Visuals, Mackinlay Design Criteria, Retinal Variables: Size, texture, shape, orientation, color, color Saturation, color hue; Where to use which variable? Bertin's visual attributes, Seven Stages of Visualizing Data.

UNIT II Types of visualization chart: Scatter, line, pie, bar, histogram, Bubble, stacked area chart, pair plot, Heatmaps. Smart Charts: List, Process, Cycle, Hierarchy, Relationships, matrix, pyramid, pictures. Text Visualization.

UNIT III Dashboard, Characteristics, Types of dashboards, best practices and design issues, visual perception, limits of short-term memory, visual encoding data, Gestalt principles, principles of visual perception. Case studies: sales dashboard, CIO dashboard, Telesales dashboard, marketing analysis dashboard.

UNIT IV: Tableau Data Visualization Tools: Data loading, Connecting with Databases, Data Prep with Text and Excel Files, Drill Down and Hierarchies, Sorting, Grouping, Filters, Filtering for Top and Top N, Parameters Formatting; Tableau's Mapping, Custom Geocoding, Polygon Maps, WMS; Dashboards and Stories, Dashboard Layouts and Formatting

Text Books:

1. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.
2. Stephen Few, "Information dashboard design: The effective visual communication of data",O'Reilly, 2006.
3. Edward R. Tufte, "The visual display of quantitative information", Second Edition, GraphicsPress, 2001.
4. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
5. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment",O'Reilly, 2008.
6. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.

Course Outcomes:

- The student will learn basic principles of data visualization.
- The student will learn various types of charts to visualize data.

- The student will understand Dashboard concepts.
- The student will be able to use data visualization tools Tableau/Qlik view.
- The student will be able to tell stories using the dashboard and visualization.

DS7A-707: RDBMS and NOSQL Credits: 3 (2-0-2)

Objective: The purpose of this course is to provide fundamental knowledge of relational database management system and SQL to students. Student will also learn new mechanism of storage and retrieval of data, NoSQL.

COURSE DESCRIPTION:

UNIT I: Overview of DBMS: Comparison between Database approach and Traditional file accessing approach, Advantages of database systems, Schemas and instances, Data Dependency, Data Dictionary, and Meta Data. Data models, Types of Data models (Object Oriented, Record Based and Physical data models), E-R Modelling.

UNIT II: Relational Data model: Domains, Tuples, Attributes, Keys, Relational database, Schemas, Integrity constraints, Relational algebra and relational calculus; Normalization: Normal forms (INF, 2NF, 3NF, BCNF), Functional dependency, Decomposition, Dependency preservation and lossless join.

UNIT III: Structured Query Language: DDL, DML, DCL, TCL, SQL Functions, integrity constraints, various joins, sub-query, index, View, Sequence, and Clusters.

UNIT IV: NoSQL: Nosql Basics, Storage Architecture, Operations, Query Model, Modifying Data Stores and Managing Evolution, Indexing and Ordering Data Sets, Managing Transactions and Data Integrity.Using Nosql in the Cloud, Scalable Parallel Processing with Mapreduce, Analyzing Big Data with Hive, Surveying Database Internals

Text Books:

1. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, fifth Edition McGraw-Hill.
2. Elmasri Ramez and Novathe Shamkant, “Fundamentals of Database Systems”, Benjamin Cummings Publishing. Company.
3. Rob, Coronel, “Database Systems”, Seventh Edition, Cengage Learning.
4. Fred R.McFadden,Jeffrey A.Hoffer & Marry B.Prescott.?Modern Database Management, Fifth Edition,Pearson Education Asia,2001.
5. Bayross Ivan, "SQL, PL/SQL: The Programming Language Of Oracle", 4th Revised Edition, BPB Publications, 2010.
6. Tiwari Shashank, "Professional Nosql", Wiley India Pvt Ltd, 2011.

Course Outcomes:

- The student will learn the basics of database management.
- The student will be able to design database using ER diagram.
- The student will be able to optimize database using normalization.
- The student will be able to work on database software MYSQL/Oracle.
- The student will learn how to write SQL query.
- The student will be able to understand NoSQL concepts.

DS7A-709: Python for Analytics Credits: 3 (2-0-2)

Objective: The main objective is to help students to understand the fundamentals of python. Student will learn how to analysis data using Python.

COURSE DESCRIPTION:

UNIT I: Introduction to Python: Python versus Java, Python Interpreter and it's Environment, Python installation, Python basics: variables, operators, Strings, Conditional and Control Statements, loops; Data structures: lists and dictionaries; functions: global functions, local functions, lambda functions and methods.

UNIT II: Object Oriented Programming Concepts: Class, object, constructor, destructor and inheritance; Modules & Packages, File Input and Output, Catching exceptions to deal with bad data, Multithreading, Database Connectivity.

UNIT III: Numpy: Creating Arrays, Arrays Operations, Multidimensional ArraysArrays transformation, Array Concatenation, Array Math Operations, Multidimensional Array and its Operations, Vector and Matrix. **Visualization:** Visualization with matplotlib, Figures and subplots, Labeling and arranging figures, Outputting graphics.

UNIT IV: Pandas: Manipulating data from CSV, Excel, HDF5, and SQL databases, Data analysis and modelling with Pandas, Time-series analysis with Pandas, Using Pandas, the Python data analysis library, Series and Data Frames, Grouping, aggregating and applying, Merging and joining.

Text Books:

1. McKinney Wes, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.
2. Hauck Trent, "Instant Data Intensive Apps with Pandas How-To", Packt Publishing Ltd, 2013.
3. Beazley David M.,"Advanced Python Programming", Pearson Education,2009.
4. Chun Wesley , Core Python Programming, 3rd Edition,Prentice Hall Professional, 2012.

5. Telles Matt "Python Power!: The Comprehensive Guide", Cengage Learning, 2008.
6. McKinney Wes & PyData Development Team, "pandas: powerful Python data analysis toolkit", Release 0.13.1, Feb 2014.
7. https://docs.python.org/3.4/tutorial/
8. http://www.tutorialspoint.com/python/python_quick_guide.htm

Course Outcomes:
- The student will learn core data types of python.
- The student will learn conditional and looping operations in python.
- The student will be able to work with Object-oriented concepts and Database connectivity in python.
- The student will be able to analyze data using Pandas and Numpy.
- The student will be able to visualize the data using seaborn and matplotlib.

DS7A-711: Advanced Excel Credits: 2 (0-0-4)

Objective: The main objective of this course is to learn analysis of data using MS Excel, resulting in less time and better understands what the data means.

COURSE DESCRIPTION:

Unit I: Introduction to Excel User Interface**,** Application, Workbook, Worksheets & its Components, Named Ranges; Formatting: Cell Color, Font Color, Indents, Alignments, Number Formats, Custom Formats, Editing commands; Data Sorting: Built-in Sort, Sorting Levels, Custom Sort; Data Filtering: Auto Filter – Filter By Color, Filter by Icono Advanced Filter, Remove Duplicates; Data Subtotal – Built-In Subtotal (Nested Subtotal).

Unit II: Data Validation: Based on cell values (text length, whole no Based on Formulas, List Dropdown, Circle Invalid Data, Input & Error Messages; Data Grouping: Grouping Rows, Grouping Columns. Data Tables: Conditional Formatting, Formatting based on Cell values, Formatting based on Formulas, Icon Sets (bars, scales, icons), Freezing Panes, Text-to-Columns, Delimited, Fixed Length; Data Consolidation (from multiple files), Getting External Data into Excel, From MS Access, From Text files, From Web, Other Data Sources.

Unit III: Formulas, TEXT Functions, IF, ERROR Functions, LOGICAL Functions, VLOOKUP, HLOOKUP, COUNTIF, SUMIF, SUMPRODUCT, DATE & TIME FUNCTIONS, FORMULA TEXT, Information Functions (ISNA, ISEVEN, ISERR…).

Unit IV: Charts: Chart Types, Chart Components, Primary Vs Secondary Axis, Chart Formatting, Sparkline (2010 and above); Pivot Tables: Introduction & Creation, Slicer, TimeLine, Pivot Charts, Calculated Fields, Calculated Items, Grouping, Formatting – Number/Conditional, PowerPivot, PowerView.

Text Books:

1. John Walkenbac, “Excel 2016 Bible”, John Willey & sons.
2. Jordan Goldmeier , “Advanced Excel Essentials”, Apress Publisher.
3. Conrad George Carlberg , “Business Analysis with Microsoft Excel”, Que Publishers.
4. Bernd Held, ”Microsoft Excel Functions & Formulas”, Wordware publishing, Inc.
5. Steven Roman ,”Writing Excel Macros with VBA” O’Reilly Media.

Course Outcomes:
- The student will be able to perform basic operations in Excel.
- The student will be able to summarize data using Grouping and pivot table.
- The student will be able to write conditional statements and perform LOOKUP operations.
- The student will be able to create charts in excel.
- The student will be able to create a dashboard in excel.

DS7A-721: Cloud Computing Credits: 3 (2-1-0)

Objective: The main objective of this subject is to help student to understand Cloud and It’s Services, Architecture, Deployment, Core Issues, Strengths and limitations of cloud computing.

UNIT I Introduction to Cloud Computing: Overview of Cloud Computing, History of Cloud Computing, Importance of Cloud Computing, advantages and disadvantages of Cloud Computing, Applications, Cloud computing vs. Cluster computing vs. Grid computing, Future of Cloud Computing; Cloud Computing Architecture: Cloud computing stack, Comparison with traditional computing architecture (client/server), Cloud Service Models(XaaS), Deployment Models (Public cloud, Private cloud, Hybrid cloud).

Unit II: Cloud Service Models and Virtualization: Infrastructure as a Service (IaaS): Introduction, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Virtual Machine(VM), Resource Virtualization(Server, Storage, Network),VMware vSphere, Machine Image ,Porting Applications Case study on Amazon EC2;Platform as a Service(PaaS): Introduction to PaaS, advantages and disadvantages of PaaS, case study on Microsoft Azure; Software as a Service(SaaS): Introduction to SaaS, Web services, Web 2.0, Web OS; Development Services and Tools : Amazon Ec2, Google App Engine, IBM Clouds.

UNIT III: Capacity Planning: Defining Baseline and Metrics, Baseline measurements, System metrics, Load testing, Resource ceilings, Server and instance types, Network Capacity, Scaling. Understanding Service Oriented Architecture, Moving Applications to the Cloud, Working with Cloud-Based Storage, Working with Productivity Software.

UNIT IV: Managing the Cloud: Administrating the Clouds, Cloud Management Products; Cloud Security: Security Overview, Cloud Security Challenges and Risks, Security Governance, Risk Management: Security Monitoring, Security Architecture Design, Data Security, Application Security, Virtual Machine Security, Identity Management and Access Control, Authentication in cloud computing, Client access in cloud, Cloud contracting Model. Using the Mobile Cloud: Working with Mobile Devices and Working with Mobile Web Services;

Case Studies on Various Clouds: Google Web Services, Amazon Web Services, Microsoft Cloud Services, IBM Clouds, Eucalyptus.

Text Books:

1. Kris A Jamsa: Cloud computing : SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security and More 2013Jones & Bartlett Learning ISBN-13: 9781449647391.
2. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach”, TMH, 2009.
4. Sosinsky B., “Cloud Computing Bible”, Wiley India
5. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011.
6. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010.

Course Outcomes:

- The student will be able to understand the basics of Cloud Computing.
- The student will be able to understand Cloud Computing Models.
- The student will be able to work with AWS Cloud Platform.
- The student will be able to manage cloud platform.
- The student will be able to understand various cloud services.

DS7A-723: Statistical Programming in R Credits: 3 (2-0-2)

Objective: This course is an introduction to R, a powerful and flexible statistical language and environment that also provides more flexible graphics capabilities than other popular statistical packages. After taking this course, students will be able to –

1. Use R for statistical programming, computation, graphics, and modeling,
2. Write functions and use R in an efficient way,
3. Fit some basic types of statistical models,
4. Use R in their own research,
5. Be able to expand their knowledge of R on their own

COURSE DESCRIPTION:

Unit I: Introduction to R programming language: Getting R, Managing R, Arithmetic and Matrix Operations, Introduction to Functions, Control Structures. Working with Objects and Data: Introduction to Objects, Manipulating Objects, Constructing Data Objects, types of Data items, Structure of Data items, Reading and Getting Data, Manipulating Data, Storing Data.

Unit II: Data Distribution and Statistical Testing: Types of Data distribution, Normal distribution, Poisson distribution, Random number generation, Chi-Square Testing, Student’s t-test, F-test, Monte Carlo Simulation.

Unit III: Graphical Analysis using R: Basic Plotting, Manipulating the plotting window, Box-Whisker Plots, Scatter Plots, Pair Plots, Pie Charts, Bar Charts.

Unit IV: Advanced R: Statistical models in R, Correlation and regression analysis, Analysis of Variance (ANOVA), creating data for complex analysis, Summarizing data, and case studies.

Text Books:

1. Mark Gardener: Beginning R: The Statistical Programming Language, Willey publications
2. Norman Matloff: The Art of R Programming: A Tour of Statistical Software Design, OREILLY & Associates Inc.

Course Outcomes:

- Data manipulation - acquiring skills in flexible matrix manipulation
- Access online resources for R and import new function packages into the R workspace
- Scripting in such a way that the script can be used with minimal effort for similar datasets and analyses and for especially large datasets
- Explore data-sets to create testable hypotheses and identify appropriate statistical tests
- Perform appropriate statistical tests using R
- Learn how to create high-quality figures, especially associated with more complex analyses (e.g. three dimensional scatter plots, animated chart Trellis displays, etc.).

DS7A-725: Multivariate Analysis Credits: 3 (2-0-2)

Objective:

1. To understand the main features of multivariate data.
2. To be able to use exploratory and confirmatory multivariate statistical methods properly.
3. To be able to carry out multivariate statistical techniques and methods efficiently and effectively.

COURSE DESCRIPTION:

UNIT I: Analysis of categorical data. Loglinear models for two- and higher-dimensional contingency tables, Characterizing and Displaying Multivariate Data, Tests on one or two mean vectors.

UNIT II: Multivariate Analysis of Variance, Aspects of multivariate analysis, random vectors, sample geometry and random sampling, multivariate normal distribution, inferences about the mean vector, MANOVA.

UNIT III: Classification and grouping techniques: discrimination and classification, clustering. Logistic regression models.

UNIT IV: Analysis of covariance structures, Principal Component Analysis (PCA), Factor Analysis, Cluster Analysis. Use of statistical computer packages.

Text Books:

1. Applied Multivariate Statistical Analysis, by Richard A. Johnson and Dean W.Wichern (6th edition), Prentice Hall.
2. Characterizing and Displaying Multivariate Data, by A.C.Rencher, John Wiley and Sons.
3. Multivariate Data Analysis, by Joseph F.Hair, William, Babin and Anderson.
4. Cluster Analysis, by Brian S.Everitt, Sabine Landau, Morven Leese. Wiley

Course Outcomes:

- To be able to understand the concept of analysing multivariate data.
- To be familiar with a basic minimum level of matrix competency and with general aspects of handling multivariate data.
- Perform exploratory analysis of multivariate data, such as plot multivariate data, calculating descriptive statistics, testing for multivariate normality;
- Conduct statistical inference about multivariate means including hypothesis testing, confidence ellipsoid calculation and different types of confidence intervals estimation;
- Undertake statistical analyses using appropriate multivariate techniques, which includes principal component, factor analysis, discriminate and clustering analysis
- Analyse multivariate data using the statistical software package.

DS7A-751: Fundamentals of Algorithms Credits: 3 (2-1-0)

Objective: The main object of this course is to provide an introduction to create analytical skills, to enable the students to design algorithms for various applications, and to analyse the algorithms.

COURSE DESCRIPTION:

Unit I: Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation- Big oh notation, Omega notation, Theta notation and Little oh notation

Unit II: Divide and conquer: General method, applications-Binary search, Quick sort, Merge sort, Strassen's matrix multiplication.

Unit III: Greedy method: General method, applications-Job sequencing with deadlines, 0/1 knapsack problem, Minimum cost spanning trees, Single source shortest path problem. Dynamic Programming: General method, applications-Matrix chain multiplication, Optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem, Travelling sales person problem.

Unit IV: Backtracking: General method, applications-n-queen problem, sum of subsets problem, graph colouring, Hamiltonian cycles. Branch and Bound, NP-Hard and NP-

Complete problems: Basic concepts, non-deterministic algorithms, NP - Hard and NP Complete classes, Cook's theorem.

TEXT BOOKS

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithm", Pearson Education Asia, 2003.
2. T.H.Cormen,C.E.Leiserson, R.L.Rivest,and C.Stein "Introduction to Algorithms", second edition, ,PHI Pvt. Ltd./ Pearson Education
3. R.C.T.Lee, S.S.Tseng, R.C.Chang and T.Tsai, "Introduction to Design and Analysis of Algorithms A strategic approach", Mc Graw Hill.
4. Ellis Horowitz,Satraj Sahni and Rajasekharam," Fundamentals of Computer Algorithms",Galgotia publications pvt. Ltd.
5. Parag Himanshu Dave, Himanshu Bhalchandra, " Design and Analysis Algorithms", Dave Publisher: Pearson

Course Outcomes:

- The student will be able to understand the basics of algorithms.
- The student will be able to work with the divide and conquer method.
- The student will be able to work with Greedy methods.
- The student will be able to work with backtracking algorithms.
- The student will be able to understand NP-Hard and NP-Complete Problem.

Second Semester:

DS7A-702: Forecasting Methods Credits: 4 (2-1-2)

COURSE OBJECTIVE

This subject is designed in such a way to provide the basic concepts of forecasting models based on quantitative analysis. Risk and uncertainty in forecasting and it is generally considered good practice to indicate the degree of uncertainty attaching to forecasts.

COURSE DESCRIPTION:

Unit I: Introduction: Fo**re**casting perspective, an overview of forecasting methods, basic steps in forecasting. Basic forecasting tools: time series and cross-sectional data, graphical and numerical summaries, forecasting accuracy, prediction intervals, transformations and adjustments.

Unit II: Time series: Decomposition, principles of decomposition, moving averages, classical decomposition, census bureau methods, forecasting and decomposition.

Unit III: Exponential smoothing: averaging methods, Singleexponential smoothing methods, ARRSES, Double exponential soothing methodcomparison of methods, general aspects of smoothing methods.

Unit IV: Regression: Simple regression, forecasting with simple regression, non-linear relationships. Multiple regressions. Box-Jenkins methods: examining correlations in time series data, examining stationary, ARIMA models, forecasting with ARIMA models.

Text Book(s):

1. Spyros Makridakis :Forecasting Method's and application Wiley
2. N.P. Nagpal :Forecasting Techniques ,RBSA
3. Stephen A. Delurgio: Forecasting Principals and Application,McGraw Hill

Course Outcomes:

- Discuss the key factors which affect the success of forecasting procedures.
- Use Basic Statistical Techniques and statistical Graphics to forecast values.
- Find different sets of Smoothed or Average values to be used when forecasting.
- Understand the key concepts needed to use the Linear Regression model when forecasting.
- Model and Forecast the Seasonal component of a set of values.
- Model the different types of cyclical behaviour observed in different sets of values.
- Understand and use the Box-Jenkins or ARMA Procedure.

DS7A-704: Big Data Technologies Credits: 3 (2-0-2)

Course Objective: The main objective of this course is to introduce big data technologies such as Hadoop, spark and analyzing big datasets in spark using python.

COURSE DESCRIPTION:

UNIT I: Introduction

Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting – Modern Data Analytic Tools. Big Data Analytics Process, Big Data Analytics for Business. Identifying problem and solving problem in Big Data environment. Analyzing Unstructured vs. Structured Data, Databases.

UNIT II: Hadoop and MapReduce

Introduction to Hadoop, Hadoop architecture, A Brief History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases; Hadoop Distributed File system: Design of HDFS, HDFS Concepts. Introduction to MapReduce: MapReduce Basic Concepts, Understanding the Map Reduce architecture, Writing MapReduce Programs. understanding Map phase, shuffling, sorting, and reducing phase.

UNIT III: Spark

Introduction to Spark, Resilient Distributed Dataset (RDD), RDD Operations: actions and transforamtion funtions. Spark Dataframes, operations on Dataframes: Join, groupby, aggregate, handling missing data.

UNIT IV: SparkSQL and MLLib

SparkSQL and its basic operations. MLLib: Data types, Basic statistics, Classification(Logistic regression, Decision tree classifier)and linear regression model generation, Model Evaluation, Collaborative filtering, and Clustering.

Text Books:

1. Arvind Sathi, “Big Data Analytics: Disruptive Technologies for Changing theGame”, 1st Edition, IBM Corporation, 2012.
2. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, 1st Edition, Wiley and SAS Business Series, 2012.
3. Tom White,"Hadoop: The Definitive Guide", 3rd Edition, O'Reilly Media, 2012.
4. Donald Miner, Adam Shook, Eric Sammer, “Hadoop Operation”, O’Reilly 2012.
5. Donald Miner, Adam Shook “MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems”, O’Reilly 2012.
6. Chuck Lam, "Hadoop in Action", Manning Publications, 2010.
7. https://spark.apache.org/docs/2.0.0/programming-guide.html

Course Outcomes:

- The student will be able to understand core concepts of Hadoop.
- The student will know the HDFS and MapReduce.
- The student will be able to work with Big Data tool such as Spark.
- The student will be able to analyze big data sets.
- The student will be able to create machine learning models for Big data.

DS7A-706: Linear Algebra and Advanced Calculus Credits: 3 (2-1-0)

Objective: The main objective is to students will learn to solve many types of data science problems using Linear Algebra and Calculus.

Course Description:

Unit I: Vector spaces over fields, subspaces, bases and dimension. Systems of linear equations, matrices, rank, Gaussian elimination. Linear transformations, representation of linear transformations by matrices, rank-nullity theorem, duality and transpose.

Unit II: Determinants, cofactors, adjoint, Cramer's Rule. Eigenvalues and eigenvectors, characteristic polynomials, minimal polynomials, Cayley-Hamilton Theorem, triangulation, diagonalization, rational canonical form, Jordan canonical form.

Unit III: Inner product spaces, Gram-Schmidt orthonormalization, orthogonal projections, linear functions and adjoints, Hermitian, self-adjoint, unitary and normal operators, Spectral Theorem for normal operators, Rayleigh quotient, Min-Max Principle.

Unit IV: Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor’s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange’s method of undetermined multipliers. Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

Text Books:

1. K. Hoffman and R. Kunze, Linear Algebra, Pearson Education (India), 2003. Prentice-Hall of India, 1991.
2. S. Lang, Linear Algebra, Undergraduate Texts in Mathematics, Springer-Verlag, New York, 1989.
3. P. Lax, Linear Algebra, John Wiley & Sons, New York, Indian Ed. 1997

4. H.E. Rose, Linear Algebra, Birkhauser, 2002.
5. Hildebrand, Francis. Advanced Calculus for Applications. 2nd ed. Englewood Cliffs: Prentice Hall, March 31, 1976.
6. Kaplan W., "Advanced Calculus", Addison Wesley (Pearson Education, Inc.), 5 th Edition, 2003
7. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, (2011).

Course Outcomes:

After successful completion of this course students will be able to:

1) demonstrate competence with the basic ideas of linear algebra including concepts of vector spaces, linear systems, independence, theory of matrices, linear transformations, bases and dimension, eigenvalues, eigenvectors and diagonalization;
2) describe and apply the key concepts advance calculus;
3) communicate and understand mathematical statements, ideas and results, both verbally and in writing.

DS7A-708: Modelling and Simulation Credits: 3 (2-0-2)

COURSE OBJECTIVE

This course exposes the students in simulation modelling, solving and analysing business and industrial problems using simulation models.

COURSE DESCRIPTION:

Unit -I:

System modelling, classification of models, validation and verification. System simulation, simulation terminology, applications of simulation, Simulation steps, advantages and disadvantages of simulation. Monte Carlo (MC) simulation. An inventory simulation. A waiting line simulation.

Basic probability and statistics. Random variables and their properties, simulation output data and stochastic processes, estimation of means, variances, and correlations, confidence intervals, and hypothesis testing, Strong law of large numbers.

Unit-II:

Generation of Random Numbers: Pseudo random numbers: Pseudorandom numbers and algorithm for generating them-mid-square method, linear congruential method, additive congruential method, quadratic congruential method. Testing and validating of pseudo random sequences.

Generating random variants: inverse-transform method; generating continuous Random variates: uniform, exponential; generating discrete random variates: Binomial, Poisson.

Variance reduction techniques, Experimental design.

Unit-III:

Discrete-Event Simulation: Time advance mechanisms. Components and Organization of a discrete event simulation model. Simulation of a single-server queuing system. Simulation of an inventory system.

Simulation Languages: Comparison of simulation languages with general purpose languages. Classification of simulation software. Desirable software features. Simulation language – GPSS / SIMSCRIPT – II.5.

Unit-IV:
Building valid and credible simulation models, determining the level of model detailing, techniques for increasing model validity and credibility. Output data analysis.

TEXTBOOKS
Averill M. Law: Simulation Modeling & Analysis, Tata McGraw-Hill
Geoffrey Gordon: System Simulation, Prentice Hall of India
David R. Anderson, Dennis J. Sweeney, Thomas A. Williams: An Introduction to Management

Course Outcomes:
After completion of this course the students will be able to-

- model deterministic systems and differentiate between nonlinear and linear models.
- numerically simulate linear and non-linear ordinary differential equations and deterministic systems.
- estimate and validate a model based upon input and output data.
- Generate and test random number variates and apply them to develop simulation models
- Analyse output data produced by a model and test validity of the model.

DS7A-710: Machine Learning Credits: 3 (2-0-2)

Objective: The main objective is to help students to understand the fundamental concepts of machine learning.

COURSE DESCRIPTION:

UNIT I: Introduction to Machine Learning, History and Overview of machine learning, Applications, Types of Machine Learning, Basic Concepts. Concept Learning and candidate elimination learning Algorithm.

UNIT II: Artificial Neural Network: biological neural network, evolution of artificial neural network, McCulloch-Pitts neuron models, Learning (Supervise & Unsupervised) and activation function. Supervised Learning: Perceptron learning, Single layer/multilayer, linear Separability, Adaline, Madaline, Back propagation network, RBFN.

UNIT III: Bayesian Learning, Bayes Theorem, Naïve Bayesian classifier, Bayesian belief, EM Algorithm. Dimensionality Reduction: Factor Analysis, Principal Component Analysis, Linear Discriminant Analysis.

UNIT IV: Markov and Hidden Markov Models, PAC Learning, Support Vector Machine, Evolutionary Learning: Genetic Algorithm, generating offspring, applications and genetic programming.

Text Books:

1. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
2. Stephen Marsland, "Machine Learning –An Algorithmic Perspective", CRC Press, 2009.
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
4. Ethem Alpaydin, "Introduction to Machine Learning", Prentice Hall of India, 2005.
5. Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2006.
6. Sanjeev Kulkarni, Gilbert Harman, "An Elementary Introduction to Statistical Learning Theory", 2011.
7. N. Shivnandam, "Principle of soft computing", Wiley.

Course Outcomes:

- The student will be able to understand the basics of machine learning.
- The student will be able to understand Regression analysis.
- The student will be able to work on classification problems.
- The student will be able to work with unsupervised learning approaches.
- The student will be able to perform machine learning operations in scikit-learn.

DS7A-712: Data Mining and Data Warehousing Credits: 3 (2-0-2)

Course Objective The main objective of this course is to provide understanding of data warehouse fundamentals and data mining techniques for business applications.

COURSE DESCRIPTION:

UNIT I: Data Warehousing: Introduction data warehousing, Data Mart, Data Warehouse Architecture; Star, Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning. ETL Concepts. OLAP technology: Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation, Efficient Computation of Data Cubes, Processing of OLAP queries, indexing data.

UNIT II: Data Mining: Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining; Introduction to Web Mining, Text Mining. Data Processing: Data Cleaning, Data Integration and Transformation; Data Reduction: Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Data Discretization and Concept hierarchy generation for numerical and categorical data.

UNIT III: Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, FP-Growth Algorithm, latest trends in association rules mining.

UNIT IV: Classification methods: Decision tree, Bayesian Classification, Rule based; clustering methods: Partitioning methods(K-Means, K-Mediods) and Hierarchical Clustering (Agglomerative and Divisive Clustering, Multi-phase method) Prediction: Linear and non-linear regression.

Text Books:

1. P.Ponnian, "Data Warehousing Fundamentals", John Wiley.
2. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann.
3. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education.
4. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", Wiley India.
5. Michael Berry and Gordon Linoff "Data Mining Techniques",Wiley Publications.
6. M.H.Dunham, "Data Mining Introductory & Advanced Topics", Pearson Education.

Course Outcomes:

- The student will learn basics of Data Warehouse.
- The student will learn basics of Data Mining.
- The student will be able to Pre process the data.
- The student will be able to perform Market Basket analysis.
- The student will be able to work with Classification Algorithms.
- The student will be able to cluster the data.

DS7A-722: Scientific Computing Credits: 3 (2-1-0)

Objective:

The course provides an appreciation of the need for numerical methods for solving different types of problems, and discusses basic approaches. It develops the understanding of numerical mathematics or scientific computing - whether in mathematics, the sciences, engineering, or economics.

COURSE DESCRIPTION:

Unit I: Foundation of Scientific Computing, Quantum computing, Wentzel-Kramer-Brillouin Method, Runge-Kutta method, Trapezoidal method.

Unit II: Quasi-linear, Laplace equation, wave packets, Pressure fluctuation, wave phenomena, linearized shallow water wave equation, 1D convection equation, Upwinding, Numerical amplification factor, Stiff differential equation.

UNIT III: Numerical amplification factor, Heat equation, Parabolic partial differential equation, Tridiagonal matrices, Error propagation, Elliptic partial differential equations, Ordinary differential equation, Convergence properties, General elliptic equation, Multigrid method.

Unit IV: Spectral analysis of explicit and implicit, Highlight the scientific and high performance, Taylor series analysis, Buffer domain technique, Aliasing error, Accuracy compact schemes, CCD scheme Stabilizing effects of filters, Properties of filters, Scientific elements of a FEM, Lagrange and hermite interpolations, Elliptic equation with linear basis function.

Text Books:

1. Scientific Computing by Michael T Heath, Mc Graw Hill, 2001
2. Numerical Recipes: The Art of Scientific Computing, Cambridge University Press, 2007
3. Guide to Scientific Computing by Peter R Turner, CRC Press, 2001

Course Outcomes:

After successful completion of the course the students will be able to-

- transform scientific problems into generic computational models;
- have an overview of advanced algorithms for solving a wide range of problems;
- solve mathematical problems by using elementary algorithms, and compute solutions using a structured computer program.
- display and analyse data appropriately, including the results of numerical calculations.
- plan and develop efficient numerical programs.

DS7A-724: Natural Language Processing Credits: 3 (2-0-2)

Objective: The main object of this course is to provide an introduction to the field of computational linguistics, and natural language processing (NLP).

COURSE DESCRIPTION:

UNIT I: Introduction to NLP, NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field.

UNIT II: The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models. Lexical syntax. Hidden Markov Models. Maximum Entropy Models. Conditional Random Fields.

UNIT III: Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labeling and Semantic Parsing.

UNIT IV: Named entity recognition and relation extraction. IE using sequence labeling. Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars. Web 2.0 Applications : Sentiment Analysis; Text Entailment.

Text Books:

1. Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.
2. Charniack, Eugene, Statistical Language Learning, MIT Press, 1993.
3. Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
4. Steven Bird, Ewan Klein, and Edward Loper,"Natural Language Processing with Python - Analyzing Text with the Natural Language Toolkit", O'Reilly Media, 2009.
5. Ian H. Witten and Eibe Frank. "Data Mining: Practical Machine Learning Tools and Techniques" , 3rd edition, Morgan Kaufmann, 2005.
6. Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

Learning Outcomes:

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

1. Broad understanding of the field of Natural Language Processing.
2. Understand mathematical concepts for NLP algorithms.
3. Understanding the capabilities and limitations of NLP technologies.
4. Apply the fundamental knowledge of various types of basic NLP techniques to analyze, design, formulate and implement solutions for any real time situation.
5. Understand the theoretical concepts of NLP in formal language theory.

DS7A-726: Web Mining Credits: 3 (2-0-2)

Objective: The main objective of this course is to learn how to apply web mining to derive data driven results.

COURSE DESCRIPTION:

UNIT I: Introduction to Web Mining: Web content, web usage mining and web structure mining. Web crawling: Crawling Basics; Indexing, Text analysis and classification.

UNIT II: Similarity and Clustering/community algorithms: Partitioning Approaches, Geometric Embedding Approaches, and Probabilistic Approaches; Topical locality,

UNIT III: Supervised Text Learning: Evaluating Text Classifiers, Nearest Neighbour Learners, Greedy Inclusion Algorithms, Truncation Algorithms, Exploiting Hierarchy among Topics, Discriminative Classification, Regression, Support Vector Machines, Hypertext Classification. SEMISUPERVISED LEARNING: Expectation Maximization, Labelling Hypertext Graphs.

UNIT IV: Link analysis: PageRank and HITS ranking methods, Ranking algorithms; Web search and retrieval, Web growth models, Web traffic models; Social tagging, Social networks and social media, Information diffusion. Applications of Web mining in Recommendation system.

Text Books:

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008.
2. Michael Berry and Gordon Linoff, “Data Mining Techniques for Marketing, Sales, and Customer Relationship Management”, Third Edition, John Wiley, 2011.
3. Soumen Chakrabarti,"Mining the Web: Discovering Knowledge from Hypertext Data",Morgan Kaufmann, 2003.
4. Bing Liu “Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data”,2011 edition, Springer.
5. Anthony Scime,"Web Mining: Applications and Techniques", Idea Group Inc (IGI), 2005.

Course Outcomes:

- The student will be able to understand basics of web mining.
- The student will be able to scrap the web content.
- The student will be able to Analyzing web content.
- The student will be able to create NLP models to analyzing the web content.
- The student will be able to understand link analysis and page rank.

DS7A-752: Technical Communication Credits: 3 (2-1-0)

Objective:

This course is designed to help the students to develop skills that will enable them to produce clear and effective scientific and technical documents.

Unit I:

Technical writing: Definition, Similarities to other writings, Unique features, importance, technical writing as profession, qualifications for technical writing. Identifying audience. Problems involving content, words and phrases, punctuation, unity, coherence, logic, etc. Being concise.

Unit II:

Techniques of Technical Communication. Analysing-Division, Classification, Partition. Defining-Formal, informal, expanded. Describing-subjective versus objective, spatial description, description of mechanism, process, selected details. Illustrating-Tables, graphs, charts, pictorials. Researching-Basic types of research, original research, searching the literature. Abstracting of your own reports, the works of others, precautions. Oral communication-one to one reporting, participation in conferences, speaking to large audiences, organising the speech.

Unit III:

Basic forms of Technical Writings. The memorandum, The business letter, Formal report.

Unit IV:

Technical reports. Justification reports and proposals, the progress reports, periodic reports, status reports, trip reports. Laboratory reports, Feasibility reports, State-of-the-Art reports. Instructions and manuals.

Text Books:

1. James Sherlock: A Guide to Technical Communication

Course Outcome:

After completion of this course student will be able to-

- Document the knowledge about products, services, technology, or concepts into well-crafted and organised information collateral.
- Write technical reports, memorandum, business letters, manuals, proposals, progress reports etc.
- Develop document involving spatial description, description of mechanism, process, illustrations, etc.

SCHOOL OF DATA SCIENCE AND FORECASTING

PROGRAM CODE: DS9Z BATCH: 2018
PROGRAM TITLE: DOCTOR OF PHILOSOPHY (Ph.D.)
- DATA SCIENCE

PROGRAM OUTCOMES:

- Developing research aptitude.
- Following the steps of research methodology. Learning the ways to data collection and analysis.
- Writing of scientific reports, research papers and dissertation.

PROGRAM SPECIFIC OUTCOMES:

- Problem understanding and developing the solution methods.
- Data collection and analysis.
- Use Data Visualization techniques.
- Employ cutting edge tools and technologies of Data Science.
- Demonstrate knowledge of mathematical and statistical skills.

COURSE WORK STRUCTURE:

Course Code	Course Title	Credits (L-T-P)
DS9Z-901	Research Methodology	4 (2-1-2)
DS9Z-902	Review of Published Research	3 (0-0-6)
DS9Z-903	Computer Applications	3 (1-0-4)
DS9Z-904	Forecasting Methods	3 (2-0-2)
DS9Z-905	Comprehensive Viva-Voce	3

DETAILED SYLLABUS:

DS9Z-901: Research Methodology: **4 (2-1-2)**

Objectives:

- To understand the problem and define it.
- To portray accurately the characteristics of a particular individual, situation or a group.
- To determine the frequency with which something occurs or with which it is associated with something else.

- To test a hypothesis of a causal relationship between variables.

Course contents:

Unit-I:

Introduction to research, Need, Importance and Characteristics of research, Types of research – An overview, Quantitative and qualitative research, Review of literature. Identification, Definition and Statement of Problem, Variables, Role of variables in research, Research Questions and Objectives.

Unit-II:

Hypotheses, Hypotheses Testing, Population and Sample, Probability Sampling Techniques, Non - Probability Sampling Techniques.

Unit-III:

Research Design – An Overview, Philosophical and Historical, Survey, Case Studies. Experimental Designs, Research Tools. Process of Research Tools Designing, Questionnaire Designing, Test Designing, Scale Designing, Scaling Techniques. Process of Standardising Research Tools, Data Analysis Overview.

Unit-IV:

Frequency Distribution, Statistical Tools: Measures of Central Tendency, Measure of Variability, Comparing Means: Independent Sample t-test, Paired Sample t-test, One Way ANOVA, Factorial Design ANOVA, ANCOVA, Correlation, Regression, Factor Analysis and Non-parametric Statistical Techniques.

Report Writing, IPR and Plagiarism, Statistical Software and Research Paper Writing.

Text Books:

1. Kerlinger, F.N: Foundations of Behavioral Research, Surjeet Publication, New Delhi, 1983.
2. Sterling, T. and Pollack, S: Introduction to Statistical Data Processing, Prentice Hall, 1968.
3. Campbell, W: Forms and style in Thesis Writing, 3rd ed., Boston., Houghton, Mifflim, 1969.
4. McNemar, Orinn: Psychological Statistics, John Wiely and Sons, 1960.
5. Molstad, John A.: Selective Review of Research Studies Showing Media Effectiveness: A Primer for Media Director. AV communication review vol.22, 1974.

Course Outcomes:

- To be able to understand the basic concept of research and data collection.

- To be able to formulate research questions and develop a sufficiently coherent research design.
- To be able apply advanced knowledge in statistics to experimental and applied research. Development of hypothesis and testing.
- To be able to critically evaluate the methodological designs and select appropriate analytical strategies for their research projects.
- To understand the interpretation and appropriate reporting requirements for research and thesis writing.

DS9Z-902: Review of Published Research: **3 (0-0-6)**

- Introduction to Literature Review
- Problem Identification
- Process of Literature Review
    - Searching for related literature to research problem
    - Methods of organizing the literature
    - Synthesize the results
    - Finalize the review

Course Outcomes:

At the end of the course the student will learn to

- do literature survey for research.
- synthesize the results and writing the review.

DS9Z-903: Computer Applications: **3 (2-0-2)**

Objective:
To make effective use of the computer in research.

Unit I: Basic Knowledge of Computer:
System software, Application software, introduction to operating system, single user, multi-user, multi-tasking single tasking, application of computer for research, MS-windows, Linux.

Data Communication and Networks: Data communication concepts, local area network, wide area network, internet, intranet, extranet, website. E-mail, search engines-enterprise E-communication and E-collaboration

Unit II: Use of Internet in Research:
Introduction to internet, INFLIBNET, sights (DOAJ), searching on the internet, Using

graphics on internet, E-mail. The use of multimedia on the internet, Security on the internet, Exploring e-mail facilities. Internet and the society, study of search engines, Use of EBSCO HOST online database of Academic Libraries. Use of E-Journals, Use of E-library, searching the keyword search engines.

Unit III: Use of Softwares in Research:

Introduction to Data analysis software-SPSS: Definition, objectives and features, data analysis using SPSS: Data entry creating variables, switching to data labels, data analysis: Frequencies, recording into different variables, cross tabulations and layers. MATLAB.

Unit V: Research Related Tools and Utilities:

MS-Office and its application, File handing in window, various versions of MSOffice, Research publishing tool- MS-word, Adobe acrobat, Graphics tool- MSexcel. MS-Power Point: Creating presentations and adding effects. Subject/Field specific tools on www.freeware.com

Text Books:

Shelly, G., Cashman,T,. & Vermaat, M. (2008). Microsoft Office 2007. Boston: Cengage Learning.

Softwares: MS Office, SPSS, MATLAB.

Course Outcomes:

At the end of the course the students will be able to-

- Apply computer resources for use in academics.
- Construct academic documents using Microsoft Word.
- Create spreadsheets with formulas and graphs using Microsoft Excel.
- Develop presentations containing animation and graphics using Microsoft PowerPoint.
- Conduct data analysis with SPSS, MATLAB.

DS9Z-904: Forecasting Methods Credits: 3 (2-0-2)

COURSE OBJECTIVE

This subject is designed in such a way to provide the basic concepts of forecasting models based on quantitative analysis. Risk and uncertainty in forecasting and it is generally considered good practice to indicate the degree of uncertainty attaching to forecasts.

COURSE DESCRIPTION:

Unit I: Introduction: Forecasting perspective, an overview of forecasting methods, basic steps in forecasting. Basic forecasting tools: time series and cross-sectional data, graphical and numerical summaries, forecasting accuracy, prediction intervals, transformations and adjustments.

Unit II: Time series: Decomposition, principles of decomposition, moving averages, classical decomposition, census bureau methods, forecasting and decomposition.

Unit III: Exponential smoothing: averaging methods, Single exponential smoothing methods, ARRSES, Double exponential soothing methods, comparison of methods, general aspects of smoothing methods.

Unit IV: Regression: Simple regression, forecasting with simple regression, non-linear relationships. Multiple regressions. Box-Jenkins methods: examining correlations in time series data, examining stationary, ARIMA models, forecasting with ARIMA models.

Text Book(s):

1. Spyros Makridakis :Forecasting Method's and application Wiley
2. N.P. Nagpal :Forecasting Techniques ,RBSA
3. Stephen A. Delurgio: Forecasting Principals and Application,McGraw Hill

Course Outcomes:

- Discuss the key factors which affect the success of forecasting procedures.
- Use Basic Statistical Techniques and statistical Graphics to forecast values.
- Find different sets of Smoothed or Average values to be used when forecasting.
- Understand the key concepts needed to use the Linear Regression model when forecasting.
- Model and Forecast the Seasonal component of a set of values.
- Model the different types of cyclical behaviour observed in different sets of values.
- Understand and use the Box-Jenkins or ARMA Procedure.