# IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Scheme Based on AICTE Flexible Curriculum

## Department of Computer Science & Engineering

## Master of Engineering (M.E.) [Computer Science & Engineering]

## II Semester

| S.No. | Subject Code | Category | Subject Name | Maximum Marks Allotted | | | | | Total Marks | Contact Hours per week | | | Total Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | Practical | | | | | | |
| | | | | End Sem | Mid Sem. Exam. | Quiz/ Assignment | End Sem | Term work / Lab Work & Sessional | | L | T | P | |
| 1. | PSCC-MCS201 | PSCC | Machine Learning | 70 | 20 | 10 | – | – | 100 | 3 | 1 | – | 4 |
| 2. | PSCC-MCS202 | PSCC | Data Visualization | 70 | 20 | 10 | – | – | 100 | 3 | 1 | – | 4 |
| 3. | PSEC-MCS201 | PSEC | Program Specific Elective Course-II | 70 | 20 | 10 | – | – | 100 | 3 | – | – | 3 |
| 4. | OEC-MCS201 | OEC | Open Elective Course | 70 | 20 | 10 | – | – | 100 | 3 | – | – | 3 |
| 5. | LC-MCS201 | LC | Machine Learning Lab | – | – | – | 60 | 40 | 100 | – | – | 4 | 2 |
| 6. | LC-MCS202 | LC | Data Visualization Lab | – | – | – | 60 | 40 | 100 | – | – | 4 | 2 |
| 7. | MLC-MCS201 | MLC | Research Methodology & IPR | 70 | 20 | 10 | – | – | 100 | 2 | – | – | 2 |
| 8. | AUD-MCS201 | AUD | Audit Course-II | – | – | – | – | – | – | 2 | – | – | 0 |
| | | | Total | 350 | 100 | 50 | 120 | 80 | 700 | 16 | 2 | 8 | 20 |

| Program Specific Elective Course-II | Open Elective Course | Audit Course-II |
|---|---|---|
| PSEC-MCS201(A) Text Processing | OEC-MCS201(A) Business Analytics | AUD-MCS201(A) Soft Skills and Interpersonal Communication |
| PSEC-MCS201(B) Fuzzy Logic and Application | OEC-MCS201(B) Operation Research | AUD-MCS201(B) Business Communication |
| PSEC-MCS201(C) Data Warehousing and Mining | OEC-MCS201(C) Industrial Safety | AUD-MCS201(C) Communication Skills |
| PSEC-MCS201(D) Data Science | OEC-MCS201(D) Voice & Data Network | AUD-MCS201(D) Life Science |

| 1 Hr Lecture | 1 Hr Tutorial | 2 Hr Practical |
|---|---|---|
| 1 Credit | 1 Credit | 1 Credit |

# IPS Academy
# Institute of Engineering & Science
# Department of Computer Science & Engineering
## II-Semester

| PSCC-MCS201 | Machine Learning | 3L: 1T (4 hrs.) | 4 credits |
|---|---|---|---|

**Prerequisite:** Artificial Intelligence

## Course Objective:

The objective of this course is to introduce the basic concepts and techniques of Machine Learning and to become familiar with various methods used in ML like regression methods, classification methods, clustering methods.

## Course Contents: (40 hrs.)

**Module 1:** **(8 hrs.)**
Introduction to machine learning, scope and limitations, regression, probability, statistics and linear algebra for machine learning, convex optimization, data visualization, hypothesis function and testing, data distributions, data preprocessing, data augmentation, normalizing data sets, machine learning models, supervised and unsupervised learning.

**Module 2:** **(8 hrs.)**
Linearity v/s non Linearity, activation functions like sigmoid, ReLU, etc., weights and bias, loss function, gradient descent, multilayer network, Back propagation, weight initialization, training, testing, unstable gradient problem, auto encoders, batch normalization, dropout, L1 and L2 regularization, momentum, tuning hyper parameters.

**Module 3:** **(8 hrs.)**
Convolution neural network, flattening, sub sampling, padding, stride, convolution layer, pooling layer, loss layer, dance layer 1x1 convolution, inception network, input channels, transfer learning, one shot learning, dimension reductions, implementation of CNN like tensor flow, keras etc.

**Module 4:** **(08 hrs.)**
Recurrent neural network, Long short-term memory, gated recurrent unit, translation, beam search and width, Bleu score, attention model, Reinforcement Learning, RL-framework, MDP, Bellman equations, Value Iteration and Policy Iteration, Actor-critic model, Q-learning, SARSA

**Module 5:** **(08 hrs.)**
Support Vector Machines, Bayesian learning, application of machine learning in computer vision, speech processing, natural language processing etc, Case Study: ImageNet Competition

## Course Outcome:

1. Apply knowledge of computing and mathematics to machine learning problems, models and algorithms;
2. Analyze a problem and identify the computing requirements appropriate for its solution;
3. Design, implement, and evaluate an algorithm to meet desired needs
4. Apply mathematical foundations, algorithmic principles and computer science theory to the modeling and design of computer-based systems.
5. Demonstrates comprehension of the trade-offs involved in design choices.

## List of Text / Reference Books:


1. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer-Verlag New York Inc., 2nd Edition, 2011.
2. Tom M. Mitchell, “Machine Learning”, McGraw Hill Education, First edition, 2017.
3. Ian Goodfellow and Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press, 2016
4. Aurelien Geon, “Hands-On Machine Learning with Scikit-Learn and Tensorflow: Concepts, Tools, and Techniques to Build Intelligent Systems”, Shroff/O'Reilly; First edition (2017).
5. Francois Chollet, "Deep Learning with Python", Manning Publications, 1 edition (10 January 2018).
6. Andreas Muller, "Introduction to Machine Learning with Python: A Guide for Data Scientists", Shroff/O'Reilly; First edition (2016).
7. Russell, S. and Norvig, N., “Artificial Intelligence: A Modern Approach”, Prentice Hall Series in Artificial Intelligence. 2003.

| PSCC-MCS202 | Data Visualization | 3L : 1T (4 hrs) | 4 credits |
|---|---|---|---|

**Prerequisite:** Computer Graphics, AI, Mathematics: basic linear algebra, calculus, probability

## Course Objective:

The objective of this course is to focus on how accurately represent voluminous complex data set in web and from other data sources and understand the methodologies used to visualize large data sets and to know the process involved in data visualization with security aspects

## Course Contents: (30 hrs.)

**Module 1:** **(06 hrs.)**

Introduction of visual perception, visual representation of data, Gestalt principles, information overloads.

**Module 2:** **(06 hrs.)**

Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

**Module 3:** **(12 hrs.)**

Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents.

**Module 4:** **(08 hrs.)**

Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization

**Module 5:** **(08 hrs.)**

Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating, visualizations

## Course Outcome:

1. State the core concepts of Data Visualization.
2. Illustrate various concepts of visual representations.
3. Illustrate various techniques and classification of visualization systems.
4. State the core concepts of network, distributed and multiprocessor operating system.
5. Describe the concepts of process, simulations and visualization of GIS.

## List of Text / Reference Books:


1. Scott Murray, "Interactive data visualization for the web", O"Reilly Media, Inc., 2013.
2. Ben Fry, "Visualizing Data", O"Reilly Media, Inc., 2007.
3. Greg Conti, "Security Data Visualization: Graphical Techniques for Network Analysis", No Starch Press Inc, 2007.

| MLC-MCS201 | Research Methodology and IPR | 2L (2 hrs.) | 2 credits |
|---|---|---|---|

**Prerequisite:** Basic knowledge of research, Simple mathematics

## Course Objective:

The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property. It will create consciousness for Intellectual Property Rights and its constituents. Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad.

## Course Contents: (40 hrs.)

**Module 1:** **(06 hrs.)**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

**Module 2:** **(12 hrs.)**

Effective literature studies approaches, analysis Plagiarism, Research Ethics.

**Module 3:** **(10 hrs.)**

Effective technical writing, how to write report, Developing a Research Proposal, Format of research proposal, presentation and assessment by a review committee

**Module 4:** **(08 hrs.)**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright, Process of Patenting and Development: technological research, innovation, patenting, development, International Scenario: International cooperation on Intellectual Property, Procedure for grants of patents, Patenting under PCT

**Module 5:** **(04 hrs.)**

Patent Rights: Scope of Patent Rights, Licensing and transfer of technology, Patent information, and databases, Geographical Indications, New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software, Traditional knowledge, Case Studies.

## Course Outcome:

1. Understanding and formulation of research problem.
2. Analyze research related information.
3. Understand plagiarism and follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

## List of Text / Reference Books:


1. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction".
2. Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners", 2nd Edition.
3. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
4. Mayall, "Industrial Design", McGraw Hill, 1992.
5. Niebel , "Product Design", McGraw Hill, 1974.
6. Asimov, "Introduction to Design", Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
8. T. Ramappa, "Intellectual Property Rights Under WTO".
9. Stuart Melville and Wayne Goddard, "Research methodology: An introduction for science & engineering students", Pubished By- Kenwyn, South Africa : Juta & Co. Ltd., 1996.

| PSEC-MCS201 | Text Processing | 3L (3 hrs.) | 3 credits |
|---|---|---|---|

**Prerequisite:** Machine Learning, Computer Programming

## Course Objective:

The objective of this course is to knowledge extracted from **text** data facilitates our life in a broad spectrum of areas, including business intelligence, information acquisition, social behavior **analysis** and decision making.

## Course Contents: (40 hrs.)

**Module 1:** **(06 hrs.)**

Overview of text mining, Definition, General Architecture, Algorithms, Core Operations, Pre-processing, basics of document classification- information retrieval- clustering and organizing documents, information extraction- prediction and evaluation, Textual information to numerical vectors, Collecting documents- document standardization, tokenization- lemmatization, vector generation for prediction, sentence boundary determination, evaluation performance

**Module 2:** **(12 hrs.)**

Text Categorization: Definition, Document Representation, Feature Selection, Decision Tree Classifiers, Rule-based Classifiers, Probabilistic and Naive Bayes Classifiers, Linear Classifiers, Classification of Linked and Web Data, Meta-Algorithms– Clustering, Definition, Vector Space Models, Distance-based Algorithms, Word and Phrase-based Clustering, Semi-Supervised Clustering, Transfer Learning

**Module 3:** **(10 hrs.)**

Information retrieval and text mining, keyword search- nearest-neighbor methods, similarity- web- based document search, matching- inverted lists, evaluation, Information extraction, Architecture, Co-reference, Named Entity and Relation Extraction, Template filling and database construction, Applications, Inductive -Unsupervised Algorithms for Information Extraction, Text Summarization Techniques - Topic Representation, Influence of Context, Indicator Representations, Pattern Extraction - Apriori Algorithm.

**Module 4:** **(08 hrs.)**

Probabilistic Models for Text Mining, Mixture Models, Stochastic Processes in Bayesian Nonparametric Models, Graphical Models, Relationship Between Clustering, Dimension Reduction and Topic Modeling, Latent Semantic Indexing - Probabilistic Latent Semantic Indexing, Latent Dirichlet Allocation, Interpretation and Evaluation, Probabilistic Document Clustering and Topic Models, Probabilistic Models for Information

Extraction, Hidden Markov Models, Stochastic Context-Free Grammars Maximal Entropy Modeling - Maximal Entropy Markov Models -Conditional Random Fields

**Module 5:** **(04 hrs.)**

Visualization Approaches: Architectural Considerations, Visualization Techniques in Link Analysis, Example, Mining Text Streams, Text Mining in Multimedia, Text Analytics in Social Media, Opinion Mining and Sentiment Analysis, Document Sentiment Classification, Opinion Lexicon Expansion, Aspect-Based Sentiment Analysis, Opinion Spam Detection, Text Mining Applications and Case studies

## Course Outcome:

1. Use basic methods for information extraction and retrieval of textual data
2. Apply text processing techniques to prepare documents for statistical modelling
3. Apply relevant machine learning models for analyzing textual data and correctly interpreting the results
4. Use machine learning models for text prediction
5. Evaluate the performance of machine learning models for textual data

## List of Text / Reference Books:


1. Sholom Weiss, Nitin Indurkhya, Tong Zhang, Fred Damerau "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Springer, paperback 2010
2. Ronen Feldman, James Sanger -"The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data"-Cambridge University press, 2006.
3. Charu C. Aggarwal ,ChengXiang Zhai**, "**Mining Text Data", Springer; 2012

| PSEC-MCS201 | Fuzzy Logic and Applications | 3L (3 hrs.) | 3 credits |
|---|---|---|---|

**Prerequisite:** Discrete Structure

**Course Objective:** The main objective of this course is to introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.

## Course Contents: (40 hrs.)

**Module 1:** **(06 hrs.)**

Basic concepts of fuzzy set theory, operations of fuzzy sets, properties of fuzzy sets: Crisp relations, Fuzzy relational equations, operations on fuzzy relations, fuzzy systems – propositional logic, Inference, Predicate Logic, Inference in predicate logic, fuzzy logic principles, fuzzy quantifiers, fuzzy inference, fuzzy rule based systems, fuzzification and defuzzification: Types.

**Module 2:** **(12 hrs.)**

Fuzzy logic controllers, principles, review of control systems theory, various industrial applications of FLC, adaptive fuzzy systems, fuzzy decision making, Multi objective decision making – fuzzy classification, means clustering, fuzzy pattern recognition, image processing applications, systactic recognition – fuzzy optimization.

**Module 3:** **(10 hrs.)**

Fundamentals of neural networks: model of an artificial neuron, neural network architectures, Learning methods – Taxonomy of Neural network architectures, Standard back propagation algorithms, selection of various parameters, variations Applications of back propagation algorithms.

**Module 4:** **(08 hrs.)**

Fundamentals of genetic algorithms – genetic modeling, hybrid systems, integration of fuzzy logic, neural networks and genetic algorithms, nontraditional optimization techniques like ant colony optimization, Particle swarm optimization and artificial immune systems: applications in design and manufacturing.

**Module 5:** **(04 hrs.)**

Rough Set Theory - Introduction, Fundamental Concepts, Set approximation, Rough membership, Attributes, Optimization, Hidden Markov Models, Decision tree model, Introduction to Swarm Intelligence, Swarm Intelligence Techniques: Ant Colony Optimization, Particle Swarm Optimization, Bee Colony Optimization and Applications of Computational Intelligence.

## Course Outcome:

1. Develop the skill in basic understanding on fuzzy logic.
2. Develop the skill in basic understanding on neural network.
3. Explore the functional components of neural classification conducer and the functional components of fuzzy logic classification on controller.
4. Develop and implement a basic trainable neural network (or) a fuzzy logic system to design and manufacturing.
5. Understand the recent advances in fundamentals of genetic algorithm.

## List of Text / Reference Books:


1. Rajasekaran. S.. Vijayalakshmi Pai. G.A. “Neural Networks, Fuzzy Logic and Genetic Algorithms”, Prentice Hall of India Private Limited, 2003
2. Timothy J.Ross, “Fuzzy logic with Engineering Applications”, McGraw Hill, 1995
3. Zurada J.M. “Introduction to Artificial Neural Systems”, Jaico publishing house, 1994.
4. Klir.G, Yuan B.B. “Fuzzy sets and Fuzzy Logic Prentice Hall of India private limited, 1997.
5. Laurance Fausett, “Fundamentals of Neural Networks”, Prentice hall, 1992
6. Gen, M. and Cheng R. “Genetic Algorithm and Engineering Design”, john wiley 1997.

| PSEC-MCS201 | Data Warehousing and Mining | 3L (3 hrs.) | 3 credits |
|---|---|---|---|

**Prerequisite:** Database Management System (Relational & Non-Relational Databases), SQL

**Course Objective:** The objective of this course is to identify the scope and essentiality of Data Warehousing and Mining and to analyze data, choose relevant models and algorithms for respective applications.

## Course Contents: (40 hrs.)

**Module 1:** **(06 hrs.)**

Introduction to Data Mining: Definitions, KDD v/s Data Mining, DBMS v/s Data Mining, DM techniques, Mining problems, Issues and Challenges in DM, DM Application areas.

**Module 2:** **(12 hrs.)**

Association Rules & Clustering Techniques: Introduction, Various association algorithms like APriori, Partition, Pincer search etc., Generalized association rules, Clustering paradigms, Partitioning algorithms like K-Medioid, CLARA, CLARANS, Hierarchical clustering, DBSCAN, BIRCH, CURE, categorical clustering algorithms, STIRR, ROCK, CACTUS

**Module 3:** **(10 hrs.)**

Other DM techniques & Web Mining: Application of Neural Network, AI, Fuzzy logic and Genetic algorithm, Decision tree in DM, Web Mining, Web content mining, Web structure Mining, Web Usage Mining.

**Module 4:** **(08 hrs.)**

Temporal and spatial DM: Temporal association rules, Sequence Mining, GSP, SPADE, SPIRIT and WUM algorithms, Episode Discovery, Event prediction, Time series analysis, Spatial Mining, Spatial Mining tasks, Spatial clustering, Spatial Trends.

**Module 5:** **(06 hrs.)**

Data Mining of Image and Video: A case study, Image and Video representation techniques, feature extraction, motion analysis, content based image and video retrieval, clustering and association paradigm, knowledge discovery.

## Course Outcome:

1. Understand Data Warehouse fundamentals, Data Mining Principles.
2. Identify appropriate data mining algorithms to solve real world problems.
3. Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining.
4. Describe complex data types with respect to spatial and web mining.
5. Benefit the user experiences towards research and innovation Integration.

## List of Text / Reference Books:


1. Arun K.Pujari, “Data Mining Techniques”, University Press, First Edition, 2001.
2. Adriaans & Zantinge, “Data Mining”, Pearson education, First Edition, 1996.
3. Berry, Linoff , “Mastering Data Mining”, Wiley Publications, 2011.
4. Dunham, “Data Mining”, Pearson education, 2003.
5. Konchandy Manu, “Text Mining Applications” “Cengage Learning, 2006.

| PSEC-MCS201 | Data Science | 3L (3 hrs.) | 3 credits |
|---|---|---|---|

**Prerequisite:** Data Structure, Database management System, Data Visualization

## Course Objective:

The objective of this course is to focus on insights about the roles of a Data Scientist.

## Course Contents: (40 hrs.)

**Module 1:** **(06 hrs.)**

Introduction to core concepts and technologies: Introduction, Terminology, data science, process, data science toolkit, Types of data, Example applications

**Module 2:** **(10 hrs.)**

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, using multiple data sources

**Module 3:** **(12 hrs.)**

Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

**Module 4:** **(06 hrs.)**

Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings.

**Module 5:** **(06 hrs.)**

Applications of Data Science, Technologies for visualization, Bokeh (Python), recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

## Course Outcome:

1. Apply quantitative modeling and data analysis techniques to the solution of real world business problems
2. Communicate findings, and effectively present results using data visualization techniques.
3. Demonstrate knowledge of statistical data analysis techniques utilized in business decision making.
4. Illustrate data visualization types and techniques.
5. Describe various applications and recent trends of data science.

## List of Text / Reference Books:


1. Field Cady, “The Data Science Handbook”, 1/e ,2018,Publisher: Wiley
2. Sinan Ozdemir, “Principles of Data Science”, 1/e, 2016Packt Publishing Limited.
3. Peter Bruce, “Practical Statistics for Data Scientists: 50 Essential Concepts”
4. Shroff/O'Reilly; “First edition”, 2017
5. Pang-Ning Tan, “Introduction to Data Mining”, Pearson Edu.
6. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, “Modern Information Retrieval”, Pearson Education.

| OEC-MCS201 | Business Analytics | 3L (3 hrs.) | 3 credits |
|---|---|---|---|

**Prerequisite:** Basic Computer Engineering, Microsoft Office, Business/strategy Acumen, Mathematics, Data Mining

## Course Objective:

The objective of this course is to focus on enable all participants to recognize, understand and apply the language, theory and models of the field of business analytics and foster an ability to critically analyze, synthesis and solve complex unstructured business problems

## Course Contents: (40 hrs.)

**Module 1:** **(10 hrs.)**

Business Analytics: Introduction to Business Analytics (BA) – Need, Components (Business Context, Technology, Data Science), Types (Descriptive, Predictive and Prescriptive), Business Intelligence versus Business Analytics, Transaction Processing v/s Analytic Processing, OLTP v/s OLAP, OLAP Operations, Data models for OLTP (ER model) and OLAP, (Star & Snowflake Schema)

**Module 2:** **(10 hrs.)**

Types of Digital Data: Definition, Sources, Storage and Characteristics of Structured, Unstructured and Semi Structured Data, Data Warehouse: Definition, characteristics, framework, Data lake, Business Reporting, Visual Analytics: Definition, concepts, Different types of charts and graphs, Emergence of data visualization and visual analytics

**Module 3:** **(08 hrs.)**

Data Mining: Concepts and applications, Data mining process, Text & Web Analytics: Text analytics and text mining overview, Text mining applications, Web mining overview, Social media analytics, Sentiment analysis overview, Big Data Analytics: Definition and characteristics of big data, Fundamentals of big data analytics

**Module 4:** **(06 hrs.)**

Business Performance Management: Business performance management cycle, KPI, Dashboard Analytics in Business Support Functions: Sales & Marketing Analytics, HR Analytics, Financial Analytics, Production and operations analytics

**Module 5:** **(06 hrs.)**

Analytics in Industries: Telecom, Retail, Healthcare, Financial Services

## Course Outcome:

1. Understand the key issues in big data management and its associated applications in intelligent business and scientific computing and identify and describe complex business problems in terms of analytical models.
2. Acquire fundamental knowledge of data warehousing and enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics.
3. Understand basic concepts of data mining, web mining and big data analytics.
4. Translate results of business analytic projects into effective courses of action and Demonstrate ethical decision-making in structured or unstructured and ambiguous situations.
5. Exhibit effective collaboration and leadership skills and Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

## List of Text / Reference Books:


1. Ramesh Sharda, Dursun Delen, Efraim Turban, "Business Intelligence: A Managerial Perspective on Analytics", Pearson 3rd edition.
2. R.N.Prasad and Seema Acharya, "Fundamentals of Business Analytics", Wiley, 2016.
3. U. Dinesh Kumar, "Business Analytics – The Science of Data Driven Decision Making", Wiley 2017.
4. Anil Maheshwari, "Data Analytics", McGraw Hill, 2017.
5. Jesper Thorlund & Gert H.N. Laursen, "Business Analytics for Managers: Taking Business Intelligence Beyond", Wiley Latest.
6. Sahil Raj, "Business Analytics", Cengage, Latest.
7. James R. Evans, "Business Analytics", Pearson, Latest

| OEC-MCS201 | Operation Research | 3L (3 hrs.) | 3 credits |
|---|---|---|---|

**Prerequisite:** Mathematics, Computer Programming

## Course Objective:

To impart knowledge in concepts and tools of Operations Research and to understand mathematical models used in Operations Research and to apply these techniques constructively to make effective business decisions.

## Course Contents: (40 hrs.)

**Module 1: (06 hrs.)**

Introduction to Operations Research: Introduction, Historical Background, Scope of Operations Research, Features of Operations Research, Phases of Operations Research, Types of Operations Research Models, Operations Research Methodology, Operations Research Techniques and Tools, Structure of the Mathematical Model, Limitations of Operations Research

**Module 2: (12 hrs.)**

Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Case Studies of LPP, Graphical Methods to Solve Linear Programming Problems, Applications, Advantages, Limitations

**Module 3: (10 hrs.)**

Graphical Analysis of Linear Programming Problems: Introduction, Graphical Analysis, Some Basic Definitions, Graphical Methods to Solve LPP, Some Exceptional Cases, Important Geometric Properties of LPP

**Module 4: (08 hrs.)**

Simplex Method: Introduction, Standard Form of LPP, Fundamental theorem of LPP, Solution of LPP – Simplex Method, The Simplex Algorithm, Penalty Cost Method or Big M-method, Two-Phase Method, Solved Problems on Minimization, Duality in Linear Programming Problem: Introduction, Importance of Duality Concepts, Formulation of Dual Problem, Economic Interpretation of Duality, Sensitivity Analysis

**Module 5: (04 hrs.)**

Study of various problems: Transportation Problems: Introduction, Formulation of Transportation Problem (TP), Transportation Algorithm (MODI Method), The initial basic feasible solution, moving towards Optimality, Assignment Problem, Hungarian methods, Routing problem, Travelling salesman problem, Integer Programming Problem., All IPP Algorithm, Branch and Bound Technique

## Course Outcome:

1. Solve Linear Programming Problems
2. Solve Transportation and Assignment Problems
3. Understand the usage of game theory and Simulation for Solving Business Problems
4. Learn various concepts for research and operations.
5. Study various real world problems.

## List of Text / Reference Books:


1. Taha H.A., “Operations Research”, Sixth Edition, Prentice Hall of India, 2003.
2. Shennoy G.V. and Srivastava U.K., “Operation Research for Management”, Wiley Eastern, 1994.
3. Bazara M.J., Jarvis and Sherali H., “Linear Programming and Network Flows”, John Wiley, 1990.
4. Philip D.T. and Ravindran A., “Operations Research”, John Wiley, 1992.
5. Hillier and Libeberman, “Operations Research”, Holden Day, 1986
6. Budnick F.S., “Principles of Operations Research for Management”, Richard D Irwin, 1990.
7. Tulsian and Pasdey V., “Quantitative Techniques”, Pearson Asia, 2002.

| OEC-MCS201 | Voice and Data Network | 3L (3 hrs.) | 3 credits |
|---|---|---|---|

**Prerequisite:** Computer Network and Data Communication

## Course Objective:

The objective of this course is to build an understanding of the fundamental concepts of computer networking and familiarize the student with the basic taxonomy and terminology of the computer networking area.

## Course Contents: (40 hrs.)

**Module 1:** **(06 hrs.)**
Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks.

**Module 2:** **(10 hrs.)**
Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, Statistical Multiplexing.

**Module 3:** **(10 hrs.)**
Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.

**Module 4:** **(06 hrs.)**
Queuing Models of Networks, Traffic Models, Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols, Aloha System, Carrier Sensing, Examples of Local area networks.

**Module 5:** **(08 hrs.)**
Inter-networking, Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter domain Routing (CIDR), IP address lookup, Routing in Internet, End to End Protocols, TCP and UDP, Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery, Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.

## Course Outcome:

1. Protocol, algorithms, trade-offs rationale.
2. Routing, transport, DNS resolutions
3. Network extensions and next generation architectures.
4. Independently understand basic computer network technology.
5. Understand and explain Data Communications System and its components.

## List of Text / Reference Books:


1. D. Bertsekas and R. Gallager, “Data Networks”, 2nd Edition, Prentice Hall, 1992.
2. L. Peterson and B. S. Davie, “Computer Networks: A Systems Approach”, 5th Edition, Morgan Kaufman, 2011.
3. Kumar, D. Manjunath and J. Kuri, “Communication Networking: An analytical approach”, 1st Edition, Morgan Kaufman, 2004.
4. Walrand, “Communications Network: A First Course”, 2nd Edition, McGraw Hill, 2002.
5. Leonard Kleinrock, “Queueing Systems”, Volume I: Theory”, 1st Edition, John Wiley and Sons, 1975.
6. Aaron Kershenbaum, “Telecommunication Network Design Algorithms”, McGraw Hill, 1993.
7. Vijay Ahuja, “Design and Analysis of Computer Communication Networks”, McGraw Hill, 1987

| LC--MCS201 | Machine Learning Lab | 4P (4 hrs.) | 2 credits |
|---|---|---|---|

**Prerequisite:** Artificial Intelligence

## Course Objective:

Implement the basic concepts and techniques of Machine Learning algorithms.

## List of Experiments:

**Week 1:**

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

**Week 2:**

1. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

**Week 3:**

1. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

**Week 4:**

1. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

**Week 5:**

1. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

**Week 6:**

1. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

**Week 7:**

1. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

**Week 8:**

1. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

**Week 9:**

1. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

**Week 10:**

1. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

## Course Outcome:

1. Apply knowledge of computing and mathematics to machine learning problems, models and algorithms;
2. Analyze a problem and identify the computing requirements appropriate for its solution;
3. Design, implement, and evaluate an algorithm to meet desired needs
4. Apply mathematical foundations, algorithmic principles and computer science theory to the modeling and design of computer-based systems.
5. Demonstrates comprehension of the trade-offs involved in design choices.

| LC-MCS202 | Data Visualization Lab | 4P (4hrs) | 2 credits |
|---|---|---|---|

**Prerequisite:** Computer Graphics, AI, Mathematics: basic linear algebra, calculus, probability

## Course Objective:

To learn the process involved in data visualization with security aspects.

## List of Experiments:

**Week 1:**

1. Introduction to data Visualization tools.

2. **Data preprocessing methods on student and labor datasets**: Data preprocessing methods on student and labor datasets implement data cube for data warehouse on 3-dimensional data.

**Week 2:**

1. Basic and Specialized Visualization Tools

2. **Data Cleaning:** Implement various missing handling mechanisms ,Implement various noisy handling mechanisms

**Week 3:**

1. **Exploratory Analysis:** Develop k-means and MST based clustering techniques: Develop k-means and MST based clustering techniques, Develop the methodology for assessment of clusters for given dataset.

**Week 4:**

1. **Association Analysis:** Design algorithms for association rule mining algorithms.

**Week 5:**

1. **Hyptothysis Generation:** Derive the hypothesis for association rules to discovery of strong association rules; Use confidence and support thresholds.

**Week 6:**

1. **Transformation Techniques:** Construct Haar wavelet transformation for numerical data, Construct principal component analysis (PCA) for 5-dimensional data.
2.

**Week 7:**

1. **Data Visualization:** Implement binning visualizations for any real time dataset, Implement linear regression techniques.

**Week 8:**

1. **Clusters Assessment:** Visualize the clusters for any synthetic dataset, Implement the program for converting the clusters into histograms

**Week 9:**

1. **Hierarchical Clustering:** Write a program to implement agglomerative clustering technique ,Write a program to implement divisive hierarchical clustering technique

**Week 10:**

1. **Scalability Algorithms**: Develop scalable clustering algorithms, Develop scalable apriori algorithm.

## Course Outcome:

1. State the core concepts of Data Visualization.
2. Illustrate various concepts of visual representations.
3. Illustrate various techniques and classification of visualization systems.
4. State the core concepts of network, distributed and multiprocessor operating system.