

M. Tech Degree (Full Time) Programme in Information Technology
(Specialization: Business Analytics and Intelligence)-CURRICULUM & SYLLABUS-2023

M. Tech Degree (Full Time) Programme
in
Information Technology
(Specialization: Business Analytics and Intelligence)

CURRICULUM & SYLLABUS

DIVISION OF INFORMATION TECHNOLOGY
SCHOOL OF ENGINEERING
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY
COCHIN– 682 022

M. Tech Degree (Full Time) Programme in Information Technology
(Specialization: Business Analytics and Intelligence)-CURRICULUM & SYLLABUS-2023

Eligibility Criteria for admission

Program Name	Eligibility Criteria (Proposed)	Duration	Nature of Programme	Professional/Non-Professional	Intake
M.Tech. in Business Analytics and Intelligence Branch: Information Technology	<p>1. B.Tech. / BE / B.Sc. Engineering Degrees / AMIE in any discipline with a first class (60%) from any recognised university or institution / MCA / M.Sc. in Computer Science / Information Technology/ Electronics, from any Universities in Kerala or an examination of any other University / Institution accepted by this University as equivalent thereto, with a minimum of 60% marks / 6.5 CGPA (in 10-point scale or equivalent)</p> <p>2. A valid GATE score *</p> <p><i>*Note:</i></p> <p><i>In the absence of sufficient number of candidates with GATE score, candidates without GATE score shall also be considered subject to passing an admission test conducted by the University</i></p>	4 semesters	Full time	Professional	18

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SEMESTER I						
Sl No.	Course Code	Course Name	Hours/Week			Credits
			L	T	P	
1	-0101	Introduction to Business Analytics and Data Science	3	1	0	4
2	-0102	Computational Learning Theory /Computational Thinking	3	1	0	4
3	-0103	Financial Analytics	3	1	0	4
4	-01**	Elective I	3	1	0	3
5	-01**	Elective II	3	1	0	3
6	-0112	Research Methodology and Intellectual Property Rights	2	1	0	2
7	-0113	Data Visualization & Descriptive Analytics Lab	0	0	3	1
8	-0114	Seminar –I	0	0	3	1
Total			17	6	6	22

SEMESTER II						
Sl No.	Course Code	Course Name	Hours/Week			Credits
			L	T	P	
1	-0201	Digital marketing	3	1	0	4
2	-0202	E-business and Information management	3	1	0	4
3	-0203	Block Chain Technology	3	1	0	4
4	-02**	Elective III	3	1	0	3
5	-02**	Elective IV	3	1	0	3
6	-0212	Design Thinking and Innovation Lab	0	0	3	1
7	-0213	Seminar- II	0	0	3	1
Total			15	5	6	20

SEMESTER III						
Sl No.	Course Code	Course Name	Hours/Week			Credits
			L	T	P	
1	-0301	Internship/MOOC Course	0	0	6	2
2	-0302	Dissertation Phase – I	0	0	24	13
Total			0	0	30	15

SEMESTER IV						
Sl No.	Course Code	Course Name	Hours/Week			Credits
			L	T	P	
1	-0401	Dissertation Phase – II	0	0	30	15
Total			0	0	30	15

Total credits for the M.Tech programme = 72

***Electives must be selected from the following list for the corresponding semester*

ELECTIVES I & II (I Semester)

- 0104 Machine Learning for Data Science
- 0105 Agile Project Management
- 0106 Recommender System
- 0107 Cloud Computing & Bigdata Analytics
- 0108 Python for Business Analytics
- 0109 Social media and Web analytics
- 0110 Knowledge Management Systems
- 0111 Optimization Techniques

ELECTIVES III & IV (II Semester)

- 0204 Operation Research
- 0205 Cyber law and Ethics
- 0206 DevOps for Enterprise Business Agility
- 0207 Data Mining Techniques – Predictive Modeling & Pattern Discovery
- 0208 Deep Learning
- 0209 Graph Theory
- 0210 Trend Analysis and Forecasting
- 0211 Software Reliability for Information Technology

SEMESTER - I

#-#-0101 INTRODUCTION TO BUSINESS ANALYTICS AND DATA SCIENCE

Course Outcomes:

On completion of this course, the student will be able to:

1. Understand the big picture of data analytics as a transformative force in the world of modern business
2. Recognize the ethical implications of collecting, managing, and using data in business
3. Understand the increasing role of evidence-based decision-making in supporting business decision-making.
4. Explain the differences between predictive, prescriptive, and descriptive analytics, and the business questions that can be answered with each approach
5. Apply business analytics principles to examples in marketing, finance, management and entrepreneurship, accounting, and economics.
6. Communicate the insights and applications identified within quantitative data
7. Identify opportunities to use analytics to address unstructured business problems

Module I

Business analytics: Four primary methods of business analysis-Descriptive, Diagnostic, Predictive, Prescriptive. Business Analytics & Data Science. Growing Role of Business Analytics. Data Analytics as a Predictive Tool. Data Analytics as an Evaluative Tool. Data Analytics as an Evaluative Tool.

Module II

Essentials of Business Analytics: Introduction to the Methodology-Data Collection, Challenges in Data Collection, Data Collection Validation and Presentation. Big Data Management-Elements of Big Data, Characteristics of Big Data. Cloud Computing for Big Data. Data Visualization-Six Meta-Rules for Data Visualization. Statistical Methods for Basic Inferences.

Module III

Modelling Methods: Decision Making Under Uncertainty, Methods in Optimization, Forecasting Analytics, Count Data Regression, Survival Analysis, Machine Learning- Supervised &Unsupervised. Deep Learning. Introduction to R.

Module IV

Applications: Retail Analytics, Marketing Analytics, Financial Analytics, Social media and Web Analytics, Healthcare Analytics, Supply Chain Analytics. Case Study-Health Insurance Industry, Airline Corp, Info Media Solutions.

References:

1. Essentials of Business Analytics: An Introduction to the Methodology and its Applications, Bhimasankaram Pochiraju & Sridhar Seshadri, International Series in Operations Research & Management Science, © Springer Nature Switzerland AG 2019.

2. EMC Education Services.(2015). Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data. Wiley.
3. Michael Minelli, Michele Chambers, Ambiga Dhiraj. (2013). Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses. Wiley.
4. Bart Baesens. (2014). Analytics in a Big Data World”, The Essential Guide to Data Science and its Applications, Wiley, First edition.

#-#-0102 COMPUTATIONAL THINKING

Course Outcomes:

On completion of this course, the student will be able to:

1. Understand the evolution and importance of CT
2. Apply abstraction, decomposition, algorithmic thinking and pattern recognition in solving real-world problems.
3. Design algorithms for various computing problems.
4. Test the software solutions to identify and correct bugs.
5. Write simple to moderate programs using python.

Module I

Introduction to CT: Computational Thinking, Computational Methods and Computing Machines; Wishful Thinking; Design Thinking; Definition Computational Thinking; Evolution of CT; Computational thinking for academic disciplines; CT for software systems; CT for science; CT for all.

Module II

Pillars of CT: - Abstraction, Decomposition, Algorithmic Thinking and Pattern Recognition:

Information represented in real world: Data Types, Encoding and Decoding, Data structures: Lists, Arrays, Linked Lists, Graphs.

Abstraction: Definition of abstraction, layers of abstraction; Representation of abstraction: Class diagrams, Use Case diagrams, Activity Diagrams, State Diagrams.

Decomposition: Definition of decomposition, decomposition in software design, other uses of decomposition, functions and modularity.

Algorithms: Problem Definition, Logical Reasoning, Types of Logics, Applications of Logic; Data representations, Flowcharts, Flow control, conditional logics, Loops.

Pattern Recognition: Identify and create patterns, use cases.

Module III

Simulations and Use Cases using Python: Hand simulation of a small program (squaring an integer), Iterative and recursive implementations (factorial), rabbit population (Fibonacci series), Palindromes; Searching (linear and binary search) and Sorting (selection and merge sort); Lists and Dictionaries; Monte Carlo simulation: Pascal's Problem and Pass or Don't Pass.

Module IV

Error Handling: Computer Error and its types; Software Correctness: Validation and Verification; Software testing (black box and white box testing); Programs with bugs; Exception handling.

Other forms of CT: Plugged and Unplugged approaches (Code.org, MIT Scratch Programming, Google Blockly, MIT App Inventor).

References:

1. Computational Thinking by Peter J. Denning and Matti Tedre, MIT Press, 14 May 2019, ISBN: 0262536560.
2. Computational Thinking for the Modern Problem Solver, Chapman & Hall/CRC Textbooks in Computing by David Riley and Kenny A. Hunt, 30 April 2014, ISBN: 1466587776.
3. Introduction to Computation and Programming Using Python, Third Edition by John V. Guttag, 5 January 2021, ISBN: 0262045788.

#-#-0103 FINANCIAL ANALYTICS

Course Outcomes:

On Completion of this course, the student will be able to:

1. Evaluate financial analytics techniques.
2. Discuss fundamentals of financial time-series, performance models, and forecasting models.
3. Discuss how predictive analysis tools can be used to analyse real-life business problems such as prediction, classification and discrete choice problems.
4. To use the most powerful and sophisticated tools for analytical finance.

Module I

Introduction to Financial Analytics: Definition, relevance and scope financial Analytics, recent trends in financial analytics. Types of Financial analytics : Client Profitability Analysis, Product Profitability Analysis, Cash-Flow Analysis, Predictive Sales Analysis, Value-Drivers Analysis, Shareholder-Value.

Module II

Financial and Management Accounting :Financial Accounting Concepts, Principles and Mechanics, Inventory Accounting, Depreciation Accounting, Management Accounting, Funds Flow Analysis & Cash Flow Analysis, Marginal Costing and Break-Even Analysis, Recent Development in Accounting, Principles of Financial Decision Making.

Module III

Predictive Analytics: simple linear regression, multiple linear regression, logistic and multinomial regression, decision trees and unstructured data analysis, forecasting technique; Time Series data and Their Characteristics: Asset Returns, Distributional Properties of Returns, Review of Statistical Distributions and properties of financial time series.

Module IV

Data Analytics & Machine Learning for Finance; Predictive Financial Modeling; Applied Financial Analytics ; Financial Intelligence & Data Visualisation; Introduction to ARIMA and its implementation.

References:

1. Introduction to Machine Learning with Python: A Guide for Data Scientists, Book by Andreas C. Müller and Sarah Guido(2018) ISBN:9789352134571.
2. Shuangzhe Liu and Milind Sathye. 2021. Financial Statistics and Data Analytics, ISBN 978-3-03943-975-1
3. Brigham, E.F., and J.F. Houston. 2012. Fundamentals of Financial Management, Concise. 7th ed. Mason, OH: Harcourt College Publisher
4. Hastie, Tibshirani, Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Second edition, Springer, 2017
5. McKinney, Python for Data Analysis: Data Wrangling with Pandas, Numpy, and IPython,O'Reilly, 2017, second edition

#-#-0104 MACHINE LEARNING FOR DATA SCIENCE

Course Outcomes:

On Completion of this course, the student will be able to:

1. To understand a wide variety of machine learning algorithms.
2. To be able to formulate machine learning problems corresponding to different applications.
3. To understand the basic theory underlying the concept of data science.
4. To apply the principles of data science to the analysis of machine learning problems.

Module I

Introduction to machine learning - Learning Systems Classification; Classification, Regression, Supervised & Unsupervised Learning, Reinforcement Learning, Bayes Theorem, Bayesian Classifier.

Module II

Kernel methods, Support Vector Machines, Decision Trees, Artificial Neural Networks, Perceptrons, Multilayer Perceptrons and Back propagation, Clustering Methods.

Module III

Data Science in a big data world, The data science process, Applications for machine learning in data science, Python tools used in machine learning, The modeling process.

Module IV

Recent Trends.

Case study: Discerning Digits from Images

References:

1. Crina Grosan and Ajith Abraham.(2011). Intelligent Systems: A Modern Approach. Springer
2. Elaine Rich, Kevin Knight, & Shivashankar B Nair.(2009). Artificial Intelligence. McGraw Hill, 3rd ed.
3. Russel Eberhart, Yuhui Shi. (2007). Computational Intelligence Concepts to Implementations. MK Publishers. Andries P. Engelbrecht.(2007). Computational Intelligence: An Introduction. Second Edition, Wiley.
4. Davy Cielen, Arno D.B. Meysman, & Mohamed Ali.(2016). Introducing Data Science: BIG DATA, MACHINE LEARNING, AND MORE, USING PYTHON TOOLS. Manning Publications.

##-0105 AGILE PROJECT MANAGEMENT

Course Outcomes:

On completion of this course, the student will be able to:

1. Understand the concept of agile programming.
2. Apply principles of agile programming in real world applications.
3. Analyze the techniques for managing project, cost, resource, communication and risk.
4. Evaluate the techniques for managing project, cost, resource, communication and risk.
5. Investigate agile life cycle with other life cycles used in software process.

Module I

Agile Overview - Origins of Agile, Agile Manifesto, Agile Principles, Project Life Cycle, Project management processes, Agile Project Life Cycle - Agile Project, Agile Release, Agile Iteration. The Bridge - Agile Practices, Integration Management - Develop the project charter and Preliminary Scope Statement, Develop Project Management Plan, Direct and Manage Project Execution and Monitor and Control, Integrated change control, Scope Management, Scope Planning, Time Management, Release Planning, Iteration Planning

Module II

Cost Management, Cost Estimating, Project Cost Budgeting, Project Cost Control. Quality Management - Quality Planning, Quality Assurance, Quality Control, Human Resource Management - Human Resource Planning, Acquiring a Project Team, Develop the Project Team, Manage the Project Team.

Module III

Communications Management - Communication Planning Communications Basic Project Information, Information Distribution, Performance Reporting, Manage Stakeholders. Risk Management , Organic Risk Management in Agile, Risk Management Planning, Risk Identification, Risk Analysis, Risk Response Planning, Risk Monitoring and Controlling, Procurement Management.

Module IV

Crossing the Bridge to Agile - Formation. Agile Team in Waterfall Enterprise, Clearing the Hurdles in Waterfall Enterprise, An Extension of Product Management, Project Initiation, Project Metrics, Selling the benefits of Agile, Selling to Management, Selling to Customer/Product Owners, Common Mistakes.

References:

1. Sliger, M., & Broderick, S., The software project manager's bridge to agility. Addison- Wesley. ,2008.
2. Goodpasture, J., Project management the agile way: Making it work in the enterprise (2nd ed.). Cengage Learning India.,2014.
3. Highsmith, J., Agile project management: Creating innovative products (2nd ed.). Addison- Wesley.,2010
4. Shore, J., & Warden, S., The art of agile development. O'Reilly Media.,2008
5. Martin, R., Agile software development: Principles, patterns, and practices. Prentice Hall., 2003.
6. Cohn, M., Succeeding with agile: Software development using Scrum. Addison- Wesley.,2010.
- Cockburn, A., Agile software development (2nd ed.). Addison-Wesley., 2006.

#-#-0106 RECOMMENDER SYSTEM

Course Outcomes:

On completion of this course, the student will be able to:

1. Understand the concept of recommender systems in online platforms.
2. Apply data mining and machine learning concepts for recommender system design.
3. Analyze and evaluate recommendation accuracy.
4. Evaluate various recommendation algorithms.

Module I

An Introduction to Recommender Systems - Goals of Recommender Systems, Basic Models of Recommender Systems, Domain-Specific Challenges in Recommender Systems.

Advanced Topics and Applications: The Cold -Start problem, Attack Resistant Recommender Systems, Application Domains.

Module II

Collaborative filtering - Neighborhood-Based Collaborative Filtering, Key Properties of Ratings Matrices, Predicting Ratings with Neighborhood-Based Methods: User- Based, Item-Based, Clustering and Neighborhood-Based Methods, Dimensionality Reduction and Neighborhood Methods.

Model- Based Collaborative Filtering: Decision and Regression Trees, Rule-Based Collaborative Filtering, Naive Bayes Collaborative Filtering

Module III

Content-Based Recommender Systems - Basic Components of Content-Based Systems, Preprocessing and Feature Extraction, Learning User Profiles and Filtering.

Content-Based Versus Collaborative Recommendations.

Knowledge-Based Recommender Systems - Constraint-Based Recommender Systems, Case-Based Recommenders

Module IV

Ensemble-Based and Hybrid Recommender Systems - Ensemble Methods from the Classification Perspective, Weighted Hybrids, Switching Hybrids, Cascade Hybrids, Feature Combination Hybrids, Mixed Hybrids.

Evaluating Recommender Systems - Evaluation Paradigms, General Goals of Evaluation Design, Design Issues in Offline Recommender Evaluation, Accuracy Metrics in Offline Evaluation, Limitations of Evaluation Measures.

References:

1. Aggarwal, C. Charu., Recommender Systems: The Textbook (1st ed.). Springer.,2016
2. Ricci, F., Rokach, L., & Shapira, B.,Recommender Systems Handbook (2nd ed.) Springer.,2015
3. Jannach, D., Zanker, M., & Felfernig, A., Recommender systems: An introduction. New York: Cambridge University Press.,2011
4. Bhasker, B., & Srikumar, K. ,Recommender Systems In E-Commerce. Tata McGraw Hill Education Pvt.,2010

##-0107 CLOUD COMPUTING & BIGDATA ANALYTICS

Course Outcomes:

On completion of this course, the student will be able to:

1. Understand the key technologies in cloud architecture and Models.
2. Apply appropriate Virtualization tools by knowing its importance (including Virtualization of CPU, Memory, I/O Devices.).
3. Understand the key concepts behind the cloud architecture.
4. Analyze the business areas where big data technologies are used .
5. Analyze the ideas to integrate big data with cloud service and provide solutions for big data applications .
6. Apply the MapReduce algorithms in different Ecosystem tools such as Pig,Hive,HBase etc.

Module I

Distributed Computing Taxonomy – Cluster, Grid, P2P, Utility, Cloud, Edge, Fog computing paradigms; What is cloud computing,Cloud computing services, Types of cloud computing, Cloud security ,Cloud use cases

Module II

Virtualization: What is virtualization? Benefits of virtualization, Virtual machines (VMs), Hypervisors, Types of virtualization, Use cases for VMs, Types of VMs, Dockers, Containers, Kubemetes, Orchestration Methods, Virtualization vs. containerization, Virtual machines vs. bare metal servers, Multi-tenant vs. single-tenant VMs, Choosing a virtual machine provider, VMware, Security.

Module III

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, Analysing Data with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big Data Strategy, Introduction to Infosphere BigInsights and Big Sheets.

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.

Module IV

Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.

Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators.

Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions.

Hbase : HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.

Big SQL : Big SQL architecture,Big SQL features, Big SQL use case: EDW optimization

NoSQL (MongoDB, Apache CouchDB) , Apache Mahout- Features and Applications

Big Data Analytics with BigR.

References:

1. “Cloud Computing (Principles and Paradigms)”, Publications, 2006. Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
2. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
3. “Docker: Up & Running: Shipping Reliable Containers in Production 1st Edition, Kindle Edition” Karl Matthias , Sean P. Kane
4. EMC Education Services.(2015). Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data. Wiley.
5. Michael Minelli, Michele Chambers, Ambiga Dhiraj. (2013). Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses. Wiley.
6. Bart Baesens. (2014). Analytics in a Big Data World”, The Essential Guide to Data Science and its Applications, Wiley, First edition.
7. Thomas H. Davenport, Jeanne G. Harris. (2007). Competing on Analytics: The New Science of Winning. Harvard Business Review Press, First edition.
8. Paul C. Zikopoulos, Chris Eaton. (2012). Understanding Big Data. McGraw Hill.
9. Tom White. (2015). Hadoop: The Definitive Guide. Third Edition, O'Reilley.

##-0108 PYTHON FOR BUSINESS ANALYTICS

Course Outcomes:

On completion of this course, the student will be able to :

1. Understand the importance and relevance of business analytics
2. Gain skills to play with data using Python programming language and its supported libraries.
3. Distinguish between supervised and unsupervised learning and its various approaches.
4. Implement algorithms to gain useful information from business domain datasets.

Module I

Understanding Data Analytics, Importance of data in business, Data analytics ecosystem, Basics of Python programming, Variables and Operators, Data types, Lists, Dictionary and Functions.

Module II

Introduction to Machine Learning, Introduction to Python libraries, Numpy, Scikit Learn, Pandas, Matplotlib, Data visualization - EDA. Importing datasets and Data wrangling. Representing data and engineering features, Preprocessing.

Module III

Supervised learning- Linear regression, Logistic regression, Decision Tree, Naive Bayes, K Nearest Neighbor, Random Forest, Dimensionality reduction techniques, Gradient Boosting algorithms, Support Vector Machine.

Module IV

Unsupervised learning – Clustering using K-means, hierarchical clustering. Reinforcement learning and Deep learning. Model evaluation and improvement- cross validation, grid search and evaluation metrics. Case study on supervised and unsupervised learning on large datasets from the business domain.

References:

1. David Beazley and Brian K. Jones, Python Cookbook (2013). O'reilly
2. Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python (2016). O'reilly.
3. EMC Education Services.(2015). Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data. Wiley.
4. Michael Minelli, Michele Chambers, Ambiga Dhiraj. (2013). Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses. Wiley.
5. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning (2016), MIT press.

##-0109 SOCIAL MEDIA AND WEB ANALYTICS

Course Outcomes:

On completion of this course the student will be able to

1. Understand social media, web and social media analytics, and their potential impact
2. Understand usability, user experience, and customer experience
3. Understand the relationship between the experiences and ROI
4. Identify data relating to the metrics and key performance indicators
5. Analyze and interpret the data collected from Web and social media tracking tools

Module I

Network Fundamentals: The Social Networks Perspective - Nodes, Ties and Influencers, Social Network, Web Data and Methods.

Web and social media (Web sites, web apps, mobile apps and social media) , Usability, user experience, customer experience, customer sentiments, web marketing, conversion rates, ROI, brand reputation, competitive advantages, Web analytics and a Web analytics 2.0 framework (clickstream, multiple outcomes analysis, experimentation and testing, voice of customer, competitive intelligence, Insights)

Module II

Measuring user experience - Usability metrics (performance metrics, issues-based metrics, self-reported metrics), Planning and performing a usability study (study goals, user goals, metrics and evaluation methods, participants, data collection, data analysis), Typical types of usability studies and their corresponding metrics (comparing alternative designs, comparing with competition, completing a task or transaction, evaluating the impact of subtle changes)

Module III

Web metrics and web analytics - PULSE metrics (Page views, Uptime, Latency, Seven-day active users) on business and technical issues; HEART metrics (Happiness, Engagement, Adoption, Retention, and Task success) on user behavior issues; On-site web analytics, off-site web analytics, the goal-signal-metric process

Social media analytics - Social media analytics (what and why). Social media KPIs (reach and engagement). Performing social media analytics (business goal, KPIs, data gathering, analysis, measure and feedback)

Module IV

Data (Structured data, unstructured data, metadata, Big Data and Linked Data). Data analysis basics (types of data, metrics and data, descriptive statistics, comparing means, correlations, nonparametric tests, presenting data graphically)

Data analysis language and tools - Ready-made tools for Web and social media analytics (Key Google Analytics metrics, dashboard, social reports). Statistical programming language (R), its graphical development environment (Deducer) for data exploration and analysis, and its social media analysis packages (RGoogleTrends, twitterR)

References:

1. David Easley and Jon Kleinberg, “Networks, Crowds and Markets “, Cambridge University Press, 2010
2. Matthew O. Jackson, “Social and Economic Networks”, Princeton University Press, 2010.
3. Avinash Kaushik “Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity”, 1st Ed, Sybex, 2009.
4. Matthew Ganis, Avinash Kohirkar, “Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media”, IBM Press, 2015.
5. Jim Sterne , “Social Media Metrics: How to Measure and Optimize Your Marketing Investment”, Wiley, 2010.
6. Oliver Blanchard, “Social Media ROI: Managing and Measuring Social Media Efforts in Your Organization” (Que Biz-Tech), Que Publishing, 2011.
7. Brian Clifton, “Advanced Web Metrics with Google Analytics,” John Wiley & Sons; 3rd Edition

#-#-0110 KNOWLEDGE MANAGEMENT SYSTEMS

Course Outcomes:

On completion of this course, the student will be able to:

1. Discuss KM, learning organizations, intellectual capital and related terminologies in clear terms and understand the role of knowledge management in organizations.
2. Demonstrate an understanding of the history, concepts, and the antecedents of management of knowledge and describe several successful knowledge management systems.
3. Evaluate the impact of technology including information systems, networks, and Internet/intranet role in managing knowledge.
4. Discuss new jobs, roles and responsibilities resulting from the New or Knowledge Economy Ponder KMs current and future impact on individuals, organizations and society at large.

Module I

Introduction to Knowledge Management: Overview of Knowledge Management Data-Information-Knowledge-Wisdom relationship, History, and Significance of Knowledge Management, Different types of knowledge management. The Knowledge Management Cycle: The Concept Analysis Technique and Intellectual property. Concept of the Knowledge worker.

Module II

Process: Stages of Knowledge management: Erik Sveiby's Model: Alvesson and Karreman's approaches; Knowledge management Tools: Knowledge creation and Knowledge Sharing, Knowledge Dissemination. Knowledge management and learning organization. Challenges in Implementing Knowledge management in Organizations. Knowledge transfer and sharing: Transfer Methods, Role of the Internet, Knowledge Transfer in e-world

Module III

Knowledge Management Infrastructure: Social Nature of Knowledge, Social Network Analysis, Obstacles to knowledge sharing, Organizational learning & Social Capital. Knowledge Application – Individual level, Group level & Organization Level. Knowledge Management Team–Roles & Responsibilities, Ethics in Knowledge Management, Strategies issues in Knowledge Management

Module IV

Knowledge Management Strategy, Knowledge audit, Road Map, Knowledge Management Metrics. Future of Knowledge Management. Components of a Knowledge Strategy - Case Studies (Knowledge Management in Developing Countries).

References:

1. Madanmohan Rao (2004). Knowledge Management Tools and Techniques: Practitioners and Experts Evaluate KM Solutions. Butterworth-Heinemann. ISBN: 0750678186.
2. Irma Becerra Fernandez, Rajiv Sabherwal, Knowledge Management: Systems and Processes, Routledge, 2014 / 2nd

3. Knowledge Management in Theory and Practice, Kimiz Dalkir, 2005
4. Srikantaiah. T. K., Koenig, M., “Knowledge Management for the Information Professional” Information Today, Inc., 2000
5. Anu Singh Lather, Anil K Saini and Sanjay Dhingra, Knowledge Management, Macmillan.
6. Stuart Barnes , Knowledge Management Systems – Theory and Practice,Cengage, 2001 / 1st
7. Knowledge Management - Elias. M. Awad & Hassan M. Ghaziri –Pearson Education 2003.
8. Knowledge Management – a resource book – A Thohothathri Raman, Excel, 2004

#-#-0111 OPTIMIZATION TECHNIQUES

Course Outcomes:

On completion of this course the student will be able to:

1. Understanding the Concept of optimization and classification of optimization problems.
2. Formulation simplex methods variable with upper bounds
3. Study the Queuing Model, poisson and exponential distributions
4. Understand the maximization and minimization of convex functions
5. Study equality constraints, inequality constraints

Module I

Concept of optimization – classification of optimization – problems.

LINEAR PROGRAMMING - Examples of linear programming problems – formulation simplex methods variable with upper bounds – principle duality -dual simplex method - sensitivity analysis – revised simplex procedure – solution of the transportation problem – assignment – network minimization – shortest route problem – maximal two problem – L.P. representation of networks.

Module II

QUEUING THEORY - Queuing Model, poisson and exponential distributions -Queues with combined arrivals and departures-random and series queues

Module III

UNCONSTRAINED OPTIMIZATION - Maximization and minimization of convex functions. Necessary and sufficient conditions for local minima – speed and order of convergence – univariate search – steepest and descent methods- metcher reeves method -conjugate gradient method.

Module IV

CONSTRAINED OPTIMIZATION - Necessary and sufficient condition – equality constraints, inequality constraints -kuhn – tucker conditions – gradient projection method – penalty function methods – cutting plane methods of sibel directions.

Non-linear problems - Non-linear constrained optimization models , KKT conditions, Projection methods

References :

1. Rao S.S,"Optimization – Theory and applications", Wiley Easter Ltd., 1979.
2. David G.Luerbeggan, "Introduction to Linear and Non Linear Programming", Addison Wesley Publishing Co. 1973.
3. Hadley G. "Nonlinear and – dynamic programming" Addison Wesley Publishing Co. 1964.
4. Cordan C.C. Beveridge and Robert S. Schedther, "Optimization, Theory and Practice" McGraw Hill Co.1970.
5. HarndyA.Tahh. "operations Research, An Introduction", Macmillan Publishers Co.NewYork,1982.
6. Beightferand S. others, "Foundations of Optimization Pill", New Delhi, 1979.

#-#-0112 RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS

Course Outcomes:

On completion of this course, the student will be able to:

1. Demonstrate knowledge of research process (reading, evaluating, and developing)
2. Perform literature reviews using print and online databases.
3. Summarize and discuss important issues and trends within the actual research area.
4. Write a scientific article within a limited topic but with a quality such that the article could be accepted for presentation in a conference or workshop.
5. Create a scientifically sound and reasonable and well documented plan for a Masters thesis project of excellent quality.
6. Understand the basics of the four primary forms of intellectual property rights.
7. Compare and contrast the different forms of intellectual property protection in terms of their key differences and similarities.

Module I

Meaning of research problem, Sources of research problem, Criteria and Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

Approaches to investigation of solutions for research problem - data collection, analysis, interpretation. Necessary instrumentation.

Module II

Effective literature review approaches, Plagiarism, Research ethics.

Effective technical writing. How to write a good report and a paper?

Developing a Research Proposal, Format of research proposal, Presentation and assessment by a review committee.

Module III

Nature of Intellectual Property: Patents, Industrial Designs, Trademark and Copyright.

Process of Patenting and Development: technological research, innovation, patenting, development.

International Scenario: International cooperation on Intellectual Property. Procedure for grant of patents, Patenting under Patent Cooperation Treaty (PCT).

Module IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indication of goods.

New Developments in IPR: Administration of Patent System. IPR of Biological Systems, Computer Software etc. Traditional knowledge: Indigenous, medicinal and bioprospecting knowledge, Need for protection. Case Studies.

References:

1. Stuart Melville and Wayne Goddard, Research methodology: An introduction for Science & Engineering students, Juta & Co Ltd, 1996.
2. Ranjit Kumar, Research Methodology: A Step by Step Guide for beginners, 2nd Edition, Pearson, 2005.
3. Gopalakrishnan N S, and Agitha T G, Principles of Intellectual Property, 2nd Edition, Eastern Book Company, 2015.
4. Bansal K and Bansal P, Fundamentals of Intellectual Property for Engineers, BS Publications, 2013.
5. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets, 4th Edition, Cengage Learning, 2012.
6. Markel, Mike, Technical Communication. 11th Edition, Mac Millan, 2015.

##-0113 DATA VISUALIZATION & DESCRIPTIVE ANALYTICS LAB

Course Outcomes:

On completion of this course, the student will be able to:

1. Understand and describe the main concepts of data visualization
2. Implement descriptive analytics on data analytics applications

List of Experiments:

1. Introduction to different visualization techniques and visualization of Spreadsheet Models in Python (Box plot, Scatter plot, Histogram, Pie chart, Area plot, Bar chart etc)
2. READING AND WRITING DIFFERENT TYPES OF DATASETS
 - a. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location.
 - b. Reading Excel data sheet in R.
 - c. Reading XML dataset in R.
3. DESCRIPTIVE STATISTICS IN R
 - a. Basic descriptive statistics using summary, str, quartile function on multiple datasets.
 - b. Subset of dataset by using subset (), aggregate () functions on the dataset
 - c. Descriptives by conditions
4. VISUALIZATIONS
 - a. Find the data distributions using box and scatter plot.
 - b. Find the outliers using plot.
 - c. Plot the histogram, bar chart and pie chart on sample data
5. Introduction to Tableau
6. Create Common visualizations (bar chart, line chart etc)
7. Interactivity with text and visual tooltips.

References:

- 1.Hadley Wickham, Garrett Golemund. (2016). R for Data Science: Import, Tidy, Transform, Visualize, and Model Data. O'reilly Publications.
2. C.Chen, W. Hardle, A.Unwin. (2008). Handbook of Data Visualization. Springer

#-#-0114 SEMINAR - I

Course Objective

To encourage and motivate the students to read and collect recent and relevant information from their area of interest confined to the relevant discipline from technical publications including peer reviewed journals, conferences, books, project reports, etc., prepare a report based on a central theme and present it before a peer audience.

Course Outcomes:

On completion of this course the student will be able to

1. Identify and familiarize with some of the good publications and journals in their field of study.
2. Acquaint oneself with preparation of independent reports, name them based on a central theme and write abstracts, main body, conclusions and references identifying their intended meaning and style.
3. Understand effective use of tools of presentation, generate confidence in presenting a report before an audience and improve their skills in the same.
4. Develop skills like time management, leadership quality and rapport with an audience.

Individual students are required to choose a topic of their interest from the field of Business Analytics & Intelligence preferably from outside the M.Tech syllabus and give a seminar on that topic for about 30 minutes. A committee consisting of at least three faculty members shall assess the presentation of the seminar and award marks to the students.

SEMESTER - II

##-0201 DIGITAL MARKETING

Course Outcomes:

On completion of this course, the student will be able to:

1. Understand Digital Marketing
2. Understand and analyze different internet tools for marketing
3. Design marketing plan using digital tools.
4. Discuss and analyze different online marketing methodologies

Module I

Definition of digital marketing; origin of digital Marketing, Traditional VS Digital Marketing. The internet micro- and macro-environment, Internet users in India , Interactive order processing: choosing a supplier; selecting a product; check stock Availability; placing order; authorization of payment, input of data; data transfer; Order processing; online confirmation and delivery information; tracking of order; Delivery, data integrity and security systems;

Module II

The internet marketing mix: product and branding; place e.g. channels, virtual Organizations; price e.g. auctions; promotions; people; processes; physical evidence,. : Digital marketing tools/e-tools; the online marketing matrix including business and

Consumer markets; the online customer.

Module III

Search engine marketing (SEM): definition of SEM, definition of search engine Optimization (SEO); advantages and disadvantages of SEO; best practice in SEO, Paid search engine marketing, pay per click advertising (PPC); landing pages; long Tail concept; geo-targeting e.g. Google Ad Words; opt in email and email Marketing

Module IV

Design digital marketing plan, SWOT, situational analysis, key performance Indicators in internet marketing, Digital Landscape, P-O-E-M Framewok, Segmenting and Customising Messages, Digital Advertising Market in India

References:

1. Seema Gupta (IIM-B), Digital Marketing
2. Dave Chaffey & Fiona Ellis Chadwick, Digital Marketing: Strategy, Implementation & Practice
3. Damian Ryan and Calvin Jones, Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation

#-#-0202 E-BUSINESS AND INFORMATION MANAGEMENT

Course Outcomes:

On completion of this course, the student will be able to:

1. Design and analyze different e-Business model
2. Understanding strategic elements of undertaking e-Business.
3. Understand the need Information Management methods and implement various customer relationship management models for e-Business.
4. Discuss and analyze different Selling Chain Management, Supply Chain Management and E-Procurement models.

Module I

Introduction to e-Business: Defining e-business - development of new economy - Types of e-business.

E-business markets and models - e-business environment, market places, models - Types of e-business models - Framework for analyzing e business, E-Business Trend Spotting.

E-Business Design: Technology -Constructing an e-Business Design - Self-Diagnosis - Reversing the Value Chain -Choosing a Narrow Focus -Case Study

E-business architecture: functional integrated apps -integrating application clusters into an e-business architecture -aligning the e-business design with application integration.

Module II

E-business Strategy- formulation:strategic management and objective setting, the strategic process, internal analysis, external analysis; competitive strategies for e-business.

E-business strategy- implementation:Strategic controls, Organizational learning, Organizational culture and e-business, Organizational structure and e-business.

E-business strategy- evaluation: The evaluation process Organizational control and evaluation, Financial evaluation, Technology evaluation, Human resources evaluation, Website evaluation, Business model evaluation. Case Study.

Module III

Introduction To Information Management Systems: The Need for Information Systems, Changing Business Environment IT and Organizational Design IT-enabled Organizational Transformation, Four R's of Business Transformation, Five Levels of IT-induced Reconfiguration.

Customer Relationship Management: Integrating processes to build relationships -Customer Relationship Management -definition -organizing around the customer - CRM Architecture -CRM Infrastructure -Implementing CRM -CRM trends - building a CRM Infrastructure

Module IV

Selling Chain Management: Transforming sales into interactive order acquisition -defining Selling- Chain Management - Business forces driving the need for selling -technology forces driving the need for selling -Managing the order acquisition process.

Enterprise Resource Planning: The e-Business Backbone -ERP Decision - Enterprise Architecture Planning- ERP Implementation.

Supply Chain Management And E-Procurement: Inter-enterprise Fusion -Defining Supply Chain

Management - Basics of Internet-Enabled SCM- e-Supply Chain Fusion- Management Issues

References:

1. Combe, C. (2006). Introduction to e-business management and strategy. Butterworth-Heinemann. Amsterdam.
2. Deitel, H., & Deitel, P. (2001). The complete e-business & e-commerce programming training course. Prentice-Hall.
3. Girdhar Joshi (2013) Management Information Systems, Oxford Publications
4. Kalakota, R., & Robinson, M. (2001). E-business 2.0: Roadmap for success. Addison-Wesley. Boston, MA
5. Almeida, V. (2000). Scaling for e-business: Technologies, models, performance, and capacity planning. Prentice Hall PTR
6. Paul Bocij, Andrew Greasley, Simon Hickie (2014) Business Information Systems, 5th edn: Technology, Development and Management
7. Claude Doom (2010) An Introduction to Business Information Management

#-#-0203 BLOCK CHAIN TECHNOLOGY

Course Outcomes:

On completion of this course, the student will be able to:

1. Understand the basic notion of distributed systems and to acquire knowledge about Cryptographic primitives used in Blockchain
2. Learn about different types of blockchains and familiarize Bitcoin protocol followed by the Ethereum protocol
3. Understand the smart contract higher-level language Solidity and apply it to create smart contracts.
4. Apply security features in blockchain technologies and familiarize real-life applications of blockchain technology.

Module I

Need for Distributed Record Keeping, Modeling faults and adversaries, The Double-Spend Problem, Byzantine Generals' Problems, Distributed Systems - Atomic Broadcast, Consensus, Byzantine Models of fault tolerance, Distributed Consensus, Public-Key Cryptography, Hashing, Digital Signature.

Module II

Introduction to Blockchain, Types of Blockchain, Blockchain Implementations – Bitcoin, Namecoin, Ripple, Ethereum, Blockchain Collaborative Implementation- Hyperledger, Corda, Blockchain 1.0 -Bitcoin Blockchain - Structure, Operations, Features, Consensus Model, Incentive Model. Blockchain 2.0 - Ethereum Blockchain – Smart Contracts, Ethereum Structure, Operations, Consensus Model, Incentive Model.

Module III

Smart Contracts: Definition and Need, Features of Smart Contracts, Life Cycle of a Smart Contract, Introduction to Ethereum Higher-Level Languages. Development Environment: Building A Simple Smart Contract with Solidity, Solc- Compiler, Ethereum Contract ABI, Remix-IDE for Smart Contract Development. Introduction to Solidity: Contracts, Constructors & Functions, Variables, Getters & Setters, Arrays, Memory vs Storage, Mappings in Solidity, Structs, Error Handling & Restrictions, Libraries, Global Variables in Solidity, Abstract Contracts, Inheritance, And Interfaces, Events

Module IV

Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains – such as Sybil attacks, selfish mining, 51% attacks - advent of algorand, and Sharding based consensus algorithms, Blockchain Use Cases: Financial Services Related Use Cases, Revolutionization of Global Trade, Digital Identity, Auditing Services, Supply Chain Management, Healthcare Related Services, Blockchain and IOT, Blockchain and AI.

References:

1. Joseph J. Bambara, Paul R. Allen, Kedar Iyer, Rene Madsen, Solomon Lederer, Michael Wuehler - Blockchain - A Practical Guide to Developing Business, Law, and Technology Solutions-McGraw-Hill Education
2. Josh Thompson, 'Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming', Create Space Independent Publishing Platform, 2017.
3. Anshul Kaushik, Blockchain & Crypto Currencies, Khanna Publishing House.
4. Tiana Laurence, Blockchain for Dummies, 2nd Edition 2019, John Wiley & Sons.
5. Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Imran Bashir, Packt Publishing, 2020

#-#-0204 OPERATION RESEARCH

Course Outcomes:

On completion of this course, the student will be able to:

1. Understand the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type.
2. Build and solve Transportation Models and Assignment Models.
3. Improve decision –making and develop critical thinking and objective analysis of decision problems
4. Understand linear programming with examples

Module I

Introduction: The origin, nature and impact of OR; Defining the problem and gathering data; Formulating a mathematical model; Deriving solutions from the model; Testing the model; Preparing to apply the model; Implementation .

Module II

The essence of the simplex method; Setting up the simplex method; Types of variables, Algebra of the simplex method; the simplex method in tabular form; Tie breaking in the simplex method, Big M method, Two phase method.

Module III

Primal dual relationship, conversion of primal to dual problem and vice versa. The dual simplex method.

Module IV

The transportation problem, Initial Basic Feasible Solution (IBFS) by North West Corner Rule method, Matrix Minima Method, Vogel's Approximation Method. Optimal solution by Modified Distribution Method (MODI). The Assignment problem; A Hungarian algorithm for the assignment problem. Minimization and Maximization varieties in transportation and assignment problems.

References:

1. D.S. Hira and P.K. Gupta, Operations Research, (Revised Edition), Published by S. Chand & Company Ltd, 2014
2. S Kalavathy, Operation Research, Vikas Publishing House Pvt Limited, 01-Aug-2002
3. S D Sharma, Operation Research, Kedar Nath Ram Nath Publishers.

#-#-0205 CYBER LAW AND ETHICS

Course Outcomes:

On completion of this course, the student will be able to:

1. Understand the various security threats in computing, database, network etc.
2. Analyze the structure, mechanics and evolution of the internet in the context of emerging crime threats and technological and other trends in cyber space.
3. Assess the impact of cyber crime on government, businesses, individuals and society.
4. Evaluate the effectiveness of cyber-security, cyber-laws and other countermeasures against cyber crime and cyber welfare.

Module I

Introduction to Information Technology Law: Information Technology and Intellectual Property, Overview of Intellectual Property Rights, Basic principles of copyright, Copyright and computer programs, Database copyright and the database right, Computer-generated works, Copyright in the information society, The law of confidence, Patent Law, Design Law, Trademarks, passing off and malicious falsehood, Criminal offences and intellectual property.

Module II

Information Technology Contracts, Fundamentals of information technology contracts, Liability for defective hardware or software, Contracts for writing software, License agreements for ready-made software, Open source software licenses, Website development contracts, Outstanding contracts, Hardware contracts.

Module III

Electronic Contracts and Torts, Nature, content and formation of electronic contracts, Performance of electronic contracts and evidential aspects, Torts related to electronic information, Liability of information society service providers for illegal material Information and Communications Technology Crime: Information and communications technology fraud, unauthorized access to computer material, unauthorized modification of computer programs or data, Computer pornography and harassment, Computer evidence and forensics.

Module IV

Data Protection and Freedom of Information: Data protection, the principles, definitions and Information Commissioner, Data controllers and the Data Protection Act 1998, Data subjects' rights, Freedom of information, Privacy and electronic communications
Professional, Ethical and Social Issues of Information Technology: The computer professional, Privacy and freedom of expression

References:

1. David Bainbridge., Introduction to Information Technology Law, 6/E, ISBN-10: 1405846666., 2007
2. Bainbridge, D., Introduction to Computer Law. (5th ed.). Pearson Education., 2004
3. Duggal, P., Cyber law: The Indian Perspective., 2005.
4. Pfleeger, C., Security in computing (4th ed.). Prentice Hall PTR., 2006.
5. Bishop, M., Computer Security: Art and Science. Pearson Education., 2003.
6. Zittrain, J., Internet Law: Technological Complements to Copyright. Foundation Press., 2005
7. Sood, V. Cyber Law Simplified, Tata McGraw Hill

##-0206 DEVOPS FOR ENTERPRISE BUSINESS AGILITY

Course Outcomes:

On completion of this course the student will be able to:

1. Understand the key concepts and principles of DevOps.
2. Understand the benefits of DevOps practices in the Software Delivery Lifecycle (SDLC) such as test, infrastructure, and build and deployment automation.
3. Analyze how DevOps utilises Lean and Agile methodologies to drive product-focused development.
4. Analyze specific DevOps methodologies and frameworks.

Module I

Introduction to DevOps: What is DevOps, Benefits of DevOps, Principles of DevOps, The DevOps Life Cycle. DevOps culture. Relationship with Agile and DevOps, Challenges with the Traditional Approach, DevOps Approach to the challenges

Module II

DevOps tools: Building a DevOps toolchain, Project management tools, Collaborative source code repositories, CI/CD pipelines, Test automation frameworks, Configuration management (infrastructure as code) tools, Monitoring tools, Continuous feedback tools

Module III

DevOps and cloud-native development : Microservices: Microservices benefit the organization, Microservices both enable and require DevOps, Key enabling technologies and tools, Microservices and cloud services, Common patterns and Anti Patterns of DevOps, Microservices and Cloud .

Containers: What are containers, Containers vs. virtual machines (VMs), Benefits of containers, Use cases for containers, Containerization, Container orchestration with Kubernetes, Istio, Knative, and the expanding containers ecosystem, Containers and Cloud.

Kubernetes: What is Kubernetes, Container orchestration with Kubernetes, Kubernetes architecture, Istio service mesh, Knative and serverless computing

Module IV

DevSecOps: DevSecOps,, Benefits of DevSecOps, Best practices for DevSecOps, DevSecOps in an organization .

DevOps and site reliability engineering (SRE) :Site Reliability engineering, Job of a site reliability engineer, Error Budget Tool, SRE and DevOps, Other SRE benefits, SRE, cloud and cloud-native development.

References:

1. The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations Paperback – October 6, 2016 by Gene Kim , Patrick Debois, John Willis, Jez Humble, John Allspaw
2. Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale, by Jennifer Davis , Ryn Daniels

3. DevOps for Developers (Expert's Voice in Web Development) , First Edition by Michael Hüttermann
4. Accelerate: The Science of Lean Software and DevOps: Building and Scaling High Performing Technology Organizations, March 27, 2018 by Nicole Forsgren, Jez Humble, Gene Kim
5. The Phoenix Project: A Novel about IT, DevOps, and Helping Your Business Win, January 10, 2013 by Gene Kim, Kevin Behr, George Spafford

##-0207 DATA MINING TECHNIQUES - PREDICTIVE MODELING & PATTERN DISCOVERY

Course Outcomes:

On completion of this course the student will be able to

1. Understand the importance of data mining to the decision-support systems.
2. Understand the predictive and descriptive modeling.
3. Prepare the data needed for data mining using pre-processing techniques.
4. Discover interesting patterns and association rules from huge volume of data in making classifications and predictions.
5. Gain knowledge on emerging areas like Web Mining.

Module I

Data Mining: Introduction to data mining-Data mining functionalities-Steps in data mining process- Classification of data mining systems, Major issues in data mining. Data Wrangling and Preprocessing: Data Preprocessing: An overview-Data cleaning-Data transformation and Data discretization.

Overview of data mining techniques - Market basket analysis, Classification and prediction, Clustering, Memory-based reasoning, Evaluation and Interpretation

Module II

Predictive Modeling: General approach to classification-Decision tree induction- Bayes classification methods- advanced classification methods: Bayesian belief networks. Classification by Backpropagation- Support Vector Machines-Lazy learners

Descriptive Modeling: Types of data in cluster analysis-Partitioning methods- Hierarchical methods-Advanced cluster analysis: Probabilistic model-based clustering- Clustering high dimensional data-Outlier analysis

Module III

Discovering Patterns and Rules: Frequent Pattern Mining: Basic Concepts and a Road Map - Efficient and scalable frequent item-set mining methods: Apriori algorithm, FP-Growth algorithm- Mining frequent itemsets using vertical data format- Mining closed and max patterns- Advanced Pattern Mining: Pattern Mining in Multilevel, Multidimensional Space

Module IV

Data Mining Trends and Research Frontiers: Other methodologies of data mining: Web mining- Temporal mining-Spatial mining-Statistical data mining- Visual and audio data mining- Data mining applications- Data mining and society: Ubiquitous and invisible data mining- Privacy, Security, and Social Impacts of data mining

References:

1. Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, third edition ,2013
2. Pang-Ning Tan,Michael Steinbach, Anuj Karpatne, Vipin Kumar, Introduction to Data Mining, second edition, Pearson, 2019
3. Ian.H.Witten, Eibe Frank and Mark.A.Hall, Data Mining:Practical Machine Learning Tools and Techniques,third edition , 2017
4. Alex Berson and Stephen J. Smith, Data Warehousing, Data Mining & OLAP, Tata McGraw Hill Edition, Tenth Reprint, 2008.
5. Hand, D., Mannila, H. and Smyth, P. Principles of Data Mining, MIT Press: Massachusets. third edition, Pearson, 2013

#-#-0208 DEEP LEARNING

Course Outcomes:

On completion of this course, the student will be able to:

1. Understand the fundamentals of Deep Learning
2. Design, train, deploy neural networks for solving different problems and analyze its efficacy
3. Understand conceptual and mathematical intuitions of neural networks to pursue research in this field.
4. Build skill in using established Machine Learning tools.

Module I

Neural Networks basics – Perceptron and Multi-layer Perceptron Linear Separable Problems and Perceptron – Multi layer neural networks, Neural net as an Approximator - Training a neural network - Perceptron learning rule , Back Propagation,

Practical aspects of Deep Learning: Bias, variance, Vanishing and exploding gradients, Gradient checking, Hyper Parameter Tuning. Optimization by gradient descent

Module II

Convolutional Neural Networks – Convolution / Pooling Layers, spatial arrangement, layer patterns, layer sizing patterns, Basics and Evolution of Popular CNN architectures – Transfer Learning– Applications : Object Detection and Localization, Face Recognition, Neural Style Transfer.

Recurrent Neural Networks –Modeling sequences - Back propagation through time - Bidirectional RNNs - GRU – LSTM – NLP – Word Embeddings – Transfer Learning – Attention Models – Applications : Sentiment Analysis, Speech Recognition, Action Recognition.

Module III

Restricted Boltzmann Machine – Deep Belief Network – Auto Encoders – Applications: Semi Supervised classification, Noise Reduction, Non-linear Dimensionality Reduction.

Goal Oriented Decision Making – Policy and Target Networks – Deep Quality Network for Reinforcement Learning.

Module IV

Introduction to GAN – Encoder/Decoder, Generator/Discriminator architectures.

Challenges in NN training – Data Augmentation – Hyper parameter Settings – Transfer Learning–
Developing and Deploying ML Models . Deep learning hardware and software: CPUs,GPU's and
TPUs, Tensorflow and Pytorch frameworks.

References:

1. Ian Goodfellow, YoshuaBengio and Aeron Courville,” Deep Learning”, MIT Press, First Edition, 2016.
2. Adam Gibson and Josh Patterson,” Deep Learning, A practitioner’s approach”, O’Reilly, FirstEdition, 2017.
3. Francois Chollet,” Deep Learning with Python”, Manning Publications Co, First Edition, 2018.
4. Michael Nielsen, Neural Networks and Deep Learning, Online book, 2016

#-#-0209 GRAPH THEORY

Course Outcomes:

On completion of this course, the student will be able to:

1. Understand the concept of vertex connectivity and edge connectivity in graphs.
2. Develop the understanding of Geometric duals in Planar Graphs.
3. Understand the concept of digraphs, Euler digraphs and Hamiltonian digraphs
4. Have an idea of matching in graphs and study some applications of matching in day to day life problems.

Module I

Subgraphs, Isomorphic graphs, Matrix representations of graphs, Degree of a vertex, Directed walks, paths and cycles, Connectivity in digraphs, Eulerian and Hamilton digraphs, Eulerian digraphs, Hamilton digraphs, Special graphs, Complements, Larger graphs from smaller graphs, Union, Sum, Cartesian Product, Composition, Graphic sequences

Module II

Walks, trails, paths, cycles, Connected graphs, Distance, Cut-vertices and cut-edges, Blocks, Connectivity, Weighted graphs and shortest paths, Weighted graphs, Dijkstra's shortest path algorithm, Floyd-Warshall shortest path algorithm.

Module III

Definitions and characterizations, Number of trees, Cayley's formula, Kircho-matrix-tree theorem, Minimum spanning trees, Kruskal's algorithm, Prim's algorithm, Special classes of graphs, Bipartite Graphs, Line Graphs, Chordal Graphs, Eulerian Graphs, Chinese Postman problem, Hamilton Graphs, Introduction, Necessary conditions and sufficient conditions.

Module IV

Independent sets and coverings: basic equations, Matchings in bipartite graphs, Hall's Theorem, Kőnig's Theorem, Perfect matchings in graphs, Cliques and chromatic number,, Greedy coloring algorithm, Coloring of chordal graphs, Brooks theorem

References:

1. J. A. Bondy and U. S. R. Murty. Graph Theory with Applications
2. R. Balakrishnan and K. Ranganathan, A Text Book of Graph Theory

##-0210 TREND ANALYSIS AND FORECASTING

Course Outcomes:

On Completion of this course, the student will be able to:

1. To learn the fundamental concepts of trend analysis and its objectives.
2. To demonstrate different methods of trend analysis.
3. To understand the basics of forecasting.
4. To learn how various fields of artificial intelligence impacts forecasting.

Module I

Introduction to Trend Analysis, Types of trend- Uptrend, downtrend, sideways/horizontal trend. Purpose of trend analysis, Trend analysis as a design research methodology, Types of trend analysis - geographic, temporal and intuitive, Advantages and disadvantages of trend analysis.

Module II

Trend analysis indicators, Examples, Different methods, Trend charts, Challenges. Moving Averaging Models for Trend Identification , Regression Models for Trend Projection Case Study on trend analysis.

Module III

Introduction to Forecasting: The Nature and Uses of Forecasts, The Forecasting Process, Data for Forecasting, Resources for Forecasting, Business Forecasting and Time Series Data, Statistics Background for Forecasting, Regression Analysis and Forecasting.

Module IV

Artificial Intelligence and Machine Learning in Forecasting: Deep Learning for Forecasting, Current Trends and Challenges, Neural Network–Based Forecasting Strategies, Forecasting the Impact of Artificial Intelligence: The Emerging and Long-Term Future. Big Data in Forecasting.

References:

1. Douglas C., Cheryl L., & Murat Kulahci.(2015). Introduction to Time Series Analysis and Forecasting. Wiley Publishers.
2. Michael Gilliland, Len Tashman, and Udo Sglavo. (2021). Business Forecasting: The Emerging Role of Artificial Intelligence and Machine Learning. Wiley Publishers.

#-#-0211 SOFTWARE RELIABILITY FOR INFORMATION TECHNOLOGY

Course Outcomes:

On completion of this course, the student will be able to:

1. Provide students with a solid foundation in Software Reliability
2. Learn the basic concepts in Software Reliability
3. Analyse software system failures and develop convincing solutions.
4. Apply problem solving skills in producing failure free software intensive system.

Module I

Software Reliability: The need for Software Reliability, Some Basic Concepts, The SRE process, Availability, Modelling and General Model Characteristics.

Software reliability engineering approach, software reliability engineering process, defining the product. The Operational Profile: Reliability concepts, software reliability and hardware reliability, developing operational profiles, applying operational profiles, learning operations and run concepts.

Module II

Software Reliability Concepts: Defining failure for the product, common measure for all associated systems, setting system failure intensity objectives, determining develop software failure intensity objectives, software reliability strategies, failures, faults and errors, availability, system and component reliabilities & failure intensities, predicting basic failure intensity.

Module III

Parameter Estimation: Maximum Likelihood Estimation, Least Squares Estimation, Bayesian Inference

Software Reliability Modelling: Basic Features of the Software Reliability Models, Markovian Models, Finite Failure Category Models, Infinite Failure Category Models, Early Life-Cycle Prediction Models. Comparison of Software Reliability Models. Project Management and Software Security: Software Project Management, Software Security.

Module IV

Software Reliability Prediction: Problems associated with different Software Reliability Models, Software Reliability prediction parameters, Intelligent Techniques for Software Reliability Prediction. Software Reliability Prediction in Early Phases of the Life Cycle.

Software Quality Management: Software Quality Attributes, Quality Measurement & Metrics, Verification & Validation Techniques, Verification & Validation in the Life Cycle, Software Quality System (SQS), Software Quality Assurance functions, Tool support for SQA. Software Reliability Engineering (SRE), Quality, test and data plans, Roles and responsibilities, Sample

quality and test plan, Defect reporting procedure

References:

1. M. Xie, *Software Reliability Modelling*, World Scientific; 1991
2. John D. Musa, Anthony Iannino, Kazuhira Okumoto, *Software Reliability Measurement, Prediction, Application*. McGraw-Hill Book Company; 1987.
3. Michael R. Lyu, "*Handbook of Software Reliability Engineering*," IEEE Computer Society Press, McGraw-Hill Book Company, 2005.
4. Patric D. T. O Connor, "*Practical Reliability Engineering*," 4th Edition, John, Wesley & Sons, 2003.
5. Anderson and PA Lee, "*Fault tolerance principles and Practice*," PHI, 1981

##-0212 DESIGN THINKING AND INNOVATION LAB

Course Outcomes:

On completion of this course, the student will be able to:

1. Identify an opportunity from a problem.
2. Frame a Product/Service idea.
3. Design and Develop a prototype and iterate solutions.
4. Frame the design challenge properly.

Design Areas: (Communication design , Animation, Publication Design, Web Design, Graphics Design, Printing, Film and Video)

- Spatial design (Architecture and Interior Design, Environmental Design, Exhibition Design, Set Design, Signage Design)
- Industrial Design (Transportation, Furniture, Ceramics, Products and Packaging)
- Textiles Design (Fashion, Accessories, Jewellery)
- Craft Design (Material Based, Technology based)
- Digital design (User experience design, User Interface design, New Media Design, Game Design, AR/VR/MR, Information Visualisation)
- Service Design (Social Services, Health and Wellness Services, Agriculture Services, Public Services)
- Design management (Design Policy, Design Strategy, Design Planning, Transformation Design)

Apply:

- Create through observation, discovery, analysis, experience, collaboration, and Reflection

References:

1. Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School - Idris Mootee.
2. <https://dsource.in/resource/quotes>
3. <http://designindia.net/institutions/design-information/design-questions>

##-0213 SEMINAR-II

Course Objective

To encourage and motivate the students to read and collect recent and relevant information from their area of interest confined to the relevant discipline from technical publications including peer reviewed journals, conferences, books, project reports, etc., prepare a report based on a central theme and present it before a peer audience.

Course Outcomes:

On completion of this course the student will be able to

1. Identify and familiarize with some of the good publications and journals in their field of study.
2. Acquaint oneself with preparation of independent reports, name them based on a central theme and write abstracts, main body, conclusions and references identifying their intended meaning and style.
3. Understand effective use of tools of presentation, generate confidence in presenting a report before an audience and improve their skills in the same.
4. Develop skills like time management, leadership quality and rapport with an audience.

Individual students are required to choose a topic of their interest from the field of Business Analytics & Intelligence preferably from outside the M.Tech syllabus and give a seminar on that topic for about 30 minutes. A committee consisting of at least three faculty members shall assess the presentation of the seminar and award marks to the students.

SEMESTER - III
#-#-0301 INTERNSHIP/MOOC COURSE

Course Outcomes:

On completion of this course, the student will be able to:

1. Acquire insights into tasks and problems which are usually not experienced in an academic environment.
2. Get an exposure to real world professional activities, which will help them to gain a better understanding of their academic curriculum contents.
3. Work with various groups of professionals, managers, technicians etc.
4. Learn advanced topics through various courses.

Every student shall undergo a MOOC Course/ internship programme in an IT industry/ Public Sector organization. The evaluation of the course will be conducted under the supervision of a minimum of two teachers.

#-#-0302 DISSERTATION PHASE- I

Course Outcomes:

On completion of this course the student will be able to:

1. Identify, understand and discuss current, real-world issues.
2. Distinguish and integrate differing forms of knowledge and academic disciplinary approaches (e.g., humanities and sciences) with that of Software Systems and apply a multidisciplinary strategy to address current, real-world issues.
3. Demonstrate oral and written communication skills.
4. Apply appropriate techniques, resources, and modern engineering and IT tools
5. Apply principles of ethics and respect in interaction with others.

The student is required to undertake Project work during the third semester and the same is continued in the fourth semester. A project guide will be allotted to each student by the head of division/course coordinator. The project work shall be reviewed periodically by the project guide. Under special cases, students can carry out a project in a reputed Industry/ R&D institution with the permission of course coordinator/HOD. At the end of the semester, each student shall submit a project report comprising of the following:

- a) Literature Review.
- b) Application and feasibility of the project.
- c) Objectives.
- d) Detailed documentation including diagrams and algorithms.
- e) Project implementation action plan.
- f) References

The Project evaluation shall be conducted by an Evaluation committee consisting of minimum two teachers

SEMESTER - IV

#-#-0401 DISSERTATION PHASE-II

Course Outcomes:

On completion of this course the student will be able to:

1. Identify, understand and discuss current, real-world issues.
2. Distinguish and integrate differing forms of knowledge and academic disciplinary approaches (e.g., humanities and sciences) with that of Software Systems and apply a multidisciplinary strategy to address current, real-world issues.
3. Demonstrate oral and written communication skills.
4. Apply appropriate techniques, resources, and modern engineering and IT tools
5. Apply principles of ethics and respect in interaction with others.
6. Explore an appreciation of the self in relation to its larger diverse social and academic contexts.

The student is required to complete the Project work in the fourth semester. The Project evaluation shall be conducted at the end of the fourth semester by an Evaluation Committee consisting of three teachers. The committee shall consist of the project guide, course coordinator and one faculty appointed by HOD. At the end of the semester, each student shall submit a project report comprising of the following:

- a) Literature Review.
- b) Objectives.
- c) Detailed documentation including diagrams and algorithms.
- d) Result/Output
- e) Future Scope
- f) Conclusion
- g) References

The final evaluation of the project shall include the following:

- a) Presentation of the work.
- b) Demonstration of the project against objectives.
- c) Quality and content of the project

