KAMARAJ
COLLEGE OF ENGINEERING & TECHNOLOGY

(An Autonomous Institution - AFFILIATED TO ANNA UNIVERSITY, CHENNAI)
S.P.G.Chidambara Nadar - C.Nagammal Campus
S.P.G.C. Nagar, K.Vellakulam – 625 701 (Near VIRUDHUNAGAR).

DEPARTMENT OF COMPUTER SCIENCE

M.E COMPUTER SCIENCE AND ENGINEERING

REGULATIONS 2020 - AUTONOMOUS

CHOICE BASED CREDIT SYSTEM (CBCS)

I TO IV SEMESTERS

CURRICULUM AND SYLLABI

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VISION OF THE DEPARTMENT:

To make the Department of Computer Science and Engineering the unique of its kind in the field of Research and Development activities in this part of the world

MISSION OF THE DEPARTMENT:

To impart highly innovative and technical knowledge to the urban and unreachable rural student folks in Computer Science and Engineering through “Total Quality Education”.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO 1: Apply fundamental concepts, tools and advanced techniques to build solutions to problems of varying complexity.

PEO 2: Pursue research to have a successful career in academia or industries associated with Computer Science and Engineering.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: To analyze, design and develop computing solutions by applying fundamental concepts, tools and advanced techniques of Computer Science and Engineering.

PSO2: To adapt to emerging Information and Communication Technologies to solve scientific or societal problems.

The credit requirement for the programme **M.E Computer Science and Engineering** (as per Regulation 2020) is outlined below:

Sl. No	Category of Courses	Credits
1.	**Foundation Courses (FC)**	**4**
2.	**Professional Core Courses (PC)**	**30**
3.	**Professional Elective Courses (PE)**	**15**
4.	**Online Courses (OC)**	**3**
5.	**Open Elective Courses (OE)**	**3**
6.	**Employability Enhancement Courses (EEC)**	**18**
Total Credits		**73**

Category	Semester				Credits
	I	**II**	**III**	**IV**	
FC	4				**4**
PC	14	16			**30**
PE	3	6	6		**15**
OC			3		**3**
OE			3		**3**
EEC			6	12	**18**
TOTAL	**21**	**22**	**18**	**12**	**73**

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M.E.COMPUTER SCIENCE AND ENGINEERING

REGULATIONS 2020 - AUTONOMOUS

CHOICE BASED CREDIT SYSTEM (CBCS)

I TO IV SEMESTERS

CURRICULUM AND SYLLABI

SEMESTER I

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	MA1106	Applied Probability and Statistics	FC	3	1	0	4	4
2	MC1101	Advanced Data Structures and Algorithms	PC	3	0	0	3	3
3	MC1102	Agile Software Development and Usability Engineering	PC	3	0	0	3	3
4	MC1103	Machine Learning Techniques	PC	3	0	0	3	3
5	MC1104	Operating System Internals	PC	3	0	0	3	3
6	PE1	Professional Elective I	PE	3	0	0	3	3
PRACTICAL								
7	MC1111	Advanced Data Structures and Algorithms Laboratory	PC	0	0	4	4	2
			TOTAL	**18**	**1**	**4**	**23**	**21**

SEMESTER II

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	MC1201	Big Data Analytics Framework	PC	3	0	0	3	3
2	MC1202	Ethical Hacking and Network Defense	PC	3	0	0	3	3
3	MC1203	Internet of Things in Application Perspective	PC	3	0	0	3	3
4	MC1204	Network Design and Technologies	PC	3	0	0	3	3
5	MC1205	Research Methodology and Intellectual Property Rights	PC	2	0	0	2	2
6	PE2	Professional Elective II	PE	3	0	0	3	3
7	PE3	Professional Elective III	PE	3	0	0	3	3
PRACTICAL								
8	MC1211	Big Data Analytics and Mining Laboratory	PC	0	0	4	4	2
			TOTAL	**20**	**0**	**4**	**24**	**22**

SEMESTER III

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	PE4	Professional Elective IV	PE	3	0	0	3	3
2	PE5	Professional Elective V	PE	3	0	0	3	3

3	OE1	Open Elective – I	OE	3	0	0	3	3
4	OC1	Online course – I	OC	3	0	0	3	3
PRACTICAL								
5	MC1321	Project Phase – I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**12**	**24**	**18**

SEMESTER IV

Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**PERIODS PER WEEK**			**TOTAL CONTACT PERIODS**	**CREDITS**
				L	**T**	**P**		
PRACTICAL								
1	MC1421	Project Phase – II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

Course	**I**	**II**	**III**	**IV**
M.E. Computer Science and Engineering	**21**	**22**	**18**	**12**

Professional Elective Courses (Elective – I, Semester I)

Sl. No.	**COURSE CODE**	**COURSE TITLE**	**CATEGORY**	**CONTACT PERIODS**	**L**	**T**	**P**	**CREDITS**
1	MC1131	Artificial Intelligence and Applications	PE	3	0	0	0	3
2	MC1132	Cloud Computing Technologies	PE	3	0	0	0	3
3	MC1133	Data Science using Python	PE	3	0	0	0	3

4	MC1134	Formal Models of Software Systems	PE	3	0	0	0	3
5	MC1135	Image Processing and Analysis	PE	3	0	0	0	3
6	MC1136	Web Engineering	PE	3	0	0	0	3

Professional Elective Courses (Elective – II, Semester II)

SI. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	CREDITS
1	MC1231	Advanced Databases	PE	3	0	0	0	3
2	MC1232	Deep learning Techniques	PE	3	0	0	0	3
3	MC1233	Language Technologies	PE	3	0	0	0	3
4	MC1234	Real Time Systems - Principles	PE	3	0	0	0	3
5	MC1235	Software Architectures and Design	PE	3	0	0	0	3
6	MC1236	Speech Processing and Synthesis	PE	3	0	0	0	3

Professional Elective Courses (Elective – III, Semester II)

SI. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	CREDITS
1	MC1237	Computer Vision Principles	PE	3	0	0	0	3
2	MC1238	Information Retrieval Techniques	PE	3	0	0	0	3
3	MC1239	Mobile and Pervasive Computing	PE	3	0	0	0	3

4	MC1240	Natural language processing – Principles and Practices	PE	3	0	0	0	3
5	MC1241	Parallel Programming Paradigms	PE	3	0	0	0	3
6	MC1242	Performance Analysis of Computer Systems	PE	3	0	0	0	3

Professional Elective Courses (Elective – IV, Semester III)

SI. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	CREDITS
1	MC1331	Augmented reality and Virtual reality Tools and Techniques	PE	3	0	0	0	3
2	MC1332	Data Visualization Tools and Techniques	PE	3	0	0	0	3
3	MC1333	Information Storage Management	PE	3	0	0	0	3
4	MC1334	Mobile Application Development Technologies	PE	3	0	0	0	3
5	MC1335	Reconfigurable Computing	PE	3	0	0	0	3
6	MC1336	Software Quality Assurance and Testing	PE	3	0	0	0	3

Professional Elective Courses (Elective – V, Semester III)

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	CREDITS
1	MC1337	Bio Informatics for Computer Engineers	PE	3	0	0	0	3
2	MC1338	Bio-Inspired Computing	PE	3	0	0	0	3
3	MC1339	Enterprise Application Design and Development	PE	3	0	0	0	3
4	MC1340	Risk Modeling and Assessment	PE	3	0	0	0	3
5	MC1341	Robotics and Intelligent Control systems	PE	3	0	0	0	3
6	MC1342	Social Network Analysis	PE	3	0	0	0	3

Open Electives

Suggested List of Open Electives

Open Elective – I (Semester III)

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	CREDITS
1	OMC151	Advanced Software Engineering	PE	3	0	0	0	3
2	OMC152	Internet Programming Practices	PE	3	0	0	0	3
3	OMC153	Big Data Analytics – Concepts and Frameworks	PE	3	0	0	0	3

SEMESTER – I

MA1106 APPLIED PROBABILITY AND STATISTICS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

To enable the students to,

- Understand the fundamentals on topics in applied probability and various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modelling.
- Address the issues and the principles of estimation theory, testing of hypothesis and multivariate analysis.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Probability – Axioms of probability – Conditional probability – Baye‘s theorem – Random variables – Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT III ESTIMATION THEORY 12

Unbiased estimators – Method of moments – Maximum likelihood estimation –Curve fitting by principle of least squares – Regression lines.

UNIT IV TESTING OF HYPOTHESIS 12

Sampling distributions – Type I and Type II errors – Small and large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit

UNIT V MULTIVARIATE ANALYSIS 12

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components – Population principal components – Principal components from standardized variables

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to,

CO1: Demonstrate competency in the Basic probability axioms and rules

and the moments of discrete and continuous randomvariables.

CO2: Compute the correlation between two variables and linear regression equation for a set of data.

CO3: Estimate the Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.

CO4: Apply statistical tests in testing hypotheses on various data.

CO5: Perform exploratory analysis of multivariate data, such as multivariate normal density,calculating descriptive statistics, testing for multivariate normality.

REFERENCES:

1. Devore, J. L., 2014, *Probability and Statistic for Engineering and the Sciences*, 8th Edition, Cengage Learning.
2. Dallas E. Johnson, 1998, *Applied Multivariate Methods for Data Analysis*, Thomson and Duxbury press.
3. Gupta S.C& Kapoor V.K., 2001, *Fundamentals of Mathematical Statistics*, Sultan and Sons, New Delhi.
4. Johnson, R.A., Miller, I & Freund J. , 2015, *Probability and Statistics for Engineers* , Pearson Education, Asia, 8th Edition.
5. Richard A. Johnson & Dean W. Wichern, 2002, *Applied Multivariate Statistical Analysis*, 5th Edition, Pearson Education, Asia.

MC1101 ADVANCED DATA STRUCTURES AND ALGORITHMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Understand the role of algorithms in computing
- Learn hierarchical data structures and its operations
- Learn the usage of graphs and its applications
- Understand algorithm design techniques
- Study about NP Completeness of problems

UNIT I ROLE OF ALGORITHMS IN COMPUTING 9

Algorithms – Algorithms as a Technology- Insertion Sort – Analyzing Algorithms- Designing Algorithms- Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions- Recurrences: The Substitution Method – The Recursion-Tree Method

UNIT II HIERARCHICAL DATA STRUCTURES 9

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red-Black trees: Properties of Red-Black Trees – Rotations – Insertion-Deletion -B-Trees: Definition of B- trees – Basic operations on B-Trees – Deleting a key from a B-

Tree- Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree

UNIT III GRAPHS 9

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra's Algorithm; All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd- Warshall Algorithm**;**

UNIT IV ALGORITHM DESIGN TECHNIQUES 9

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem – Elements of the Greedy Strategy- Huffman Codes

UNIT V NP COMPLETE AND NP HARD 9

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP-Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to,

CO1: Explain the role of algorithms to solve computing problems.
CO2: Make use of hierarchical data structures to solve problems
CO3: Apply graph algorithms to solve problems.
CO4: Interpret the algorithm design techniques.
CO5: Summarize NP Complete and NP hard problems.

REFERENCES

1. Alfred V. Aho, John E. Hopcroft & Jeffrey D. Ullman,2006, Reprint, *Data Structures and Algorithms*, Pearson Education
2. Robert Sedgewick & Kevin Wayne, 2011, A*lgorithms*, Fourth Edition, Pearson Education.
3. Sridhar S., 2014, *Design and Analysis of Algorithms*, First Edition, Oxford University Press.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest & Clifford Stein, 2011, *Introduction to Algorithms*, Third Edition, Prentice-Hall.

MC1102 AGILE SOFTWARE DEVELOPMENT AND USABILITY ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Familiarize theoretical as well as practical understanding of agile software development practices.
- Learn agile project management
- Organize and monitor the agile projects
- Learn agile testing techniques and user interface design
- Familiarize with DevOps practices

UNIT I AGILE SOFTWARE DEVELOPMENT 9

Theories for Agile Management – Classification of Agile Methods Agile vs Traditional models, Agile manifesto - Agile methodologies - DSDM, FDD- Crystal, Scrum, Agile Modeling - Extreme Programming-Lean Software Development- Unified Process (UP)

UNIT II MANAGING AGILE PROJECTS 9

Gathering software requirements -Eliciting requirements from users - Adopting Agile values, Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment, Leveraging – KM in Software Engineering – Managing Software Knowledge – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM)

UNIT III PLANNING AGILE PROJECTS 9

Prioritizing and estimating work - Organizing projects by features, Dividing features into tasks -Reporting Team Progress Documenting work completed with backlogs - Tracking progress with burn down charts, Projecting project costs and completion dates - Monitoring work in progress with task boards.

UNIT IV TEST-DRIVEN DEVELOPMENT AND USABILITY ENGINEERING 9

Unit, integration, system and Acceptance testing - Exploratory testing, automated and manual testing, exercising boundary conditions - Driving development through constant testing - Usability Engineering- usability engineering life cycle, Human Computer interaction and user interface design -GUI design- user interaction diagrams, GUI design heuristics - Usability testing -Usability across interface types.

UNIT V DEVOPS 9

DevOps: Motivation-Cloud as a platform-Operations- Deployment Pipeline: Overall Architecture-Building and Testing-Deployment-Case study: Migrating to Micro services.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to,

CO1: Illustrate the importance of interacting with business stakeholder's Stories for given software specification.
CO2: Develop skills to manage the agile projects.
CO3: Interpret agility and knowledge management.
CO4: Summarize quality with test-driven development and Usability Engineering.
CO5: Illustrate the advantages of DevOps practices.

REFERENCES:

1. Mike Holcombe, 2008, *Running an Agile Software Development Project*, Wiley
2. Laura M. Leventhal & Julie A. Barnes, 2008, *Usability Engineering: Process, Products and Examples*, Pearson/Prentice Hall
3. Len Bass, Ingo Weber &Liming Zhu, 2016, *DevOps: A Software Architect's Perspective*, Pearson Education
4. Orit Hazzan & Yael Dubinsky, 2014, *Agile software engineering*, Springer
5. Jakob Nielsen, 1993, *Usability Engineering*, Academic Press
6. David J. Anderson & Eli Schragenheim, 2003, *Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results*, Prentice Hall
7. Hazza & Dubinsky, 2009, *Agile Software Engineering, Series: Undergraduate Topics in Computer Science*, Springer
8. Kevin C. Desouza, 2007, *Agile Information Systems: Conceptualization, Construction and Management*, Butterworth-Heinemann

MC1103 MACHINE LEARNING TECHNIQUES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:
To enable the students to,

- Understand the basic concepts and techniques of Machine Learning.
- Learn the concepts of Supervised and Unsupervised learning Techniques
- Study the various probability based learning techniques
- Learn the concepts of dimensionality reduction and evolutionary models
- Understand graphical models of machine learning algorithms

UNIT I INTRODUCTION 9

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

UNIT II LINEAR MODELS 9

Multi-layer Perceptron – Going Forwards – Going Backwards: Back PropagationError – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview– Deriving Back- Propagation –Radial Basis Functions and Splines – Concepts – RBF Network –Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

UNIT III TREE AND PROBABILISTIC MODELS 9

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map.

UNIT IV DIMENSIONALITY REDUCTION AND EVOLUTIONARYMODELS 9

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process.

UNIT V GRAPHICAL MODELS 9

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to,

CO1: Explain supervised, unsupervised and semi-supervised learning techniques
CO2: Apply the appropriate machine learning strategy for any given problem
CO3: Use the supervised, unsupervised or semi-supervised learning algorithms.
CO4: Apply the dimensionality reduction and evolutionary models techniques
CO5: Build the systems that uses the appropriate graphical models of Machine learning

REFERENCES:

1. Ethem Alpaydin, 2014, (Adaptive Computation and Machine Learning Series, Third Edition, *Introduction to Machine Learning,* 3rd Edition, MIT Press
2. Jason Bell, 2014, *Machine learning – Hands on for Developers and Technical Professionals*, First Edition, Wiley
3. Peter Flach, 2012, *Machine Learning: The Art and Science of Algorithms that Make Sense of Data*, First Edition, Cambridge University Press

4. Stephen Marsland, 2014, *Machine Learning – An Algorithmic Perspective*, Second Edition. Chapman and Hall/CRC Machine Learning and Pattern Recognition Series
5. Tom M Mitchell, 2013, *Machine Learning*, First Edition, McGraw Hill Education

MC1104 OPERATING SYSTEM INTERNALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Understand sample open source programs and header files.
- Learn about process implementation in Linux.
- Understand the implementation of Linux file system.
- Study Linux memory management data structures and algorithms.
- Acquire knowledge about the implementation of interprocess communication and how program execution happens in Linux.

UNIT I INTRODUCTION 9

Basic Operating System Concepts - Overview of Unix File System - Files - Links - Types – Inodes -Access Rights - System Calls - Overview of Unix Kernels - Model - Implementation - Reentrant Kernels - Address Space - Synchronization - Interprocess Communication - Process Management - Memory Management - Device Drivers.

UNIT II PROCESSES 9

Processes, Lightweight Processes and Threads - Process Descriptor - State - Identifying a Process - Relationships among processes - Organization - Resource Limits - Creating Processes - System Calls - Kernel Threads - Destroying Processes - Termination – Removal.

UNIT III FILE SYSTEM 9

The Virtual File System (VFS) - Role - File Model -System Calls - Data Structures - Super Block, Inode, File, dentry Objects - dentry Cache - Files Associated with a Process – File system Types - Special File systems – File system Type Registration – File system Handling - Namespaces – Mounting - Unmounting - Implementation of VFS System Calls.

UNIT IV MEMORY MANAGEMENT 9

Page frame management -page descriptors - non-uniform memory access - memory zones - reserved page frames - zoned page frame allocator - kernel mappings - buddy system algorithm - page frame cache - zone allocator.

UNIT V PROCESS COMMUNICATION AND PROGRAM EXECUTION 9

Process Communication - Pipes -Usage - Data Structures - Creating and Destroying a Pipe - Reading From and Writing into a Pipe. Program Execution - Executable Files - Process Credentials - Command-Line Arguments and Shell Environment - Libraries

- Program Segments and Process Memory Regions - Execution tracing - Executable Formats - Execution Domains - The exec Functions.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, students will be able to,

CO1: Explain the functionality of a large software system by reading its source.
CO2: Illustrate the concept of process management in Linux.
CO3: Summarize the details about Linux file system implementation.
CO4: Outline the memory management data structures and algorithms that are used in Linux.
CO5: Illustrate the concept of interprocess communication and process execution in Linux.

REFERENCES:

1. Daniel P Bovet & Marco Cesati, 2005, *Understanding the Linux Kernel*, 3rd ed, O'Reilly Publications.
2. Harold Abelson, Gerald Jay Sussman & Julie Sussman, 2013, *Structure and Interpretation of Computer Programs*, 2nd ed, Universities Press.
3. Maurice J Bach, 2003, The Design of the Unix Operating System, 1st ed, Pearson Education.
4. Michael Beck, Harald Bohme, Mirko Dziadzka, Ulrich Kunitz, Robert Magnus, & Dirk Verworner, 1998, *Linux Kernel Internals*, 2nd ed, Addison-Wesley.
5. Robert Love, 2010, *Linux Kernel Development*, 3rd ed, Addison-Wesley

MC1111 ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:
To enable the students to,

- Implement the solution for sorting problems using data structures.
- Implement hierarchical data structures, Trees to solve problems.
- Implement hierarchical data structures, heaps to solve problems.
- Learn the usage of graph data structure in solving problems.
- Understand the usage of dynamic programming and greedy algorithms in solving problems.

LIST OF EXPERIMENTS:

1. Implementation of Merge Sort and Quick Sort-Analysis
2. Implementation of a Binary Search Tree
3. Red-Black Tree Implementation

4. Heap Implementation
5. Fibonacci Heap Implementation
6. Graph Traversals
7. Spanning Tree Implementation
8. Shortest Path Algorithms (Dijkstra's algorithm, Bellmann Ford Algorithm)
9. Implementation of Matrix Chain Multiplication
10. Activity Selection and Huffman Coding Implementation.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to,

CO1: Apply basic data structures to solve sorting problems.
CO2: Make use of trees data structures to solve problems.
CO3: Build heaps data structure for problem solving.
CO4: Utilize graph algorithms for problem solving.
CO5: Develop dynamic programming and greedy algorithms for problem solving.

REFERENCES:

1. Alfred V. Aho, John E. Hopcroft & Jeffrey D. Ullman, 2006, Reprint, *Data Structures and Algorithms*, Pearson Education
2. Robert Sedgewick & Kevin Wayne, 2011, *Algorithms*, Fourth Edition, Pearson Education.
3. S.Sridhar, 2014, Design and Analysis of Algorithms, First Edition,Oxford
4. University Press.
5. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest & Clifford Stein, 2011, Introduction *to Algorithms*, Third Edition, Prentice-Hall.

LIST OF LAB EQUIPMENTS FOR A BATCH OF 25 STUDENTS:

Sl. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500 GB, 4 GB RAM)	25
2.	Printer	1
3.	Server (Intel Core i3, 4 GB RAM) (High Speed Processor)	1
4.	Compilers: C / C++	25 users

SEMESTER – II

MC1201 BIG DATA ANALYTICS FRAMEWORK

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Understand the fundamentals of big data analytics.
- Understand the big data frameworks.
- Learn data analytic methods.
- Learn stream computing.
- Gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig and Hive for big data analytics.

UNIT I INTRODUCTION TO BIG DATA 7

Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern DataAnalytic Tools.

UNIT II HADOOP FRAMEWORK 9

Distributed File Systems - Large-Scale File System Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN.

UNIT III DATA ANALYSIS 13

Statistical Methods: Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in ClusterAnalysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.

UNIT IV MINING DATA STREAM 7

Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time AnalyticsPlatform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

UNIT V BIG DATA FRAMEWORKS 9

Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to,

CO1: Outline the fundamentals big data analytics
CO2: Explain the big data frameworks
CO3: Summarize the various data analytics methods
CO4: Make use of mining techniques in stream data to predict in realtime applications.
CO5: Explain different big data frameworks

REFERENCES:

1. Hurwitz JS, Nugent A, Halper F & Kaufman M, 2013, *Big data for dummies*, John Wiley & Sons.
2. Alan Gates & Daniel Dai, 2016, *Pig : Data flow Scripting with Hadoop*, O'Reilly Media.
3. Jason Rutherglen, Dean Wampler & Edward Capriolo, 2012, Programming Hive", 1st ed, O'Reilly Media.
4. Judith Hurwitz, Alan Nugent, Fern Halper & Marcia Kaufman, 2014, *Big Data*, Wiley Publications.
5. Mark Van Rijmenam, 2014, *Think Bigger: Developing a Successful Big Data Strategy for Your Business*, 1st ed, Amazon.
6. Hurwitz JS, Nugent A, Halper F & Kaufman M, 2013, *Big data for dummies,* John Wiley & Sons.
7. Tom White, 2011, *Hadoop: The Definitive Guide*, O'Reilly Publications.
8. Dayong Du, 2015, *Apache Hive Essentials*, Packet Publishing.
9. Hanish Bansal & Saurabh Chauhan, 2016, *Apache Hive Cookbook*, Packet publishing
10. Richard Cotton, 2013, *Learning R – A Step-by-step Function Guide to Data Analysis*, O'Reilly Media.

MC1202 ETHICAL HACKING AND NETWORK DEFENSE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:
To enable the students to,

- Understand the basic concepts of Ethical Hacking.
- Know the various tools used for collecting information.
- Familiarize with different techniques to override existing security measures.
- Understand the techniques used to safeguard web services.
- Learn different techniques used to safeguard wireless networks.

UNIT I ETHICAL HACKING OVERVIEW AND VULNERABILITIES 9

Understanding the importance of security, Concept of ethical hacking and essential

Terminologies- Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking.

UNIT II FOOTPRINTING AND PORT SCANNING 9

Foot printing - Introduction to foot printing, Understanding the information gathering methodology of the hackers, Tools used for the reconnaissance phase. Port Scanning - Introduction, using port scanning tools, ping sweeps, Scripting Enumeration- Introduction, Enumerating windows OS & Linux OS.

UNIT III SYSTEM HACKING 9

Aspect of remote password guessing, Role of eavesdropping, Various methods of password cracking, Keystroke Loggers, Understanding Sniffers, Comprehending Active and Passive Sniffing, ARP Spoofing and Redirection, DNS and IP Sniffing, HTTPS Sniffing.

UNIT IV HACKING WEB SERVICES AND SESSION HIJACKING 9

Web application vulnerabilities, application coding errors, SQL injection into Back-end Databases, cross-site scripting, cross-site request forging, authentication bypass, web services and related flaws, protective http headers Understanding Session Hijacking, Phases involved in Session Hijacking, Types of Session Hijacking, Session Hijacking Tools.

UNIT V HACKING WIRELESS NETWORKS 9

Introduction to 802.11, Role of WEP, Cracking WEP Keys, Sniffing Traffic, Wireless DOS attacks, WLAN Scanners, WLAN Sniffers, Hacking Tools, Securing Wireless Networks.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to,

CO1: Explain the fundamentals of Ethical Hacking.
CO2: Outline the various tools used for collecting information.
CO3: Summarize various techniques used to counter the security measures.
CO4: Outline the techniques used to safeguard web services.
CO5: Explain the ways in which a wifi network can be secured.

REFERENCES:

1. Omar Santos & Michael Gregg, 2019, *Certified Ethical Hacker Version 10*, 3rd Edition, Pearson IT Certification.
2. Kimberly Graves, 2010, *Certified Ethical Hacker*, Wiley India Pvt Ltd.
3. Michael T. Simpson, 2016, *Hands-on Ethical Hacking & Network Defense*, 3rd Edition Cengage Learning.
4. Rajat Khare, 2006, *Network Security and Ethical Hacking*, Luniver Press.

5. Ramachandran. V, 2011, *BackTrack 5 Wireless Penetration Testing Beginner's Guide*, PACKT Publishing.

MC1203 INTERNET OF THINGS IN APPLICATION PERSPECTIVE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Understand the fundamentals of Internet of Things.
- Learn about the basics of IoT Architectures.
- Learn about the basics of IoT protocols.
- Build a small low cost embedded system using Raspberry Pi & Arduino.
- Apply the concept of Internet of Things in the real world scenario.

UNIT I INTRODUCTION TO IoT 9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology.

UNIT II IoT ARCHITECTURE 9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoTreference architecture.

UNIT III IoT PROTOCOLS 9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP – Security.

UNIT IV BUILDING IoT WITH RASPBERRY PI & ARDUINO 9

Building IoT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms – Arduino.

UNIT V CASE STUDIES AND REAL-WORLD APPLICATIONS 9

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs – Cloud for IoT - Amazon Web Services for IoT.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to,

CO1: Outline the fundamental concepts of Internet of Things.
CO2: Explain the basics of IoT Architectures.
CO3: Demonstrate the various IoT protocols.
CO4: Design IoT application using controllers.
CO5: Demonstrate applications of IoT in real time scenario.

REFERENCES:

1. Arshdeep Bahga & Vijay Madisetti, 2015, *Internet of Things – A hands-on approach*, Universities Press,
2. Dieter Uckelmann, Mark Harrison, Michahelles & Florian (Eds), 2011, *Architecting the Internet of Things*, Springer
3. Honbo Zhou, 2012, *The Internet of Things in the Cloud: A Middleware Perspective*, CRC Press
4. Jan Ho¨ ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis , Karnouskos, StefanAvesand.& David Boyle, 2014, *From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence*, Elsevier
5. Olivier Hersent, David Boswarthick & Omar Elloumi, 2012, *The Internet of Things – Key applications and Protocols*, Wiley

MC1204 NETWORK DESIGN AND TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:
To enable the students to,

- Understand the principles required for network design
- Explore various technologies in the wireless domain
- Learn about basics of cellular networks
- Study about 4G networks
- Understand the paradigm of Software defined networks

UNIT I NETWORK DESIGN 10

Advanced multiplexing – Code Division Multiplexing, DWDM and OFDM – Shared media networks – Switched networks – End to end semantics – Connectionless, Connection oriented, Wireless Scenarios –Applications, Quality of Service – End to end level and network levelsolutions. LAN cabling topologies – Ethernet Switches, Routers, Firewalls and L3 switches – Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP – Corenetworks, and distribution networks.

UNIT II WIRELESS NETWORKS 9

IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX -802.16e – Network Infrastructure – WLAN – Configuration – Management

Operation – Security– IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS – Bluetooth – ProtocolStack – Security – Profiles.

UNIT III CELLULAR NETWORKS 9

GSM – Mobility Management and call control – GPRS – Network Elements – Radio ResourceManagement – Mobility Management and Session Management – Small Screen Web Browsing over GPRS and EDGE – MMS over GPRS – UMTS – Channel Structure on the Air Interface – UTRAN –Core and Radio Network Mobility Management – UMTS Security.

UNIT IV 4G NETWORKS 9

LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks – Scheduling – Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10) - 4G Networks andComposite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols –Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Introduction to 5G.

UNIT V SOFTWARE DEFINED NETWORKS 9

Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDNControllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework.

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to,

CO1: Outline the components required for designing a network.
CO2: Explain the various technologies used in wireless domain.
CO3: Demonstrate the basics of cellular networks.
CO4: Outline the features of 4G networks.
CO5: Explain the paradigm of Software defined networks.

REFERENCES:

1. Erik Dahlman, Stefan Parkvall & Johan Skold, 2013, *4G: LTE/LTE-Advanced for Mobile Broadband*, Academic Press.
2. Jonathan Rodriguez, 2015. *Fundamentals of 5G Mobile Networks*, Wiley.
3. Larry Peterson & Bruce Davie, 2011, 5th edition, *Computer Networks: A Systems Approach*, Morgan Kauffman.
4. Martin Sauter, 2014, *From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband*, Wiley.
5. Martin Sauter, 2009, *Beyond 3G - Bringing Networks, Terminals and the Web Together: LTE, WiMAX, IMS, 4G Devices and the Mobile Web 2.0*, Wiley .
6. Naveen Chilamkurti, Sherali Zeadally & Hakima Chaouchi, 2013, *Next-Generation Wireless Technologies*, Springer
7. Paul Goransson & Chuck Black, 2014, Software Defined Networks: A

Comprehensive Approach, Morgan Kauffman.
8. Savo G Glisic, 2007, Advanced Wireless Networks – 4G Technologies, John Wiley & Sons.
9. Thomas D.Nadeau & Ken Gray, 2013, *SDN – Software Defined Networks*, O"Reilly Publishers.
10. Ying Dar Lin, Ren-Hung Hwang & Fred Baker, 2011, *Computer Networks: An Open Source Approach*, McGraw Hill.

MC1205 RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS

L	T	P	C
2	0	0	2

COURSE OBJECTIVES:

To enable the students to,

- Put forward the research problems, findings, analyses and interpretations effectively.
- Explain the various approaches and functions of literature review.
- Write and present technical paper without violating professional ethics.
- Take ownership of new findings through intellectual property rights.
- Learn the latest developments in intellectual property rights.

UNIT I RESEARCH PROBLEM FORMULATION 6

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.

UNIT II LITERATURE REVIEW 6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICAL WRITING/PRESENTATION 6

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

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.

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

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 etc. Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 30 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to,

CO1: Rephrase the research problems.
CO2: Summarize the existing works.
CO3: Develop a research proposal and present it.
CO4: Explain intellectual property rights.
CO5: Explain recent developments in IPR.

REFERENCES:

1. C.R. Kothari & Gaurav Garg, 2018, *Research Methodology: Methods and Techniques*, 4th Edition, New Age International.
2. Ranjit Kumar, 2011, *Research Methodology: A Step by Step Guide for beginners,* 3rd Edition, SAGE publications Limited.
3. Menell S. Peter, Lemley A. Mark & Merges P. Robert, 2020, *Intellectual Property in New Technological Age*, Clause 8 Publishing.
4. Halbert, 2007, *Resisting Intellectual Property*, Taylor & Francis Ltd.
5. Goddard Wayne & Melville Stuart, 2001, *Research Methodology: An Introduction for Science and Technology Students*, 2nd edition – reprint 2007, Juta & Co. Ltd.

MC1211 BIG DATA ANALYTICS AND MINING LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:
To enable the students to,

- Implement Map Reduce techniques for processing big data
- Analyze big data using machine learning techniques such as SVM/Decision tree classification and clustering.
- Visualize data using any plotting framework.
- Build applications that stores big data in Hbase/MongoDb.
- Use Pig scripts.

LIST OF EXPERIMENTS

Hadoop

1. Install, configure and run Hadoop and HDFS
2. Implement word count / frequency programs using MapReduce
3. Implement an MR program that processes a weather dataset

R

4. Implement Linear and logistic Regression
5. Implement SVM / Decision tree classification techniques
6. Implement clustering techniques

7. Visualize data using any plotting framework
8. Implement an application that stores big data in Hbase /MongoDB / Pig using Hadoop / R.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to,

CO1: Construct applications to Process big data using Hadoop framework
CO2: Build and apply linear and logistic regression models
CO3: Develop applications to analyze data with machine learning methods
CO4: Experiment with graphical data analysis
CO5: Construct big data applications with Hbase/MongoDB etc.

REFERENCES:

1. Alan Gates & Daniel Dai, 2016, 2nd Edition. *Programming Pig – Dataflow scripting withHadoop*, O'Reilley
2. Gareth James, Daniela Witten, Trevor Hastie & Robert Tibshirani, 2015 , *An Introduction to Statistical Learning with Applications in R*, Springer Publications
3. Hadley Wickham, 2016, 2nd Edition, *ggplot2 – Elegant Graphics for Data Analysis*, Springer Publications
4. Kristina Chodorow,2013, 2nd Edition, *MongoDB: The Definitive Guide – Powerful and Scalable Data Storage*, O'Reilley
5. Lars George, 2015, *HBase: The Definitive Guide*, O'Reilley
6. Tom White, 2015, 4th Edition, *Hadoop: The Definitive Guide – Storage and Analysis at Internet Scale*, O'Reilley

LIST OF LAB EQUIPMENTS FOR A BATCH OF 25 STUDENTS:

Sl. No.	Description of Equipment	Quantity Required
1.	Personal Computers (Intel Core i3, 500 GB, 4 GB RAM)	25
2.	Printer	1
3.	HadoopYARN R PackageHbase MongoDB,Pig.Hive	Open Source, Free Software

ELECTIVES

PROFESSIONAL ELECTIVES – I

MC1131 ARTIFICIAL INTELLIGENCE AND APPLICATIONS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Learn the various characteristics of Intelligent agents
- Study the different search strategies in Artificial Intelligence
- Learn the inference based knowledge representation in Artificial Intelligence
- Understand the different ways of designing agent communication
- Learn the various applications of Artificial Intelligence

UNIT I INTRODUCTION 9

Introduction–Definition - The Foundations of Artificial Intelligence- Typical Intelligent Agents - Characteristics of Intelligent Agents -Turing test – Agents and Environments - Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents; Problem Solving Approach to Typical AI problems

UNIT II PROBLEM SOLVING USING SEARCHING 9

Problem-Solving Agents, Formulating problems, searching for Solutions, Uninformed Search Strategies, Breadth-first search, Depth-first search, searching with Partial Information, Informed Search Strategies, Greedy best-first search, A* Search-IDA*-Heuristic Functions, Local Search Algorithms and Optimization Problems - Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – stochastic Games.

UNIT III KNOWLEDGE REPRESENTATION AND INFERENCES 9

Propositional Logic - First Order Logic – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories - Reasoning for default information.

UNIT IV AGENT COMMUNICATION 9

Architecture for Intelligent Agents – Agent communication - Agents and Objects – Negotiation and Bargaining –Argumentation among Agents – Trust and Reputation in Multi-agent systems.

UNIT V APPLICATIONS 9

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing – Machine learning - Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of course the students will be able to

CO1: Explain the various characteristics of intelligent agents.
CO2: Show appropriate search algorithms for Artificial Intelligence problem.
CO3: Illustrate a Knowledge Representation using first order logic.
CO4: Infer different ways of the agent communication and Trust and Reputation in Multi-agent systems.
CO5: Demonstrate the various applications of AI.

REFERENCES:

1. Russell, S & Norvig, P, 2020, *Artificial Intelligence: A Modern Approach,* 4th ed, Prentice Hall.
2. Elaine Rich & Kevin Knight, 2008, *Artificial Intelligence*, 3rd ed, Tata McGraw-Hill.
3. Tim Jones, M, 2008, *Artificial Intelligence: A Systems Approach (Computer Science)*, 1st edition, Jones and Bartlett Publishers, Inc.
4. Nils J Nilsson, 2009, T*he Quest for Artificial Intelligence*, Cambridge University Press.
5. Gerhard Weiss, 2013, *Multi Agent Systems*, 2nd edition, MIT Press.
6. David L Poole & Alan K Mackworth, 2010, *Artificial Intelligence: Foundations of Computational Agents*, Cambridge University Press.

MC1132 CLOUD COMPUTING TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Understand the concepts of virtualization and virtual machines
- Gain knowledge in server and storage virtualization
- Understand the cloud deployment models and its architecture
- Gain knowledge in developing services using cloud
- Understand the security issues in the cloud environment

UNIT I VIRTUALIZATION 9

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines – Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization –– Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization

UNIT II VIRTUALIZATION INFRASTRUCTURE 9

Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop

Virtualization – Application Virtualization - Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation

UNIT III CLOUD PLATFORM ARCHITECTURE 9

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery – Architectural Design Challenges - Public Cloud Platforms : GAE,AWS – Inter-cloud Resource Management

UNIT IV PROGRAMMING MODEL 9

Introduction to Hadoop Framework - Mapreduce, Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster - Mapping Applications -Google App Engine -Amazon AWS –Microsoft Azure Cloud Software Environments –Eucalyptus -Open Nebula -OpenStack –Cloudsim programming - GoGrid -Rackspace.Cloud Orchestration - Terraform, Chef, Ansible

UNIT V CLOUD SECURITY 9

Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud –Cloud Security and Trust Management

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Explain the basic concepts of virtualization.
CO2: Outline the virtualization structure.
CO3: Explain the cloud architecture.
CO4: Apply cloud services in different programming models and software environment.
CO5: Interpret the security issues in cloud.

REFERENCES:

1. Danielle Ruest & Nelson Ruest, 2009, *Virtualization: A Beginner"s Guide*, McGraw-Hill Osborne Media
2. Jim Smith & Ravi Nair, 2005, *Virtual Machines: Versatile Platforms for Systems and Processes*, Elsevier/Morgan Kaufmann
3. John W.Rittinghouse & James F.Ransome, 2010, *Cloud Computing: Implementation, Management, and Security*, CRC Press
4. Kai Hwang, Geoffrey C Fox & Jack G Dongarra, 2012, *Distributed and Cloud Computing, From Parallel Processing to the Internet of Things*, Morgan Kaufmann Publishers
5. Tim Mather, Subra Kumaraswamy, & ShahedLatif, 2009, *Cloud Security and*

Privac", O'Reilly Media, Inc.
6. Toby Velte, Anthony Velte & Robert Elsenpeter, 2009, *Cloud Computing, A Practical Approach* , McGraw-Hill Osborne Media
7. Tom White, 2012, *Hadoop: The Definitive Guide*, Yahoo Press

MC1133 DATA SCIENCE USING PYTHON

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Learn the fundamentals of Python programming.
- Use python data structures – lists, tuples and dictionaries.
- Study data analysis and interpretation with numpy on statistical parameters.
- Understand various methods of data preparation and manipulation with Pandas.
- Learn data visualization using matplotlib and seaborn.

UNIT I PYTHON FUNDAMENTALS 9

Introduction to Python Programming – The Python Environment – Variables – Types – Statements – Operators – Operator Precedence – Expression - Conditionals: If-else Constructs – Loop Structures / Iterative Statements: While Loop, – For Loop, – Break Statement, Continue Statement.

UNIT II FUNCTION, STRING, LIST AND TUPLE 9

Function – Parameter Passing – Local and Global Scope – Recursive Functions; List – Adding Items to a List – Finding and Updating an Item – Nested Lists – Cloning Lists – List Slices – Mutability – Tuples: Creation, Accessing, Updating, Deleting Elements in a Tuple, Tuple as Return Value, Dictionaries; Strings: Indexing, Traversing, Concatenating, Appending, Multiplying, Formatting, Slicing, Comparing, Iterating – Basic Built-In String Functions.

UNIT III INTRODUCTION TO NUMPY 9

Introducing NumPy - NumPy Arrays with Computations - Aggregations: Min, Max, and Everything in Between Broadcasting - Comparisons, Masks and Boolean Logic - Sorting Arrays - Structured Data with NumPy's Arrays.

UNIT IV DATA MANIPULATION WITH PANDAS 9

Introducing Pandas Objects - Data Indexing and Selection - Operating on Data in Pandas - Handling Missing Data - Hierarchical Indexing Combining Datasets - Vectorized String Operations - Working with Time Series - High-Performance Pandas: eval() and query()

UNIT V VISUALIZATION WITH MATPLOTLIB 9

Various Plots - Simple Line - Scatter Plots Error Visualization - Density and Contour Plots - Histograms, Binnings, and Density - Customizing Plots-Multiple Subplots - Three-Dimensional Plotting in Matplotlib - Geographic Data with Basemap - Visualization with Seaborn

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, students will be able to:

CO1: Solve simple mathematical and scientific problems using python control Statements.
CO2: Make use of lists, tuples, dictionaries and strings to handle compound data processing.
CO3: Apply NumPy functions and statements for data analysis and interpretation.
CO4: Choose appropriate methods in Pandas for data preparation and Manipulation.
CO5: Utilize matplotlib and seaborn for visualizing the data.

REFERENCES:

1. Reema Thareja, 2017, *Python Programming: Using Problem Solving Approach*, Oxford University Press
2. Jake Vander Plas, 2016, *Python Data Science Handbook: Essential Tools for Working with Data*, 1st ed, O'Reilly Media, Inc.
3. Nelli, F 2015, *Python Data Analytics*, 1st ed , Apress, USA,.
4. McKinney, W 2017, *Python for Data Analysis*, 2nded, O'Reilly Media, Inc.
5. John V Guttag 2013, *Introduction to Computation and Programming Using Python,* Revised and Expanded Edition MIT Press.
6. Timothy A. Budd, 2015, *Exploring Python*, Mc-Graw Hill Education Private Ltd.

MC1134 FORMAL MODELS OF SOFTWARE SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Understand the goals, complexity of software systems, the role of Specification activities and qualities to control complexity.
- Understand the fundamentals of abstraction and formal methods.
- Learn fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to system models.
- Understand formal specification models based on set theory, calculus and algebra and apply to a case study
- Learn Z, Object Z and B Specification languages with case studies.

UNIT I SPECIFICATION FUNDAMENTALS 10

Role of Specification- Software Complexity - Size, Structural, Environmental, Application, domain, Communication Complexity, How to Control Complexity. Software specification, Specification Activities-Integrating Formal Methods into the Software Life-Cycle. Specification Qualities- Process Quality Attributes of Formal Specification Languages, Model of Process Quality, Product Quality and Utility, Conformance to Stated Goals Quality Dimensions and Quality Model.

UNIT II FORMAL METHODS 8

Abstraction- Fundamental Abstractions in Computing. Abstractions for Software Construction. Formalism Fundamentals - Formal Systems, Formalization Process in Software Engineering Components of a Formal System- Syntax, Semantics, and Inference Mechanism. Properties of Formal Systems - Consistency. Automata-Deterministic Finite Accepters, State Machine Modeling Nondeterministic Finite Accepters, Finite State Transducers Extended Finite State Machine. Case Study—Elevator Control. Classification of C Methods-Property-Oriented Specification Methods, Model-Based Specification Techniques.

UNIT III LOGIC 9

Propositional Logic - Reasoning Based on Adopting a Premise, Inference Based on Natural Deduction. Predicate Logic - Syntax and Semantics, Policy Language Specification, knowledge Representation Axiomatic Specification. Temporal Logic - .Temporal Logic for Specification and Verification, Temporal Abstraction Propositional Temporal Logic (PTL), First Order Temporal Logic (FOTL).Formal Verification, Verification of Simple FOTL, Model Checking, Program Graphs, Transition Systems.

UNIT IV SPECIFICATION MODELS 9

Mathematical Abstractions for Model-Based Specifications-Formal Specification Based on Set Theory, Relations and Functions. Property-Oriented Specifications-Algebraic Specification, Properties of Algebraic Specifications, Reasoning, Structured Specifications. Case Study—A Multiple Window Environment: requirements, Modeling Formal Specifications. Calculus of Communicating Systems: Specific Calculus for Concurrency. Operational Semantics of Agents, Simulation and Equivalence, Derivation Trees, Labeled Transition Systems.

UNIT V FORMAL LANGUAGES 9

The Z Notation, abstractions in Z, Representational Abstraction, Types, Relations and Functions, Sequences, Bags. Free Types-Schemas, Operational Abstraction - Operations Schema Decorators, Generic Functions, Proving Properties from Z specifications, Consistency of Operations. Additional Features in Z. Case Study: An Automated Billing System. The Object-Z Specification Language – Basic Structure of an Object-Z, Specification. Parameterized Class, Object-Orientation, composition of Operations-Parallel Communication Operator, Nondeterministic Choice Operator, and Environment Enrichment. The B-Method -Abstract Machine Notation (AMN), Structure of a B Specification, arrays, statements. Structured Specifications, Case Study - A Ticketing System in a Parking.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Explain the complexity of software systems, the need for formal specifications activities and qualities to control complexity.
CO2: Outline the fundamentals of abstraction and formal methods
CO3: Interpret the fundamentals of logic reasoning, Propositional Logic, temporal logic.
CO4: Develop formal specification models based on set theory, calculus and algebra
CO5: Summarize the knowledge on Z, Object Z and B Specification languages with case studies.

REFERENCES:

1 Ben-Ari.M,2003, *Mathematical Logic for computer science*, second edition Springer
2 Michael Huth & Mark Ryan, 2004, *Logic in Computer Science- modeling and reasoning about systems*, second edition ,Cambridge University Press
3 Alagar.V.S, Periyasamy.K, David Grises & Fred Schneider B ,2011, *Specification of Software Systems*, Springer –Verlag London

4 Jonathan Jacky, 1996,*The ways Z: Practical programming with formal methods*, Cambridge University Press
5 Jim Woodcock & Jim Devies, 1996, *Z-Specification Refinement and Proof*, Prentice Hall
6 Antoi Diller, 1994, *Z: An introduction to formal methods* ,Second Edition Wiley

MC1135 IMAGE PROCESSING AND ANALYSIS

L	T	P	C
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COURSE OBJECTIVES:

To enable the students to,

- Understand the image processing fundamental concepts
- Gain knowledge about various image processing and restoration techniques
- Familiarize image segmentation techniques
- Understand the image analysis with classification
- Be familiar with the concepts of image registration and Image Visualization techniques

UNIT I IMAGE PROCESSING FUNDAMENTALS 9

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical, statistical and spatial operations.

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9

Image Transforms -Discrete and Fast Fourier Transform and Discrete Cosine Transform, Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models.

UNIT III IMAGE SEGMENTATION AND MORPHOLOGY 9

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations Distance Transforms- Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions- Component Labeling – Regional descriptors and Feature Selection Techniques

UNIT IV IMAGE ANALYSIS AND CLASSIFICATION 9

Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation

and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification.

UNIT V IMAGE REGISTRATION AND VISUALIZATION 9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Explain the basic concepts in Image Processing
CO2: Illustrate various image enhancement and restoration techniques
CO3: Make use of different image segmentation and feature representation Techniques
CO4: Summarize different approaches related to image analysis and classification
CO5: Outline the different restoration and visualization techniques

REFERENCES:

1. Alasdair McAndrew, 2011, *Introduction to Digital Image Processing with Matlab*, Cengage Learning, India.
2. Anil J Jain, 2011, *Fundamentals of Digital Image Processing*, PHI.
3. Kavyan Najarian & Robert Splerstor, 2006, *Biomedical signals and Image processing*, CRC – Taylor and Francis, New York
4. Rafael C.Gonzalez & Richard E.Woods, 2018, *Digital Image Processing*, Fourth Edition, Pearson Education, New Delhi
5. S.Sridhar , 2016, *Digital Image Processing*, Oxford University Press

MC1136 WEB ENGINEERING

L	T	P	C
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COURSE OBJECTIVES:

To enable the students to,

- Understand the basic concepts of web applications.
- Gain knowledge about web application architectures.
- Be familiar with different web application design methods.
- Gain knowledge about web applications testing techniques.
- Be familiar with the concepts of web project management

UNIT I INTRODUCTION TO WEB ENGINEERING 9

Motivation, Categories of Web Applications, Characteristics of Web Applications. Requirements of Engineering in Web Applications- Web Engineering- Components of Web Engineering-Web Engineering Process-Communication- Planning.

UNIT II WEB APPLICATION ARCHITECTURES &MODELLING WEB APPLICATIONS 9

Introduction- Categorizing Architectures- Specifics of Web Application Architectures, Components of a Generic Web Application Architecture- Layered Architectures, 2-Layer Architectures, N-Layer Architectures-Data-aspect Architectures, Database-centric Architectures- Architectures for Web Document Management- Architectures for Multimedia Data- Modeling Specifics in Web Engineering, Levels, Aspects, Phases Customization, Modeling Requirements, Hypertext Modeling, Hypertext Structure Modeling Concepts, Access Modeling Concepts, Relation to Content Modeling, Presentation Modeling, Relation to Hypertext Modeling, Customization Modeling, Modelling Framework-Modeling languages- Analysis Modeling for Web Apps-The Content Model-The Interaction Model- Configuration Model.

UNIT III WEB APPLICATION DESIGN 9

Design for WebApps- Goals-Design Process-Interactive Design- Principles and Guidelines- Workflow-Preliminaries-Design Steps- Usability- Issues- Information Design- Information Architecture- structuring- Accessing Information-Navigation Design- Functional Design-Wep App Functionality- Design Process- Functional Architecture- Detailed Functional Design.

UNIT IV TESTING WEB APPLICATIONS 9

Introduction-Fundamentals-Test Specifics in Web Engineering-Test Approaches-Conventional Approaches, Agile Approaches- Testing concepts- Testing Process - Test Scheme- Test Methods and Techniques- Link Testing- Browser Testing-Usability Testing- Load, Stress, and Continuous Testing, Testing Security, Test- driven Development, -Content Testing-User Interface testing-Usability Testing- Compatibility Testing-Component Level Testing-Navigation Testing-Configuration testing-Security and Performance Testing- Test Automation

UNIT V PROMOTING WEB APPLICATIONS AND WEB PROJECT MANAGEMENT 9

Introduction-challenges in launching the web Application-Promoting Web Application-Content Management-Usage Analysis-Web Project Management- Challenges in Web Project Management-Managing Web Team- Managing the Development Process of a

Web Application- Risk, Developing a Schedule, Managing Quality, Managing Change, Tracking the Project. Introduction to node JS - web sockets.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Explain the basic characteristics of web applications.
CO2: Outline different web application architectures.
CO3: Design simple applications using web application design concepts.
CO4: Make use of different testing techniques for verifying the designed web applications.
CO5: Summarize about the concepts of web project management.

REFERENCES:

1. Chris Bates, 2007, *Web Programming: Building Internet Applications*, Third Edition, 3rd ed, Wiley India Edition.
2. Gerti Kappel & Birgit Proll, 2006, *Web Engineering*, John Wiley and Sons Ltd.
3. Lecky Thompson W., 2008, *Web Programming*, Cengage Learning.
4. John Paul Mueller, 2006, *Web Development with Microsoft Visual Studio*, Wiley Dream tech.
5. Roger S. Pressman & David Lowe, 2009, *Web Engineering*, Tata McGraw Hill Publicatio

PROFESSIONAL ELECTIVES – II

MC1231 ADVANCED DATABASES

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COURSE OBJECTIVES:

To enable the students to,

- Acquire knowledge on parallel and distributed databases and its applications.
- Study the usage and applications of intelligent databases.
- Understand the emerging databases such as XML, NOSQL, and MongoDB.
- Understand the representation of mobile data.
- Learn different multimedia databases such as text, image, audio and video.

UNITI PARALLEL AND DISTRIBUTED DATABASES 9

Database System Architectures: Centralized and Client – Server Architectures - Server System Architectures - Parallel Systems - Distributed Systems - Parallel Databases: I/O Parallelism - Inter and Intra Query Parallelism - Inter and Intra operation Parallelism - Design of Parallel Systems Distributed Database Concepts - Distributed Data Storage - Distributed Transactions - Commit Protocols - Concurrency Control - Distributed Query Processing - Case Studies.

UNIT II INTELLIGENT DATABASES 9

Active Databases: Syntax and Semantics (Starburst, Oracle, DB2) - Taxonomy applications - Design Principles for Active Rules - Temporal Databases: Overview of Temporal Databases TSQL2 - Deductive Databases - Recursive Queries in SQL - Spatial Databases - Spatial Data Types - Spatial Relationships - Spatial Data Structures - Spatial Access Methods - Spatial DB Implementation.

UNIT III SEMI-STRUCTURED AND UNSTRUCTRED DATABASES 9

XML Databases: XML Data Model - DTD - XML Schema - XML Querying - NoSQL Database - Basic CRUD Operations - Indexing - Aggregation - Data Modelling concepts - Connecting MongoDB using Mongoose.

UNIT IV MOBILE DATABASES 9

Mobile Databases: Location and Hand off Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols.

UNIT V MULTIMEDIA DATABASES 9

Multidimensional Data Structures - Image Databases - Text/Document Databases - Video Databases - Audio Databases - Multimedia Database Design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Design of parallel and distributed database.
CO2: Develop intelligent databases using DB2/SQL.
CO3: Build semi-structured and unstructured databases.
CO4: Explain the concepts related to mobile database design.
CO5: Describe various types of multimedia databases and their design.

REFERENCES:

1. Abraham Silberschatz, Henry F.Korth & S.Sudharshan, 2019, *Database System Concepts*, Seventh Edition, McGrawHill.
2. Elmasri R. & Navathe S.B., 2015, *Fundamentals of Database Systems*, Seventh Edition, Pearson Education.
3. Date C.J., Kannan A. & Swamynathan S., 2006*, An Introduction to Database Systems*, Eighth Edition, Pearson Education.
4. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T.Snodgrass, V.S.Subrahmania &, Roberto Zicari, 2006, *Advanced Database Systems*, Morgan Kaufmann publishers.
5. Vijay Kumar, 2006, *Mobile Database Systems*, John Wiley & Sons.

MC1232 DEEP LEARNING TECHNIQUES

L	T	P	C
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COURSE OBJECTIVES:

To enable the students to,

- Understand the fundamentals of deep learning.
- Learn the fundamentals of various auto encoders
- Learn the various techniques for representation learning
- Select the appropriate strategies for structured probabilistic models
- Use GAN programs on deep networks

UNIT I DEEP FORWARD NETWORKS AND APPLICATIONS 9

Deep forward networks-Gradient based learning-Hidden units- Back propagation and other differentiation algorithms- Back propagation for MLP training- Applications- large scale deep learning- computer vision- Speech recognition – Natural language processing- other applications- knowledge representation and reasoning

UNIT II AUTO ENCODERS 9

Undercomplete autoencoders- Regularized autoencoders- representational power, layer size and depth- stochastic encoders and decoders-denoising autoencoders-learning manifolds with autoencoders- contractive autoencoders- predictive sparse decomposition-applications of autoencoders

UNIT III REPRESENTATION LEARNING 9

Greedy layer- wise unsupervised pretraining- transfer learning and domain adaptation-semi supervised disentangling of causal factors-distributed representation-exponential gains from depth- providing clues to discover underlying causes

UNIT IV STRUCTURED PROBABILISTIC MODELS FOR DEEP LEARNING 9

The challenge of unstructured modelling-using graphs to describe model structure-sampling from graphical models-advantage of structured modelling- learning about dependencies- Inference and approximate inference-The deep learning approach to structured probabilistic models

UNIT V DEEP GENERATIVE MODELS 9

Boltzmann Machines- Restricted Boltzmann Machines- Deep Belief networks- Deep Boltzmann Machines- Boltzmann Machines for real valued data- convolutional Boltzmann Machines- Boltzmann Machines for structured or sequential outputs-other Boltzmann Machines- Directed Generative Nets- Drawing samples from autoencoders-Evaluating Generative models

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Explain the basic concepts of deep forward Neural Networks
CO2: Apply the various concepts of autoencoders in a deep learning model
CO3: Outline the concepts of representation learning
CO4: Select the structured probabilistic models for deep learning
CO5: Apply GAN on Boltzmann Machines

REFERENCES:

1. Ian Goodfellow, Yoshua Bengio & Aaron Courville , 2016,*Deep Learning* (Adaptive Computation and Machine Learning Series), MIT Press
2. Simon Haykin, 2016, *Neural Networks and Learning Machines*, 3rd Edition, Pearson Prentice Hall.
3. Patterson J & Gibson A, 2017, *Deep learning: A practitioner's approach*. O'Reilly Media, Inc

MC1233 LANGUAGE TECHNOLOGIES

L	T	P	C
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COURSE OBJECTIVES:
To enable the students to,

- Understand the fundamentals of natural language processing.
- Familiarize with the basic concepts of speech processing techniques.
- Gain knowledge about the usage of CFG and PCFG in NLP.
- Explore the role of semantics and pragmatics in NLP.
- Gain knowledge about the different applications of NLP.

UNIT I INTRODUCTION 9

Words - Regular Expressions and Automata - Words and Transducers - N-grams - Part-of- Speech – Tagging - Hidden Markov and Maximum Entropy Models.

UNIT II SPEECH 9

Speech – Phonetics - Speech Synthesis - Automatic Speech Recognition - Speech Recognition: - Advanced Topics - Computational Phonology.

UNIT III SYNTAX 9

Formal Grammars of English - Syntactic Parsing - Statistical Parsing - Features and Unification - Language and Complexity.

UNIT IV SEMANTICS AND PRAGMATICS 9

The Representation of Meaning - Computational Semantics - Lexical Semantics - Computational Lexical Semantics - Computational Discourse.

UNIT V APPLICATIONS 9

Information Extraction - Question Answering and Summarization - Dialogue and Conversational Agents - Machine Translation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Outline the basic concepts of natural language processing.
CO2: Explain the fundamentals of speech processing.
CO3: Summarize rule based system to tackle morphology/syntax of a language.
CO4: Illustrate the role of semantics and pragmatics in NLP
CO5: Compare and contrast different statistical approaches used in different types of NLP applications.

REFERENCES:

1. Breck Baldwin, 2015, *Language Processing with Java and LingPipe Cookbook*, Atlantic Publisher.
2. Daniel Jurafsky, 2014, *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech*, Pearson Publication.
3. Nitin Indurkhya & Fred J. Damerau, 2010, *Handbook of Natural Language Processing*,2nd ed, Chapman and Hall/CRC Press.
4. Richard M Reese, 2015, *Natural Language Processing with Jav*a, O-Reilly Media.
5. Steven Bird, Ewan Klein & Edward Loper, 2009, *Natural Language Processing with Python*, 1st ed, O-Reilly Media.

MC1234 REAL TIME SYSTEMS – PRINCIPLES

L	T	P	C
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COURSE OBJECTIVES:
To enable the students to,

- Be familiar with the fundamentals of Real Time Systems.
- Learn the requirements engineering process of Real Time Systems.
- Understand inter task communication and memory management.
- Learn the concepts of real time databases.
- Understand the evaluation techniques and clock synchronization in Real Time Systems.

UNIT I REAL TIME SYSTEM AND SCHEDULING 9

Introduction– Structure of a Real Time System –Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Issues in Real Time Computing – Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms –Fault Tolerant Scheduling.

UNIT II SOFTWARE REQUIREMENTS ENGINEERING 9

Requirements engineering process – types of requirements – requirements specification for real time systems – Formal methods in software specification – structured Analysis and Design – object oriented analysis and design and unified modelling language – organizing the requirements document – organizing and writing documents – requirements validation and revision.

UNIT III INTER TASK COMMUNICATION AND MEMORY MANAGEMENT 9

Buffering data – Time relative Buffering- Ring Buffers – Mailboxes – Queues – Critical regions – Semaphores – other Synchronization mechanisms – deadlock priority inversion process stack management – run time ring buffer – maximum stack size – multiple stack arrangement – memory management in task control block - swapping – overlays – Block page management – replacement algorithms – memory locking – working sets – real time garbage collection – contiguous file systems

UNIT IV REAL TIME DATABASES 9

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two– phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

UNIT V EVALUATION TECHNIQUES AND CLOCK SYNCHRONIZATION 9

Reliability Evaluation Techniques – Obtaining parameter values, Reliability modelsfor Hardware Redundancy–Software error models. Clock Synchronization–Clock, A Nonfault– Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1 : Explain the fundamentals of Real Time Systems.

CO2 : Outline the requirements engineering process of Real Time Systems.
CO3 : Summarize inter task communication and memory management in Real Time Systems.
CO4: Explain the concepts of Real Time databases.
CO5: Interpret the evaluation techniques and synchronization.

REFERENCES:

1. Philip.A.Laplante, 2004, *Real Time System Design and Analysis*, 3rd Edition, Prentice Hall of India
2. Rajib Mall, 2009, *Real-time systems: Theory and practice*, Pearson Education.
3. R.J.A Buhur & D.L Bailey, 1999, *An Introduction to Real-Time Systems* Prentice Hall International.
4. M. Krishna & Kang G. Shin, 1997, *Real-Time Systems*, McGraw-Hill International Editions.
5. Stuart Bennett, 1998, *Real Time Computer Control-An Introduction*, Second Edition, Prentice Hall of India.
6. Allen Burns & Andy Wellings, 2009, *Real Time Systems and Programming Languages*, Pearson Education.

MC1235 SOFTWARE ARCHITECTURES AND DESIGN

L	T	P	C
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COURSE OBJECTIVES:

To enable the students to,

- Understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation.
- Learn the design principles and to apply for large scale systems
- Understand the architectures for distributed heterogeneoussystems, environment through brokerage interaction
- Interpret the knowledge on service oriented, model driven and the aspect oriented architecture.
- Develop appropriate architectures for various Case studies like semantic web services, supply chain cloud services.

UNIT I INTRODUCTION TO SOFTWARE ARCHITECTURE 10

Introduction to Software Architecture-Bridging Requirements and Implementation, Design Guidelines, Software Quality attributes. Software Architecture Design Space. Agile Approach to Software Architecture Design, Models for Software Architecture Description Languages (ADL).

UNIT II DESIGN PRINCIPLES AND TYPES OF ARCHITECTURES 8

Object-Oriented Paradigm -Design Principles, Data-Centered Software Architecture, Repository Architecture, Blackboard Architecture. Hierarchical Architecture Main-Subroutine, Master-Slave, Layered, Virtual Machine. Interaction-Oriented Software

Architectures: Model-View-Controller (MVC), Presentation-Abstraction-Control (PAC).

UNIT III DISTRIBUTED AND WEB SERVICES 9

Distributed Architecture: Client-Server, Middleware, Multi-tiers, Broker Architecture – MOM, CORBA Message Broker Architecture- Service-Oriented Architecture (SOA), SOAP, UDDI, SOA Implementation in Web Services, Grid/cloud Service Computing. Heterogeneous Architecture - Methodology of Architecture Decision, QualityAttributes.

UNIT IV USER INTERFACE 9

Architecture of User Interfaces containers, Case study-web service, Product Line Architectures - methodologies, processes and tools. Software Reuse and Product Lines - Product Line Analysis, Design and implementation, configuration Models. Model Driven Architectures (MDA) –why MDA- Model transformation and software architecture, SOA and MDA. Eclipse modeling framework.

UNIT V ASPECT ORIENTED ARCHITECTURES 9

Aspect Oriented Architectures- AOP in UML, AOP tools, Architectural aspects and middleware Selection of Architectures, Evaluation of Architecture Designs, Case Study: Online Computer Vendor, order processing, manufacture &shipping – inventory, supply chain cloud service Management, semantic web services

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Explain the need of software architecture for sustainable dynamic systems.
CO2: Demonstrate the design principles and to apply for large scale systems
CO3: Interpret the architectures for distributed heterogeneous systems
CO4: Outline the service oriented, model driven and the aspect oriented architecture.
CO5: Develop appropriate architectures through various case studies like semantic web services, supply chain cloud services.

REFERENCES:

1. Ion Gorton , 2016, *Essentials of software Architecture* Springer- verlag, Fourth Edition.
2. Kai Qian, 2014, *Software Architecture Design Illuminated*, Third Edition, Jones and Bartlett Publishers Canada
3. Frank Bachmann Regine Meunier & Hans Rohnert,2013, *Pattern Oriented Software Architecture*
4. Anthony J Lattanze, 2010, *Architecting Software Intensive System. A Practitioner's Guide*, Auerbach Publications

MC1236 SPEECH PROCESSING AND SYNTHESIS

L	T	P	C
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COURSE OBJECTIVES:

To enable the students to,

- Understand the mathematical foundations needed for speech processing.
- Gain knowledge in the basic concepts and algorithms of speech processing and synthesis.
- Understand various speech signal representation, coding and recognition techniques.
- Be familiar with various text analysis techniques.
- Learn the current speech processing technologies for real-world applications.

UNIT I FUNDAMENTALS OF SPEECH PROCESSING 9

Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – InformationTheory.

UNIT II SPEECH SIGNAL REPRESENTATIONS AND CODING 9

Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder.

UNIT II SPEECH RECOGNITION 9

Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.

UNIT IV TEXT ANALYSIS 9

Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation

UNIT V SPEECH SYNTHESIS 9

Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Explain the basic concepts in speech processing.
CO2: Identify the various features required for representing speech units.
CO3: Apply techniques for processing all types of speech signals.
CO4: Make use of various techniques for text analysis.
CO5: Demonstrate speech synthesis for real-world applications..

REFERENCES:

1. Joseph Mariani , 2009, *Language and Speech Processing*, Wiley
2. Lawrence Rabiner & Biing, Hwang Juang, 1993*, Fundamentals of Speech Recognition*, Prentice Hall Signal Processing Series.
3. Sadaoki Furui, 2010, *Digital Speech Processing: Synthesis, and Recognition*, Second Edition, (Signal Processing and Communications), Marcel Dekker
4. Thomas F.Quatieri, 2002, *Discrete-Time Speech Signal Processing*, Pearson Education
5. Xuedong Huang, Alex Acero & Hsiao-Wuen Hon, 2001, *Spoken Language Processing – A guide to Theory, Algorithm and System Development*, Prentice Hall PTR.

PROFESSIONAL ELECTIVES – III

MC1237 COMPUTER VISION PRINCIPLES

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COURSE OBJECTIVES:
To enable the students to,

- Understand various image processing techniques for computer vision.
- Familiarize shape and region analysis.
- Gain knowledge Hough Transform and its applications to detect lines, circles, ellipses.
- Learn three-dimensional image analysis techniques and motion analysis techniques.
- Study of various computer vision applications.

UNIT I IMAGE PROCESSING FOUNDATIONS 9

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.

UNIT II SHAPES AND REGIONS 9

Binary shape analysis – connectedness – object labeling and counting – size filtering distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures active contours shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

UNIT III HOUGH TRANSFORM 9

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization line fitting RANSAC for straight line detection HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location hole detection generalized Hough Transform (GHT) spatial matched filtering GHT for ellipse detection object location GHT for feature collation.

UNIT IV 3D VISION AND MOTION 9

Methods for 3D vision – projection schemes – shape from shading– photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline- based motion – optical flow – layered motion.

UNIT V APPLICATIONS 9

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Experiment with fundamental image processing techniques required for computer vision.
CO2: Illustrate the techniques of shape analysis and region descriptors.
CO3: Apply Hough Transform for line, circle, and ellipse detections.
CO4: Make use of 3D vision techniques and motion related techniques.
CO5: Develop applications using computer vision techniques.

REFERENCES:

1. Baggio D. L. et al., 2012, *Mastering OpenCV with Practical Computer Vision Proje cts*, Packt Publishing
2. Davies E. R., 2012, *Computer & Machine Vision*, Fourth Edition, Academic Press
3. Jan Erik Solem, 2012, *Programming Computer Vision with Python: Tools and algorithms for analyzing images*, O'Reilly Media
4. Mark Nixon & Alberto S. Aquado, 2012, *Feature Extraction & Image Processing for Computer Vision*, Third Edition, Academic Press
5. Szeliski R, 2011, *Computer Vision: Algorithms and Applications*, Springer.
6. Simon J. D.& Prince, 2012, Computer Vision: Models, Learning, and Inference, Cambridge University Press

MC1238 INFORMATION RETRIEVAL TECHNIQUES

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COURSE OBJECTIVES:

To enable the students to,

- Understand the basic concepts of information retrieval
- Gain knowledge of information retrieval with relevance to modeling
- Familiarize the concept of indexing and query operations in information retrieval
- Learn the machine learning techniques for text classification and clustering
- Understand the web search methodologies and the concepts of digital libraries

UNIT I INTRODUCTION: MOTIVATION 9

Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open Source IR Systems– History of Web Search - Web Characteristics – The impact of the web on IR –— IR Versus Web Search– Components of a Search engine.

UNIT II MODELING 9

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting - Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing.

UNIT III INDEXING 9

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching Sequential Searching and Pattern Matching. Query Operations -Query

Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency.

UNIT IV CLASSIFICATION AND CLUSTERING 9

Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering –Matrix decompositions and latent semantic indexing – Fusion and Meta learning.

UNIT V SEARCHING THE WEB 9

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Infer the basic concepts of information retrieval.
CO2: Make use of various IR models to rank the relevant documents.
CO3: Identify the suitable mechanism for document indexing and query operations.
CO4: Apply machine learning techniques for text classification and clustering.
CO5: Outline the different web search methodologies and the concepts of digital libraries.

REFERENCES:

1. Christopher D. Manning, Prabhakar Raghavan & Hinrich Schutze,v, 2008, First South Asian Edition, I*ntroduction to Information Retrieval,* Cambridge University Press.
2. Stefan Buttcher, Charles, L. A. Clarke & Gordon V. Cormack, 2010, *Information Retrieval: Implementing and Evaluating Search Engines,* The MIT Press, Cambridge, Massachusetts London, England.
3. Ricardo Baeza Yates & Berthier Ribeiro Neto, Second Edition, 2011, *Modern Information Retrival The concepts and Technology behind Search,* ACM Press Books.

MC1239 MOBILE AND PERVASIVE COMPUTING

L	T	P	C
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COURSE OBJECTIVES:

To enable the students to,

- Gain knowledge about the basic architecture and concepts of mobile Communication systems.
- Understand the 4G Telecommunication System Principles.
- Be familiar with the broad perspective of pervasive concepts and management.
- Gain knowledge about the role of HCI in Pervasive environment.
- Apply the pervasive concepts in mobile environment.

UNIT I INTRODUCTION 9

History – Wireless communications: GSM – DECT – TETRA – UMTS – IMT – 2000 – Blue tooth, WiFi, WiMAX, 3G ,WATM.- Mobile IP protocols -WAP push architecture- WML scripts and applications. Data networks – SMS – GPRS – EDGE – Hybrid Wireless100 Networks – ATM – Wireless ATM.

UNIT II OVERVIEW OF A MODERN 4G TELECOMMUNICATIONS SYSTEM 9

Introduction. LTE-A System Architecture. LTE RAN. OFDM Air Interface. Evolved Packet Core. LTE Requirements. LTE-Advanced. LTE-A in Release. OFDMA – Introduction. OFDM Principles. LTE Uplink—SC-FDMA. Summary of OFDMA.

UNIT III PERVASIVE CONCEPTS AND ELEMENTS 9

Technology Trend Overview - Pervasive Computing: Concepts - Challenges - Middleware - Context Awareness - Resource Management - Human–Computer Interaction - Pervasive Transaction Processing - Infrastructure and Devices - Wireless Networks - Middleware for Pervasive Computing Systems - Resource Management - User Tracking- Context Management -Service Management - Data Management - Security Management – Pervasive Computing Environments - Smart Car Space - Intelligent Campus.

UNIT IV HCI IN PERVASIVE COMPUTING 9

Prototype for Application Migration - Prototype for Multimodalities - Human– Computer Interface in Pervasive Environments - HCI Service and Interaction Migration - Context-Driven HCI Service Selection - Interaction Service Selection Overview - User Devices - Service-Oriented Middleware Support - User History and Preference - Context Manager - Local Service Matching - Global Combination - Effective Region - User Active Scope - Service Combination Selection Algorithm.

UNIT V PERVASIVE MOBILE TRANSACTIONS 9

Pervasive Mobile Transactions - Introduction to Pervasive Transactions - Mobile Transaction Framework - Unavailable Transaction Service - Pervasive Transaction Processing Framework - Context-Aware Pervasive Transaction Model - Context Model for Pervasive Transaction Processing - Context-Aware Pervasive Transaction Model - A Case of Pervasive Transactions - Dynamic Transaction Management - Context-Aware Transaction Coordination Mechanism - Coordination Algorithm for Pervasive Transactions - Participant Discovery - Formal Transaction Verification - Petri Net with Selective Transition.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Summarize about the basic architecture and concepts of mobile communication systems.
CO2: Explain about the latest 4G Telecommunication System Principles.
CO3: Interpret the pervasive concepts.
CO4: Make use of different HCI techniques for application development in Pervasive environment.
CO5: Demonstrate the usage of pervasive concepts in mobile environment.

REFERENCES:

1. Alan Colman, Jun Han, & Muhammad Ashad Kabir, 2016, *Pervasive Social Computing Socially-Aware Pervasive Systems and Mobile Applications*, Springer
2. J.Schiller, 2000, *Mobile Communication*, Addison Wesley
3. Juha Korhonen, 2014, *Introduction to 4G Mobile Communications*, Artech House Publishers
4. Kolomvatsos, Kostas, 2013*, Intelligent Technologies and Techniques for Pervasive Computing*, IGI Global
5. M.Bala Krishna & Jaime Lloret Mauri, 2016, *Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G Networks*, CRC Press
6. Minyi Guo, Jingyu Zhou, Feilong Tang & Yao Shen, 2016, *Pervasive Computing: Concepts, Technologies and Applications,* CRC Press

MC1240 NATURAL LANGUAGE PROCESSING – PRINCIPLES AND PRACTICES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Learn the fundamentals of natural language processing.
- Understand the use of Part-of-Speech Taggers and the algorithms in word level analysis.

- Understand the use of CFG and PCFG in NLP.
- Understand the role of semantics of sentences and pragmatics.
- Apply the NLP techniques to IR applications.

UNIT I INTRODUCTION 9

Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT II WORD LEVEL ANALYSIS 9

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT III SYNTACTIC ANALYSIS 9

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures.

UNIT IV SEMANTICS AND PRAGMATICS 10

Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT V DISCOURSE ANALYSIS AND LEXICAL RESOURCES 8

Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Explain the fundamentals of Natural Language Processing.
CO2: Illustrate the algorithms used in word level analysis in NLP.
CO3: Describe the use of CFG and PCFG syntactic analysis of NLP.
CO4: Explain the role of semantics of sentences and pragmatics in NLP.
CO5: Compare and contrast the use of different statistical approaches for different types of NLP applications.

REFERENCES:

1. Daniel Jurafsk & James H Martin, 2014, *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech*, Pearson Publication.
2. Steven Bird, Ewan Klein & Edward Loper, 2009, *Natural Language Processing with Python*, 1st ed, O-Reilly Media.
3. Breck Baldwin, 2015, *Language Processing with Java and LingPipe Cookbook*, Atlantic Publisher.
4. Richard M Reese, 2015, *Natural Language Processing with Java*, O-Reilly Media.
5. Nitin Indurkhya & Fred J Damerau, 2010, *Handbook of Natural Language Processing*, 2nd ed, Chapman and Hall/CRC Press.
6. Tanveer Siddiqui, Tiwary, 2008, *Natural Language Processing and Information Retrieval*, Oxford University Press.

MC1241 PARALLEL PROGRAMMING PARADIGMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Familiarize the issues in parallel computing.
- Describe distributed memory programming using MPI.
- Understand shared memory paradigm with Pthreads.
- Develop shared memory parallel programs using OpenMp.
- Learn the GPU based parallel programming using OpenCL.

UNIT I FOUNDATIONS OF PARALLEL PROGRAMMING 9

Motivation for parallel programming – Need-Concurrency in computing – Basics of processes, multitasking and threads – cache – cache mappings – caches and programs – virtual memory – Instruction level parallelism – hardware multi-threading– Parallel Hardware - SIMD – MIMD – Interconnection networks – cache coherence – Issues in shared memory model and distributed memory model – Parallel Software - Caveats- coordinating processes/ threads - hybrid model – shared memory model and

distributed memory model - I/O – performance of parallel programs—parallel program design.

UNIT II DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMD-programs– MPI_Send and MPI_Recv – message matching – MPI- I/O – parallel I/O – collective communication – Tree-structured communication - MPI_Reduce – MPI_Allreduce, broadcast, scatter, gather, allgather – MPI derived types – dynamic process management – performance evaluation of MPI programs- A Parallel Sorting Algorithm.

UNIT III SHARED MEMORY PARADIGM WITH PTHREADS 9

Basics of threads, Pthreads – thread synchronization – critical sections – busy waiting – mutex – semaphores – barriers and condition variables – read write locks with examples - Caches, cache coherence and false sharing – Thread safety- Pthreads case study.

UNIT IV SHARED MEMORY PARADIGM: OPENMP 9

Basics OpenMP – Trapezoidal Rule-scope of variables – reduction clause – parallel for directive – loops in OpenMP – scheduling loops –Producer Consumer problem – cache issues – threads safety in OpenMP – Two- body solvers- Tree Search.

UNIT V GRAPHICAL PROCESSING PARADIGMS: OPENCL AND INTRODUCTION TO CUDA 9

Introduction to OpenCL – Example-OpenCL Platforms- Devices-Contexts - OpenCL programming – Built-In Functions-Programs Object and Kernel Object – Memory Objects - Buffers and Images – Event model – Command-Queue - Event Object - case study. Introduction to CUDA programming.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Identify the issues in parallel programming.
CO2: Develop distributed memory programs using MPI framework.
CO3: Design shared memory parallel programs using Pthreads.
CO4: Develop shared memory parallel programs using OpenMP.
CO5: Develop Graphical Processing OpenCL programs.

REFERENCES:

1. Munshi A., Gaster B., Mattson T. G., Fung J., & Ginsburg D., 2011*, OpenCL programming guide*, Addison Wesley.
2. Quinn M. J., 2003, *Parallel programming in C with MPI and OpenMP*, Tata McGraw Hill.
3. Peter S. Pacheco, 2011, *An introduction to parallel programming*, Morgan Kaufmann.
4. Rob Farber, 2011, *CUDA application design and development*, Morgan Haufmann.
5. Gropp W., Lusk E., & Skjellum A., 2014, Third Edition, *Using MPI: Portable parallel programmingwith the message passing interface*, MIT Press.

MC1242 PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- learn the mathematical foundations needed for performance evaluation of computer systems
- understand the metrics used for performance evaluation of computer systems
- learn the concepts of multi-server and multi-queue systems
- learn the concepts of real-world workloads
- apply the analytical techniques for evaluating smart scheduling policies

UNIT I OVERVIEW OF PERFORMANCE EVALUATION 9

Need for Performance Evaluation in Computer Systems – Overview of Performance Evaluation Methods – Introduction to Queuing – Probability Review – Generating Random Variables for Simulation – Sample Paths, Convergence and Averages – Little‘s Law and other Operational Laws – Modification for Closed Systems

.

UNIT II MARKOV CHAINS AND SIMPLE QUEUES 9

Discrete-Time Markov Chains – Ergodicity Theory – Real World Examples – Google, Aloha – Transition to Continuous-Time Markov Chain – M/M/1.

UNIT III MULTI-SERVER AND MULTI-QUEUE SYSTEMS 9

Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke‘s Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues.

UNIT IV REAL-WORLD WORKLOADS 9

Case Study of Real-world Workloads – Phase-Type Distributions and Matrix-Alalytic Methods – Networks with Time-Sharing Servers – M/G/1 Queue and the Inspection Paradox – Task Assignment Policies for Server Farms.

UNIT V SMART SCHEDULING IN THE M/G/1 9

Performance Metrics - Scheduling Non-Preemptive and Preemptive Non-Size-Based Policies – Scheduling Non-Preemptive and Preemptive Size-Based Policies – Scheduling - SRPT and Fairness

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Explain the mathematical concept behind performance evaluation of computer Systems.
CO2: Model the performance of computer systems using Markov chain.
CO3: Explain server farms used for analytical modeling of computer systems.
CO4: Develop queuing analysis for simple and complex systems.
CO5: Apply discrete-time and continuous-time Markov chains to model real World systems.

REFERENCES:

1. Trivedi K. S., 2001, *Probability and Statistics with Reliability, Queueing and Computer Science Applications*, John Wiley and Sons.
2. Krishna Kant, 1992, *Introduction to Computer System Performance Evaluation*, McGraw-Hill.
3. Lieven Eeckhout, 2010, *Computer Architecture Performance Evaluation Methods*, Morgan and Claypool Publishers.
4. Mor Harchol - Balter, 2013, *Performance Modeling and Design of Computer Systems – Queueing Theory in Action*, Cambridge University Press.
5. Paul J. Fortier & Howard E. Michel, 2003, *Computer Systems Performance Evaluation and Prediction*, Elsevier.
6. Raj Jain, 1991, *The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation an Modeling*, Wiley-Interscience.

PROFESSIONAL ELECTIVES – IV

MC1331 AUGMENTED REALITY AND VIRTUAL REALITY TOOLS AND TECHNIQUES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Understand the basic concepts and framework of virtual reality
- Be familiar with the interactive techniques and visual computation in virtual reality
- Understand augmented reality and mixed reality methodologies.
- Learn the basics of augmented reality methodology
- Demonstrate the virtual reality multiple models and basic input output interface functionalities

UNIT I INTRODUCTION TO VIRTUAL REALITY 9

Introduction, Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality. Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark 3D Computer Graphics: Introduction, The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory, Simple 3D modelling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism- Stereographic image.

UNIT II INTERACTIVE TECHNIQUES AND VISUAL COMPUTATION IN VIRTUAL REALITY 9

Introduction, from 2D to 3D, 3D space curves, 3D boundary representation Geometrical Transformations: Introduction, Frames of reference, Modeling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems. Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

UNIT III AUGMENTED AND MIXED REALITY 9

Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

UNIT IV INTRODUCTION TO AUGMENTED REALITY 9

Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

UNIT V MULTIPLE MODELS OF INPUT AND OUTPUT INTERFACE IN VIRTUAL REALITY 9

Human factors: Introduction, the eye, the ear, the somatic senses. VR Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Introduction, Modeling virtual world, Physical simulation, VR toolkits, Introduction to VRML, Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual /Auditory / Haptic Devices

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Demonstrate the basic concepts and framework of virtual reality.
CO2: Interpret the relevance of virtual reality interactive techniques and visual computation.
CO3: Explain augmented reality and mixed reality methodologies.
CO4: Outline the basics of augmented reality methodology.
CO5: Demonstrate the virtual reality basic input output interface functionalities.

REFERENCES:

1. Burdea & Philippe Coiffet, 2008, *Virtual Reality Technology*, 2nd ed, Gregory, John Wiley & Sons, Inc.
2. Alan B Craig, 2013, *Understanding Augmented Reality, Concepts and Applications*, Morgan Kaufmann.
3. Alan Craig, William Sherman & Jeffrey Will, 2009, *Developing Virtual Reality Applications, Foundations of Effective Design*, Morgan Kaufmann.
4. John Vince, 2007, *Virtual Reality Systems*, Pearson Education Asia.
5. Anand R., Augmented and Virtual Reality, Khanna Publishing House, Delhi.
6. Adams, 2000, *Visualizations of Virtual Reality*, Tata McGraw Hill.
7. Grigore C. Burdea & Philippe Coiffet, 2006, *Virtual Reality Technology*, Wiley Inter Science, 2nd ed.
8. Dieter Schmalstieg & Tobias Hollerer, 2016, *Augmented Reality: Principles and Practice (Usability),* Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States.
9. Jason Jerald, 2015, *The VR Book: Human-Centred Design for Virtual Reality,* Association for Computing Machinery and Morgan & Claypool, New York, NY, USA.
10. Jos Dirksen, 2015, *Learning Three.js: The JavaScript 3D Library for WebGL*, 2nd ed, Packt Publishing.
11. Dieter Schmalstieg & Tobias Hollerer, 2016, *Augmented Reality: Principles &*

Practice.
12. Cawood, 2008, *Augmented Reality: A Practical Guide*.

MC1332 DATA VISUALIZATION TOOLS AND TECHNIQUES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Develop skills to both design and critique visualizations.
- Learn visual perception and core skills for visual analysis.
- Understand visualization for time-series, ranking and deviation analysis.
- Interpret the knowledge on visualization for distribution and multivariate analysis.
- Understand issues and best practices in information dashboard design.

UNIT I CORE SKILLS FOR VISUAL ANALYSIS 9

Information visualization – effective data analysis – traits of meaningful data – visual perception –making abstract data visible – building blocks of information visualization - analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns - pattern examples.

UNIT II TIME-SERIES, RANKING, AND DEVIATION ANALYSIS 9

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

UNIT III DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS 9

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

UNIT IV INFORMATION DASHBOARD DESIGN 9

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.

UNIT V DASHBOARD GRAPHICS AND GRAPHS 9

Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media –Critical Design Practices – Putting it all together- Unveiling the dashboard.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Explain core skills for visual analysis.
CO2: Apply visualization techniques for various time-series, ranking, and deviation tasks.
CO3: Interpret the visualization techniques for various distribution, correlation, and multivariate tasks.
CO4: Explain principles of visual perception.
CO5: Model information dashboard using critical design practices.

REFERENCES:

1. Ben Fry, 2008, *Visualizing data: Exploring and explaining data with the processing environment*, O'Reilly.
2. Edward R. Tufte, 2001, Second Edition *The visual display of quantitative information*, , Graphics Press.
3. Evan Stubbs, 2011, The value of business analytics: Identifying the path to profitability, Wiley.
4. Gert H. N. Laursen & Jesper Thorlund, 2010, *Business Analytics for Managers: Taking business intelligence beyond reporting*, Wiley.
5. Nathan Yau, 2013, *Data Points: Visualization that means something*, Wiley.
6. Stephen Few, 2013, second edition, *Information dashboard design: Displaying data for at-a-glance monitoring*, Analytics Press.
7. Stephen Few, 2009, *Now you see it: Simple Visualization techniques for quantitative analysis*, Analytics Press.
8. Tamara Munzner, *2014*, *Visualization Analysis and Design*, AK Peters Visualization Series, CRC Press.

MC1333 INFORMATION STORAGE MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:
To enable the students to,

- Understand the fundamentals of data storage
- Understand the storage architecture and available technologies.

- Learn various storage technologies for the required application
- Learn to establish and manage data center.
- Learn security aspects of storage and data center

UNIT I STORAGE TECHNOLOGY 9

Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities.

UNIT II STORAGE SYSTEMS ARCHITECTURE 9

Hardware and software components of the host environment, Key protocols and concepts used by each component ,Physical and logical components of a connectivity environment, Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Compare and contrast integrated and modular storage systems, high-level architecture and working of an intelligent storage system.

UNIT III INTRODUCTION TO NETWORKED STORAGE 9

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the needfor long-term archiving solutions and describe how CAS full fill the need, understand the appropriateness of the different networked storage options for different application environments.

UNIT IV INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS 9

List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime -Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identify single points of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center

UNIT V SECURING STORAGE AND STORAGE VIRTUALIZATION 9

Information security, Critical security attributes for information systems, Storage security domains, List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Select from various storage technologies to suit for required application.
CO2: Demonstrate different storage architectures.
CO3: Identify the appropriate networked storage for different application environments.
CO4: Plan to manage disaster recovery, business continuity and data centers.
CO5: Apply security measures to safeguard storage.

REFERENCES:

1. EMC Corporation, 2010, *Information Storage and Management: Storing, Managing, and Protecting Digital Information*, Wiley, India.
2. Marc Farley, 2001*, Building Storage Networks*, Tata McGraw Hill,Osborne.
3. Robert Spalding, 2003, *Storage Networks: The Complete Reference*, Tata McGraw Hill, Osborne.

MC1334 MOBILE APPLICATION DEVELOPMENT TECHNOLOGIES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:
To enable the students to,

- Understand system requirements for mobile applications.
- Gain knowledge about the basic concepts of mobile systems.
- Be familiar with advanced concepts of mobile application development.
- Construct simple mobile applications using Android.
- Build mobile applications using iOS.

UNIT I INTRODUCTION 5

Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications.

UNIT II BASIC DESIGN 8

Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.

UNIT III ADVANCED DESIGN 8

Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

UNIT IV ANDROID 12

Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

UNIT V IOS 12

Introduction to Objective C – iOS features – UI implementation – Touch frameworks Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Outline the requirements for mobile applications.
CO2: Explain the basic concepts of mobile application design and development.
CO3: Summarize the advanced concepts used in mobile application development.
CO4: Develop simple mobile application using android framework.
CO5: Build mobile application using embedded C and iOS.

REFERENCES:

1. Charlie Collins, Michael Galpin & Matthias Kappler, 2012, *Android in Practice*, DreamTech.
2. David Mark, Jack Nutting, Jeff LaMarche & Frederic Olsson, 2013, *Beginning iOS 6 Development: Exploring the iOS SDK*, Apress.
3. James Dovey & Ash Furrow, 2012, *Beginning Objective C*, Apress

4. Jeff McWherter & Scott Gowell, 2012, *Professional Mobile Application Development*, Wrox.
5. Reto Meier, 2012, *Professional android Development*, Wiley-India Edition.

MC1335 RECONFIGURABLE COMPUTING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Understand the need for reconfigurable computing.
- Learn various device architectures.
- Learn HDL programming and familiarize with the development environment.
- Understand FPGA placement and routing protocols.
- Develop applications with FPGAs.

UNIT I DEVICE ARCHITECTURE 9

General Purpose Computing Vs Reconfigurable Computing – Simple Programmable Logic Devices – Complex Programmable Logic Devices – FPGAs – Device Architecture - Case Studies.

UNIT II RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS 9

Reconfigurable Processing Fabric Architectures – RPF Integration into Traditional Computing Systems – Reconfigurable Computing Systems – Case Studies – Reconfiguration Management.

UNIT III PROGRAMMING RECONFIGURABLE SYSTEMS 9

Compute Models - Programming FPGA Applications in HDL – Compiling C forSpatial Computing Operating System Support for Reconfigurable Computing.

UNIT IV MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS 9

The Design Flow - Technology Mapping – FPGA Placement and Routing – Configuration Bitstream Generation – Case Studies with Appropriate Tools.

UNIT V APPLICATION DEVELOPMENT WITH FPGAS 9

Case Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Explain the need for reconfigurable architectures.
CO2: Summarize the reconfigurable computing architectures.
CO3: Build basic modules using any HDL.
CO4: Explain FPGA placement and routing protocols.
CO5: Build a SoPC for a particular application.

REFERENCES:

1. Christophe Bobda, 2010, *Introduction to Reconfigurable Computing – Architectures, Algorithms and Applications*, Springer.
2. Maya B. Gokhale & Paul S. Graham, 2005,*Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays*, Springer.
3. Nicole Hemsoth &Timothy Prickett Morgan, 2017, *FPGA Frontiers: New Applications in Reconfigurable Computing*, Next Platform.
4. Joao Cardoso (Editor), Michael Hübne, 2011, *Reconfigurable Computing: From FPGAs to Hardware/Software Codesign*, Springer.
5. Scott Hauck & Andre Dehon (Eds.), 2008, *Reconfigurable Computing – The Theory and Practice of FPGA-Based Computation*, Elsevier / Morgan Kaufmann.

MC1336 SOFTWARE QUALITY ASSURANCE AND TESTING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:
To enable the students to,

- Understand the basics of testing, test planning, design and test team organization
- Study the various types of test in the life cycle of the software product.
- Build design concepts for system testing and execution
- Learn the software quality assurance, metrics, defect prevention techniques
- Learn the techniques for quality assurance and applying for applications.

UNIT I SOFTWARE TESTING - CONCEPTS, ISSUES, AND TECHNIQUES 9

Quality Revolution, Verification and Validation, Failure, Error, Fault, and Defect, Objectives of Testing, Testing Activities, Test Case Selection White-Box and Black, test Planning and design, Test Tools and Automation, . Power of Test. Test Team Organization and Management - Test Groups, Software Quality Assurance Group, System Test Team Hierarchy, Team Building.

UNIT II SYSTEM TESTING 9

System Testing - System Integration Techniques-Incremental, Top Down Bottom Up Sandwich and Big Bang, Software and Hardware Integration, Hardware Design Verification Tests, Hardware and Software Compatibility Matrix Test Plan for System Integration. Built- in Testing. Functional testing - Testing a Function in Context, Boundary Value Analysis, Decision Tables, Acceptance testing - Selection of Acceptance Criteria, Acceptance Test Plan, Test Execution Test. software reliability - Fault and Failure, Factors Influencing Software, Reliability Models.

UNIT III CATEGORIES OF SYSTEM TEST 10

System test categories Taxonomy of System Tests, Interface Tests Functionality Tests, GUI Tests, Security Tests Feature Tests, Robustness Tests, Boundary Value Tests Power Cycling Tests Interoperability Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Regulatory Tests. Test Generation from FSM models- State-Oriented Model. Finite-State Machine Transition Tour Method, Testing with State Verification. Test Architectures-Local, distributed, Coordinated, Remote, System test design- Test Design Factors Requirement Identification, modeling a Test Design Process Test Design Preparedness, Metrics, Test Case Design Effectiveness. System test execution- Modeling Defects, Metrics for Monitoring Test Execution, Defect Reports, Defect Causal Analysis, Beta testing, measuring Test Effectiveness.

UNIT IV SOFTWARE QUALITY 8

Software quality - People‘s Quality Expectations, Frameworks and ISO-9126, McCall‘s Quality Factors and Criteria – Relationship. Quality Metrics. Quality Characteristics ISO 9000:2000 Software Quality Standard. Maturity models- Test Process Improvement, Testing Maturity Model.

UNIT V SOFTWARE QUALITY ASSURANCE 9

Quality Assurance - Root Cause Analysis, modeling, technologies, standards and methodologies for defect prevention. Fault Tolerance and Failure Containment - Safety Assurance and Damage Control, Hazard analysis using fault-trees and event-trees, Comparing Quality Assurance Techniques and Activities. QA Monitoring and Measurement, Risk Identification for Quantifiable Quality Improvement. Case Study: FSM-Based Testing of Web-Based Applications.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Explain the basics of testing, test planning, design and test team organization.

CO2: Outline the functional and non-functional tests in the life cycle of the software product.
CO3: Implement system testing and test execution process.
CO4: Apply defect prevention techniques and software quality assurance metrics.
CO5: Interpret the techniques of quality assurance for typical applications.

REFERENCES:

1. Kshirasagar Nak & Priyadarshi Tripathy, 2008, *Software Testing And Quality Assurance-Theory and Practice*, John Wiley & Sons Inc.
2. Jeff Tian, 2005, *Software Quality Engineering Testing, Quality Assurance and Quantifiable Improvement*, John Wiley & Sons, Inc., Hoboken, New Jersey.
3. Daniel Galin, 2004, *Software Quality Assurance - From Theory to Implementation*, Pearson Education Ltd UK.
4. Milind Limaye, 2011, *Software Quality Assurance*, TMH ,New Delhi.

PROFESSIONAL ELECTIVES – V

MC1337 BIO INFORMATICS FOR COMPUTER ENGINEERS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Understand the concepts of genomic databases and bioinformatics
- Expose to various algorithms applied in nucleic acid and protein sequence analysis
- Learn the insilico DNA pattern search phylogenetic concept
- Understand genomic studies and corresponding theorem
- Learn the approaches in human genomic analysis

UNIT I INTRODUCTION AND FUNDAMENTALS 9

Fundamentals of DNA, genes, genomics, molecular evolution – genomic technologies – Introduction to bioinformatics and its applications - genetic data –sequence data formats – secondary database – examples – data retrieval systems – genome browsers - data retrieval techniques: indices, Boolean search, fuzzy search and

neighboring, application to biological data warehouses.

UNIT II BIOINFORMATICS ALGORITHM AND ANALYSIS 9

Sequence alignment and similarity searching in genomic databases: BLAST and FASTA Dot matrix sequence comparison – additional bioinformatics analysis involving nucleic acid sequences, Algorithms for global and local alignment- additional bioinformatics analysis involving protein sequences – scoring matrices – PAM, BLOSUM and dayhoff mutation matrix.

UNIT III DNA REPLICATION AND MOLECULAR CLOCKS 9

Beginning of DNA replication – open problems – multiple replication and finding replication – computing probabilities of patterns in a string-the frequency array - converting patterns- solving problems- finding frequent words-Big-O notation – case Study -The Tower of Hanoi problem - Machine learning applications in Phylogenetic Analysis.

UNIT IV ASSEMBLE GENOMES AND SEQUENCES 9

Methods of assemble genomes – string reconstruction – De Bruijn graph – Euler‘s theorem – assembling genomes –DNA sequencing technologies – sequence antibiotic resistance genes – Brute Force Algorithm – Branch and Bound algorithm – open problems comparing biological sequences- Case Study –Manhattan tourist Problem. computers in NGS data handling, HMM in genome sequencing

UNIT V HUMAN GENOME 9

Human and mouse genomes-random breakage model of chromosome evolution – sorting by reversals – greedy heuristic approach – break points- rearrangements in tumor and break point genomes-break point graphs- synteny block construction -open problems and technologies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, students will be able to

CO1: Handle, create and analyze the gene based databases
CO2: Demonstrate the types of algorithms applied in DNA/Protein sequence analysis
CO3: Acquire theoretical knowledge on DNA replication and molecular clocks in phylogenetic studies.
CO4: Explain about the principle of genome and sequence assembling methods
CO5: Perform various human genome analysis through computational methods

REFERENCES:

1. Ion Mandoiu & Alexander Zelikovsky, 2016, *Computational Methods for Next Generation Sequencing Data Analysis*, Wiley series.
2. Istvan Miklos, Renyi Institutue, 2016, *Introduction to algorithms in bioinformatics*,Springer.
3. Philip Compeau & Pavel pevzner, 2015, *Bioinformatics Algorithms: An Active Learning Approach*, 2nd ed, volume I, Cousera.
4. Supratim Choudhuri, 2014, *Bioinformatics For Beginners*, Elsevier.

MC1338 BIO-INSPIRED COMPUTING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Interpret bio-inspired theorem and algorithms
- Understand the concepts of random walk and simulated annealing
- Explain genetic algorithms and differential evolution
- Learn swarm optimization and ant colony for feature selection
- Understand bio-inspired applications in image processing

UNIT I INTRODUCTION 9

Introduction to algorithm - Newton's method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Mataheuristics -Analysis of Algorithms -Nature Inspires Algorithms -Parameter tuning and parameter control.

UNIT II RANDOM WALK AND ANNEALING 9

Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunneling

UNIT III GENETIC ALOGORITHMS AND DIFFERENTIAL EVOLUTION 9

Introduction to genetic algorithms and - role of genetic operators - choice ofparameters - GA variants - schema theorem - convergence analysis - introduction to differential evolution - variants - choice of parameters - convergence analysis - implementation.

UNIT IV SWARM OPTIMIZATION AND FIREFLY ALGORITHM 9

Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - variants- Ant colony optimization toward

UNIT V COPING WITH THE LIMITATIONS OF ALGORITHM POWER 9

Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine- Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Explain bio inspired theorem and algorithms
CO2: Summarize random walk and simulated annealing.
CO3: Explain genetic algorithms.
CO4: Outline swarm intelligence and ant colony for feature selection
CO5: Apply bio-inspired techniques in image processing.

REFERENCES:

1. Eiben & A.E.,Smith,James E, 2015, *Introduction to Evolutionary Computing*, Springer
2. Helio J.C. Barbosa*, 2013,* "Ant Colony Optimization - Techniques and Applications,Intech
3. Xin-She Yang & Jaao Paulo papa, 2016, *Bio-Inspired Computing and Applications inImage Processing*, Elsevier
4. Xin-She Yang, 2014, *Nature Inspired Optimization Algorithm*, Elsevier
5. Yang ,Cui,Xiao & Gandomi,Karamanoglu , 2013, *Swarm Intelligence andBio-Inspired Computing*, Elsevier

MC1339 ENTERPRISE APPLICATION DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to

- Understand the different architectures of distributed Systems and compare the technologies associated with J2EE and DOTNET.
- Construct simple application using SPRING framework.
- Apply lightweight application using STRUTS.
- Build lightweight enterprise-ready applications using HIBERNATE framework.
- Gain knowledge about basic concepts of Django framework.

UNIT I CLIENT SERVER ARCHITECTURE 9

2 tier model - 3-tier model - n-tier model -J2EE architecture - DOTNET architecture - MVC architecture. MVC Architecture - How to start an ASP.NET MVC application - The folders and files for a new MVC application - Working with Views -Working with controls

UNIT II SPRING 9

Web services – Consuming a restful web service – Java desktop application / JSP, building REST service with spring – Spring security architecture – accessing relational data using JDBC with spring – Handling form submission – Creation of batch service – Securing web applications

UNIT III STRUTS 9

Struts – Introduction – MVC framework – STRUTS architecture – Business service – Parameter passing – Action class and configuration files – struts.xml tags – Namespace and wild cards – Validation – Interceptors – In built interceptors –Custom interceptors

UNIT IV HIBERNATE 9

HIBERNATE ORM – Persistence – Relational Database – The object relational impedance mismatch – Using native Hibernated APTs and hbm.xml – Using the java persistence API's – Hibernate Validator – HIBERNATE OGM – Configuration of tools HIBERNATE SEARCH – Introduction to Full Text Search.

UNIT V DJANGO 9

Introduction - Django model layer – View layer - Template layer – Forms –– Django security – Django web application tools – Core functionalities – Geographic Framework.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Explain different architectures of distributed systems and compare the technologies associated with J2EE and DOTNET.
CO2: Develop simple application using SPRING framework.
CO3: Construct lightweight application using STRUTS.
CO4: Make use of HIBERNATE framework for enterprise-ready application development.
CO5: Outline the basic concepts of Django framework.

REFERENCES:

1. Justin Couch & Daniel H.Steinberg, 2002, *J2EE Bible*, Wiley India(P) Ltd, New Delhi,
2. William S. & Vincent, 2018, *Django for Beginners: Build websites with Python and Django*, Welcome to Code
3. Christian Bauer, Gavin King & Gary Gregory, 2019, *Java Persistence with Hibernate*, Second Edition, Manning Publications Co
4. Craig Walls, 2018, *Spring in Action*, Fifth Edition, Manning Publications
5. Sharanam Shah & Vaishali Shah, 2014, *Struts 2 for Beginners* , 3rd Edition, Arizona Business Alliance

MC1340 RISK MODELING AND ASSESSMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to

- Understand the fundamentals of risk modeling and assessment
- Identify the risks through hierarchical holographic modeling and its derivatives
- Understand the objectives of risk modeling, assessment and management.
- Explore the concepts of multi objective risk impact analysis
- Learn the principles and guidelines of project risk management.

UNIT I FUNDAMENTALS OF RISK MODELING AND ASSESSMENT 9

Introduction- Systems Engineering - Risk Assessment and Management, The Role of Modeling in the Definition and Quantification of the Risk Function: -Introduction - The Risk Assessment and Management Process: Historical Perspectives- Information, Intelligence, and Models- The Building Blocks of Mathematical Models - On the Complex Definition of Risk, Vulnerability, and Resilience: a Systems Based Approach - On the Definition of Vulnerabilities in Measuring Risks to Systems-On theDefinition of Resilience in Measuring Risk to Systems- On the Complex Quantification of Risk to Systems

UNIT II IDENTIFYING RISK AND RISK FILTERING 9

Identifying Risk through Hierarchical Holographic Modeling and its Derivatives: Hierarchical Aspects -Hierarchical Overlapping Coordination -HHM - HHM and the Theory of Scenario Structuring - Adaptive Multiplayer HHM Game - Water Resources System -Sustainable Development- HHM in a System Acquisition Project - Software Acquisition - Hardening the Water Supply Infrastructure- Risk Assessment and Management for Support of Operations other than War Automated Highway System – Food Poisoning Scenarios Risk Filtering, Ranking, and Management: Introduction - Past Efforts in Risk Filtering and Ranking - RFRM: A Methodological Framework - Case Study: An OOTW 220

UNIT III ADVANCES IN RISK MODELING, ASSESSMENT, AND MANAGEMENT 9

Risk of Extreme Events and the Fallacy of the Expected Value: Introduction - Risk of Extreme Events- The Fallacy of the Expected Value -The PMRM -General Formulation of the PMRM -Summary of the PMRM- Illustrative Example-Analysis of

Dam Failure and Extreme Flood through the PMRM -Example Problems Multiobjective Decision Tree Analysis:Introduction-Methodological Approach-Differences between SODT and MODT- Example Problems

UNIT IV ADVANCES IN RISK MODELING, ASSESSMENT, AND MANAGEMENT

9

Multiobjective Risk Impact Analysis Method: Introduction - Impact Analysis- The Multiobjective, Multistage Impact Analysis Method: An Overview - Combiningthe PMRM and the MMIAM - Relating Multiobjective Decision Trees to the MRIAM - Example Problems -Statistics of Extremes: Extension of the PMRM : A Review of the Partitioned Multiobjective Risk Method - Statistics of Extremes -Incorporating the Statistics of Extremes into the PMRM- Sensitivity Analysis of the Approximation of f4 - Generalized Quantification of Risk of Extreme Events

Unit V PRINCIPLES AND GUIDELINES FOR PROJECT RISK MANAGEMENT 9

Introduction -Definitions and Principles of Project Risk Management- Project Risk Management Methods - Aircraft Development Example-Quantitative Risk Assessment and Management of Software Acquisition- Critical Factors That Affect Software Nontechnical Risk -Basis for Variances in Cost Estimation-Discrete Dynamic Modeling

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Explain about Risk modeling principles and its assessment.
CO2: Summarize the activities for risk identification and filtering
CO3: Interpret risk modeling and assessment
CO4: Demonstrate multi objective risk impact analysis.
CO5: Summarize the activities for project risk management

REFERENCES:

1. Yacov.Y.Haimes, 2015, *Risk Modelling, Assessment and Management*, Fourth Edition, Wiley Publishers.
2. Charles Yoe, 2020, *Principles of Risk Analysis: Decision Making Under Uncertainty*, CRC Press

MC1341 ROBOTICS AND INTELLIGENT CONTROL SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Study the problem solving methods in Intelligent control.
- Learn about planning methods in artificial intelligence.
- Study the reasoning concepts in intelligent control.
- Study the learning methods in intelligent systems.
- Learn the risk in Robots.

UNIT I INTRODUCTION 10

History, state of the art, Need for AI in Robotics. Problem solving: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems– Adversarial search, knowledge and reasoning– knowledge representation – first order logic.

UNIT II PLANNING 9

Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.

UNIT III REASONING 9

Uncertainty – Probabilistic reasoning–Filtering and prediction–Hidden Markov models– Kalman filters–Dynamic Bayesian Networks, Speech recognition,making decisions.

UNIT IV LEARNING 9

Forms of learning – Knowledge in learning – Statistical learning methods – reinforcement learning,Communication, perceiving and acting, Probabilistic language processing, perception.

UNIT V AI IN ROBOTICS 8

Robotic perception, localization, mapping- configuring space, planning uncertain movements,dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Illustrate appropriate intelligent methods to solve problem.
CO2: Demonstrate appropriate planning methods to solve a problem.
CO3: Explain the framework of different reasoning methods.
CO4: Illustrate basic learning methods in intelligent systems.
CO5: Identify an empirical evaluation of different algorithms of AI in Robotics

REFERENCES:

1. Russell, S & Norvig, P, 2020, Artificial Intelligence: A Modern Approach, 4th edition, Prentice Hall.
2. Negnevitsky, M, 2011, Artificial Intelligence: A guide to Intelligent Systems, 3rd edition, Harlow: Addison-Wesley.
3. David Jefferis, 1992, Artificial Intelligence: Robotics and Machine Evolution, Crabtree Publishing Company

MC1342 SOCIAL NETWORK ANALYSIS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Understand the components of the social network.
- Model and visualize the social network.
- Understand human behavior in social web and related communities.
- Be familiar with the evolution of the social network.
- Be familiar with different applications of social networks.

UNIT I INTRODUCTION 9

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis -Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web- based networks.

UNIT II MODELING AND VISUALIZATION 9

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix- Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

UNIT III MINING COMMUNITIES 9

Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

UNIT IV EVOLUTION 9

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.

UNIT V APPLICATIONS 9

A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Explain the role of semantic web and its applications
CO2: Model and visualize the social network
CO3: Identify the behavior of the users in the social network and its related communities
CO4: Summarize about the evolution of Social Networks
CO5: Outline different real time application in social networks

REFERENCES:

1. Ajith Abraham, Aboul Ella Hassanien & Vaclav Snasel, 2012*, Computational Social Network Analysis: Trends, Tools and Research Advances*, Springer
2. Borko Furht, 2011, *Handbook of Social Network Technologies and Applications*, Springer
3. Charu C. Aggarwal, 2014*, Social Network Data Analytics*, Springer
4. Giles, Mark Smit and John Yen,2010*, Advances in Social Network Mining and Analysis*, Springer
5. Guandong Xu , Yanchun Zhang &Lin Li, 2012, *Web Mining and Social Networking – Techniques and applications,* Springer
6. Peter Mika, 2007*, Social Networks and the Semantic Web*, Springer
7. Przemyslaw Kazienko & Nitesh Chawla, 2015*, Applications of Social Media and Social Network Analysis*, Springer,

OPEN ELECTIVE COURSES

OMC151 ADVANCED SOFTWARE ENGINEERING

L	T	P	C
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COURSE OBJECTIVES:

To enable the students to,

- Understand Software Engineering Lifecycle Models
- Learn about the project management and cost estimation
- Gain knowledge of the System Analysis and Design concepts.
- Understand software testing approaches
- Be familiar with DevOps practices

UNIT I INTRODUCTION 9

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management.

UNIT II SOFTWARE REQUIREMENT SPECIFICATION 9

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets –Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram.

UNIT III ARCHITECTURE AND DESIGN 9

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter –Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Clientserver - Tiered - Pipe and filter.- User interface design

UNIT IV TESTING 9

Testing – Unit testing – Black box testing– White box testing – Integration and System testing–Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking

UNIT V DEVOPS 9

DevOps: Motivation-Cloud as a platform-Operations- Deployment Pipeline: Overall ArchitectureBuilding and Testing-Deployment- Case study: Migrating to Microservices.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to:

CO1: Outline the activities of various software process models and software project management in tracking a project for its completion

CO2: Explain the concepts of requirement engineering and analysis modelling

CO3: Illustrate the software design using architectural styles and design patterns
CO4: Paraphrase the various levels of software testing and testing approaches
CO5: Apply DevOps practices to develop and monitor a software project

REFERENCES:

1. Roger S Pressman, 2014, Software Engineering: A practitioner's Approach, 7th ed, McGraw-Hill International Edition.
2. Craig Larman, 2015, Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design," 3rd ed, Pearson Publishers.
3. Ian Sommerville, Software Engineering, 10th Edition, Pearson Education, 2016.
4. Len Bass, Ingo Weber & Liming Zhu, 2016, DevOps: A Software Architect's Perspective, Pearson Education
5. Rajib Mall, 2018, Fundamentals of Software Engineering, 5th edition, PHI Learning Pvt. Ltd.

OMC152 BIG DATA ANALYTICS – CONCEPTS AND FRAMEWORKS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:
To enable the students to,

- Understand the advantages of big data analytics.
- Understand the big data framework.
- Learn data analytics methods.
- Gain knowledge on Hadoop related tools such as HBase and Cassandra.
- Use Pig and Hive for Big data analytics.

UNIT I INTRODUCTION TO BIG DATA 9

Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern DataAnalytic Tools.

UNIT II HADOOP FRAMEWORK 9

Distributed File Systems - Large-Scale FileSystem Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN

UNIT III DATA ANALYTICS 9

Statistical Methods: Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics

UNIT IV NoSQL AND HBASE 9

Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations –Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration.

UNIT V PIG AND HIVE 9

Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Explain the fundamental concepts of Big Data and its tools and techniques
CO2: Apply the concepts of MapReduce framework
CO3: Infer appropriate NoSQL database techniques for storing and processing large volumes of structure and unstructured data
CO4: Write script using Pig latin
CO5: Build various HiveQL queries

REFERENCES:

1. Hurwitz JS, Nugent A, Halper F, Kaufman M, 2013, *Big data for dummies*, John Wiley & Sons.
2. Alan Gates & Daniel Dai, 2016, *Pig : Data flow Scripting with Hadoop*, O'Reilly Media.
3. Jason Rutherglen, Dean Wampler & Edward Capriolo, 2012, Programming Hive", 1st ed, O'Reilly Media.
4. Judith Hurwitz, Alan Nugent, Fern Halper & Marcia Kaufman, 2014, *Big Data*, Wiley Publications.
5. Mark Van Rijmenam, 2014, *Think Bigger: Developing a Successful Big Data*

Strategy for Your Business, 1st ed, Amazon.
6. Hurwitz JS, Nugent A, Halper F & Kaufman M, 2013, *Big data for dummies,* John Wiley & Sons.
7. Tom White, 2011, *Hadoop: The Definitive Guide*, O'Reilly Publications.
8. Dayong Du, 2015, *Apache Hive Essentials*, Packet Publishing.
9. Hanish Bansal & Saurabh Chauhan, 2016, *Apache Hive Cookbook*, Packet publishing.

OMC153 INTERNET PROGRAMMING PRACTICES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

To enable the students to,

- Understand different Internet Technologies.
- Familiarize with interactive web applications using client side scripting languages.
- Understand the concepts three-tier web application using Servlets.
- Expose with simple web applications using Server Side Programming languages like JSP and PHP.
- Learn cross platform web applications using XML, Asynchronous Web requests and Web Services Architecture.

UNIT I WEBSITE BASICS and WEB 2.0 9

Web Essentials: Clients, Servers and Communication – The Internet – Basic Internet protocols – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 control elements –Semantic elements – Drag and Drop – Audio – Video controls - CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations.

UNIT II CLIENT SIDE PROGRAMMING 9

Java Script: An introduction to JavaScript–JavaScript DOM Model-Date andObjects,-Regular Expressions- Exception Handling-Validation-Built-in objects- Event Handling DHTML with JavaScript

UNIT III SERVER SIDE PROGRAMMING 9

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions Session Handling- Understanding Cookies- Installing and Configuring Apache Tomcat Web Server- DATABASE CONNECTIVITY: JDBC perspectives, JDBC program example

UNIT IV JSP and PHP 9

JSP: Understanding Java Server Pages - Creating HTML forms by embedding JSP code- JSP Standard Tag Library (JSTL). An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation- Regular Expressions - File handling – Cookies - Connecting to Database

UNIT V XML and WEB SERVICES 9

XML: Basic XML- Document Type Definition- XML Schema DOM and PresentingXML, XML Parsers and Validation, XSL and XSLT Transformation, News Feed (RSS and ATOM). Introduction to AJAX, Java web services Basics – Creating, Publishing, Testing and Describing a Web services (WSDL)- SOAP.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, the students will be able to:

CO1: Design a basic website using HTML and Cascading Style Sheets.
CO2: Create dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
CO3: Develop server-side web applications using Servlets.
CO4: Design simple web applications using JSP and PHP.
CO5: Construct a cross platform web applications using XML, Asynchronous Web requests and Web services Architecture.

REFERENCES:

1. Deitel and Deitel & Nieto, 2011, *Internet and World Wide Web - How to Program*, 5th Edition, Prentice Hall.
2. Chris Bates, 2009, Web Programming – Building Intranet Applications, 3rd Edition,Wiley Publications