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Medbowli, Meerpet, Balapur, Hyderabad, Telangana – 500 097
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B.TECH - COMPUTER SCIENCE AND ENGINEERING
COURSE STRUCTURE R22

SEMESTER V

S.No	Course Class.	Course Code	Name of the subject	L	T	P	C	I	E	Total
1	HS	DHSFM	Fundamantals of Management	3	0	0	3	40	60	100
2	PC	D55PC12	Formal Languages and Automata Theory	3	1	0	4	40	60	100
3	PC	D55PC13	Operating Systems	3	0	0	3	40	60	100
4	PC	D55PC14	Data Warehousing and Data Mining	2	0	0	2	40	60	100
5	PE	D55PE1	**Professional Elective I**	3	0	0	3	40	60	100
			A. Advanced Computer Architecture							
			B. Software Testing Methodologies							
			C. Fundamentals of Data Science							
			D. Agile Methodologies							
6	PE	D55PE2	**Professional Elective II**	3	0	0	3	40	60	100
			A. Information Retrieval Systems							
			B. Data Wrangling & Visualization							
			C. Artificial Intelligence							
			D.Design Patterns							
7	PC	D55PC16	Operating Systems Lab	0	0	2	1	40	60	100
8	PC	D55PC17	Data Warehousing and Data Mining Lab	0	0	2	1	40	60	100
9	MC	MC002	Environmental Science*	0	0	0	0	0	0	S
TOTAL				**18**	**0**	**4**	**20**	**320**	**480**	**800**
Mandatory Course: Environmental Science										

SEMESTER VI

S.No	Course Class.	Course Code	Name of the subject	L	T	P	C	I	E	Total
1	PC	D56PC17	Devops	3	0	0	3	40	60	100
2	PC	D56PC18	Compiler Design	3	0	0	3	40	60	100
3	PC	D56PC19	Machine Learning	3	0	0	3	40	60	100
4	PE	D56PE3	**Professional Elective III**	3	0	0	3	40	60	100
			A. Full Stack Development							
			B. Big Data Analytics							
			C. Mobile Ad hoc Networks							
			D.Service Oriented Architecture							
5	PE	D56PE4	**Professional Elective IV**	3	0	0	3	40	60	100
			A. Internet of Things							
			B. Mobile Computing							
			C. Augmented Reality & Virtual Reality							
			D.Software Project Management							
6	OE	D56OE1	Open Elective I	3	0	0	3	40	60	100
7	PC	D56PC20	Devops Lab	0	0	2	1	40	60	100
8	PC	D76PC21	Machine Learning Lab	0	0	2	1	40	60	100
9	MC	MC003	Intellectual Property Rights*	0	0	0	0	0	0	S
TOTAL				**18**	**0**	**4**	**20**	**320**	**480**	**800**
Mandatory Course: Intellectual Property Rights										

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COMPUTER SCIENCE & ENGINEERING

FUNDAMENTALS OF MANAGEMENT (DHSFM)

Semester V **L/T/P C**
3/0/0 3

Course Objective:
To enable students to understand the evolution, functions and theories of management, aspects of planning and decision making ,Organizing,leading,Motivation and controlling.

Course Outcomes:
Upon completion of this course the students will be able to :
1. To infer the basic knowledge of management functions , levels and evolution of Management. L3
2. To ensure the students in decision making problem solving for the issues in corporate in the organization. L2
3. To acquire the knowledge of entire organization design and structure. L2
4. To perceive the strategically decision in selection, requirement training and development. L3
5. To enact and impose the qualities of a leader, mentor and coach. L3

UNIT I
Introduction to Management:
Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management; Evolution of Management- Classical Approach- Scientific and Administrative Management; The Behavioral approach.

UNIT II
Planning and Decision Making:
General Framework for Planning - Planning Process, Types of Plans. Decision making and Problem solving - Programmed and Non Programmed Decisions, Steps in Problem Solving and Decision Making.

UNIT III
Organization and HRM:
Principles of Organization: Organizational Design & Organizational Structures; Departmentalization, Delegation; Empowerment, Centralization, Decentralization, Recentralization;
Human Resource Management & Business Strategy:
Talent Management, Talent Management Models and Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.

UNIT IV

Leading and Motivation:

Leadership, Power and Authority, Leadership Styles; Behavioral Leadership, Situational Leadership, Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis.

Motivation - Types of Motivation; Motivational Theories - Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.

UNIT V

Controlling:

Control, Types and Strategies for Control, Steps in Control Process, Budgetary and Non- Budgetary Controls. Characteristics of Effective Controls

Text Books:

1. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
2. Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.

References:

1. Essentials of Management, Koontz Kleihrich, Tata Mc - Graw Hill.
2. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.
3. Harold Koontz and Heinz Weihrich, 2010, Essentials of Management, TMH

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COMPUTER SCIENCE & ENGINEERING

FORMAL LANGUAGES AND AUTOMATA THEORY (D55PC12)

Semester V **L/T/P C**
3/1/0 4

Course Objective:
To equip students with the skills to apply fundamental concepts of automata theory, work with regular expressions and context-free grammars, and explore advanced topics such as undecidability and Turing machines.

Course Outcomes:
Upon completion of this course the students will be able to :

1. Apply the fundamental concepts of Automata Theory, including alphabets, strings, languages, and problems, Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (NFA) in text search. L3
2. Apply regular expressions and algebraic laws to solve language recognition problems, and demonstrate the conversion between Finite Automata and Regular Expressions. L3
3. Apply the concepts of Context-Free Grammars (CFGs) and Pushdown Automata (PDAs) to analyze and construct formal language models and to Demonstrate the equivalence between PDAs and CFGs. L3
4. Apply the Pumping Lemma, closure properties, and decision properties to analyze Context-Free Languages and apply Turing Machine concepts to model computational processes. L3
5. Apply concepts of undecidability and computational complexity to analyze problems that are not recursively enumerable and analyze the complexity of intractable problems by categorizing them within the classes P, NP, and NP-complete. L3

UNIT I
Introduction:
Introduction to Finite Automata, Structural Representations, Automata and Complexity, the Central Concepts of Automata Theory – Alphabets, Strings, Languages, Problems. Deterministic Finite Automata, Nondeterministic Finite Automata, an application: Text Search, Finite Automata with Epsilon-Transitions, Finite automata with output - Mealy and Moore machines, Equivalence of Mealy and Moore machines.

UNIT II
Regular Expressions:
Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Automata and Regular expressions, Converting DFA's to Regular Expressions, Converting Regular Expressions to DFA, Properties of Regular Languages-Pumping Lemma for Regular Languages, Applications of the Pumping Lemma, Closure Properties of Regular Languages, Decision Properties of Regular Languages, Equivalence and Minimization of Automata.

UNIT III

Context-Free Grammars

Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Sentential Applications of Context-Free Grammars, Ambiguity in Grammars and Languages .

Push Down Automata

Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata, non-deterministic pushdown automata, power of Deterministic Pushdown Automata and Non-Deterministic Pushdown Automata.

UNIT IV

Normal Forms for Context- Free Grammars:

The Pumping Lemma for Context-Free Languages,Closure Properties of Context-Free Languages, Decision Properties of CFL's - Complexity of Converting among CFG's and PDA's, Running time of conversions to Chomsky Normal Form.

Turing Machines:

Introduction to Turing Machines: Problems That Computers Cannot Solve, The Turing Machine, Programming Techniques for Turing Machines, Extensions to the basic Turing machine, Restricted Turing Machines, Turing Machines, and Computers.

UNIT V

Undecidability:

A Language that is Not Recursively Enumerable, An Undecidable Problem That is RE, Undecidable Problems about Turing Machines, Post's Correspondence Problem, Other Undecidable Problems.

Intractable Problems:

Polynomial time and space, Some NP- complete problems, The Classes P and NP, NP-Complete Problem.

Text Book:

1. Introduction to Automata Theory, Languages, and Computation, 3nd Edition, John E.Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Pearson Education.
2. Introduction to the Theory of Computation, Michael Sipser, 3rd edition, Cengage Learning.

Reference Books:

1. Introduction to Languages and the Theory of Computation, John C Martin, TMH.
2. Introduction to Computer Theory, Daniel I.A. Cohen, John Wiley.
3. A Text book on Automata Theory, P. K. Srimani, Nasir S. F. B, Cambridge University Press.
4. Introduction to Formal languages Automata Theory and Computation, Kamala Krithivasan, Rama R, Pearson.
5. Theory of Computer Science – Automata languages and computation, Mishra and Chandra shekaran, 2nd edition, PHI.

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COMPUTER SCIENCE & ENGINEERING

OPERATING SYSTEMS (D55PC13)

Semester V **L/T/P C**
3/0/0 3

Course Objective:

To provide students with a deep understanding of , the basic components of a computer operating system, scheduling polices, process synchronization, deadlocks, memory management strategies and file system implementation.

Course Outcomes:

Upon completion of this course the students will be able to :

1. Identify the components, structure, OS services and analyze the role of an Operating System in developing software applications. L3
2. Make use of the concepts of CPU scheduling, including scheduling criteria and inter process communication, and apply them to solve scheduling problems. L3
3. Apply synchronization techniques to coordinate access to shared resources among concurrent processes and various mechanisms to detect and recovery the deadlocks L3
4. Analyze memory management and virtual memory management strategies and their significance in modern computing environments. L4
5. Make use of the structure of file system and principles of protection to develop secure, efficient and reliable computing environments. L3

UNIT I

Introduction Operating system objectives, User view, System view, Operating system definition, Computer System Architecture, OS Structure, OS Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments. Operating System services, User and OS Interface, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, OS Structure.

UNIT II

CPU scheduling:

CPU Scheduling Process concepts-The Process, Process State, Process Control Block, Threads, Process Scheduling, Scheduling Queues, Schedulers, Context Switch, Operations on Processes, System calls fork(),exec(),wait(),exit(), Inter-process communication-ordinary pipes and named pipes, message queues, shared memory in Unix.

Process Scheduling:

Basic concepts, Scheduling Criteria, Scheduling algorithms, Multiple- Processor Scheduling, Real Time Scheduling, Thread scheduling, Linux scheduling and Windows scheduling.

UNIT III

Process Synchronization: Background, The Critical Section Problem, Peterson's solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization in Linux and Windows.

Deadlocks:

System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, and Recovery from Deadlock.

UNIT IV

Memory Management:

Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of Page Table.

Virtual Memory Management:

Background, Demand Paging, Copy-on-Write, Page Replacement, Page Replacement Algorithms, Allocation of Frames, Thrashing, Virtual memory in Windows.

UNIT V

Storage Management:

File System- Concept of a File, System calls for file operations – open (), read (), write (), close (), seek (), unlink (), Access methods, Directory and Disk Structure, File System Mounting, File Sharing. File System Implementation: File System Structure, File System Implementation, Directory Implementation, Allocation methods, Free-space Management, Efficiency, and Performance, Overview of Mass Storage Structure.

Protection:

System Protection, Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems, Language-Based Protection.

Text Books:

1. Operating System Concepts, Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 8th Edition, Wiley, 2016 India Edition.
2. Operating Systems – Internals and Design Principles, W. Stallings, 7th Edition, Pearson.

Reference Books:

1. Modern Operating Systems, Andrew S Tanenbaum, 3rd Edition, PHI
2. Operating Systems: A concept-based Approach, 2nd Edition, D.M. Dhamdhere,
3. Principles of Operating Systems, B. L. Stuart, Cengage learning, India Edition, TMH.
4. An Introduction to Operating Systems, P.C.P. Bhatt, PHI.
5. Principles of Operating systems, Naresh Chauhan, Oxford University Press.

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COMPUTER SCIENCE AND ENGINEERING

DATA WAREHOUSING AND DATA MINING

(D55PC14)

Semester V **L/T/P C**
2/0/0 2

Course Objectives:

To provide students with an understanding of data warehouse principles and data mining concepts.

Course Outcomes:
Upon completion of this course the students will be able to :

1. Experiment formally with data warehouse and summarizes the architecture and components used for constructing a data warehouse. L3
2. Implement the data preprocessing techniques to incorporate the data mining tasks on various kinds of data L3
3. Identify the significance of association rule by understanding the item-set representations. L3
4. Classify the data to gain learning experiences using various classification techniques. L4
5. Categorize the data based on the similarity measures through different clustering algorithms to estimate the outliers. L4

UNIT I

Data warehouse:

Introduction to Data warehouse, Difference between operational database systems and data warehouses. Data warehouse Characteristics, Data warehouse Architecture and its Components, Extraction – Transformation – Loading, Logical (Multi – Dimensional), Data Modelling, Schema Design, Star and Snow – Flake Schema, Fact Constillation, Fact Table, Fully Addictive, Semi – Addictive, Non Addictive Measures; Fact – Less – Facts, Dimension Table Characteristics; OLAP Cube, OLAP Operations, OLAP Server Architecture – ROLAP, MOLAP and HOLAP.

UNIT II

Introduction to Data Mining:

Introduction, What is Data Mining, Definition, KDD, Challenges, Data Mining Tasks, Data Preprocessing, Data Cleaning, Missing data, Dimensionality Reduction, Feature Subset Selection, Discretization and Binarization, Data Transformation; Measures of Similarity and Dissimilarity-Basics.

UNIT III

Association Rules:

Problem Definition, Frequent Item Set Generation, The APRIORI Principle, Support and Confidence Measures, Association Rule Generation; APRIOIRI Algorithm, The Partition Algorithms, FP-Growth Algorithms, Compact Representation of Frequent Item Set- Maximal Frequent Item Set, Closed Frequent Item Set.

UNIT IV

Classification:

Problem Definition, General Approaches to solving a classification problem, Evaluation of Classifiers, Classification techniques, Decision Trees-Decision tree Construction, Methods for Expressing attribute test conditions, Measures for Selecting the Best Split, Algorithm for Decision tree Induction; Naïve – Bayes Classifier, Bayesian Belief Networks; K- Nearest neighbor classification-Algorithm and Characteristics.

UNIT V

Clustering:

Problem Definition, Clustering Overview, Evaluation of Clustering Algorithms, Partitioning Clustering-K-Means Algorithm, K-Means Additional issues, PAM Algorithm; Hierarchical Clustering-Agglomerative Methods and divisive methods, Basic Agglomerative Hierarchical Clustering Algorithm, Specific techniques, Key Issues in Hierarchical Clustering, Strengths and Weakness; Outlier Detection.

Text Books:

1. Data Mining- Concepts and Techniques- Jiawei Han, Micheline Kamber, Morgan Kaufmann Publishers, Elsevier, 2 Edition,2006.
2. Introduction to Data Mining, Pang-Ning Tan, Vipin Kumar, Michael Stein banch, Pearson Education.

Reference Books:

1. Data Mining Techniques, Arun K Pujari, 3rd Edition, Universities Press.
2. Data Warehousing Fundamentals, Paulraj Ponnaiah, Wiley Student Edition.
3. The Data Ware housinG Life Cycle Toolkit – Ralph Kimbal. Wiley Student Edition.
4. Data Mining, Vikaram Pudi, P Radha Krishna, Oxford University Press.

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COMPUTER SCIENCE & ENGINEERING

ADVANCED COMPUTER ARCHITECTURE
(D55PE1A)

Semester V **L/T/P C**
3/0/0 3

Course Objective:
To provide students with a deep understanding of parallel computing architectures, designing principles, parallel computer models, pipeline processors to handle parallel workloads.

Course Outcomes:
Upon completion of this course the students will be able to:
1. Identify various parallel computer models to make informed decisions in parallel computing design and implementation. L3
2. Identify performance metrics, parallel processing applications and the impact of advanced processor, memory and virtual memory technologies in parallel computing environments and . L3
3. Analyze bus cache, shared memory systems and various pipleline processors in terms of their design characteristics for improving the computational performance L4
4. Identify parallel, scalable and vector architectures in designing the operational and performance characteristics of various parallel computing tasks. L3
5. Examine scalable, multithreaded, and dataflow architectures to determine their suitability for specific computational tasks and requirements. L4

UNIT I
Theory of Parallelism
Parallel computer models, The State of Computing, Multiprocessors and Multi computers, Multi vector and SIMD Computers, PRAM and VLSI models, Architectural development tracks, Program and network properties, Conditions of parallelism, Program partitioning and Scheduling, Program flow Mechanisms, System interconnect Architectures.

UNIT II
Principles of Scalable performance
Performance metrics and measures, Parallel Processing applications, Speed up performance laws, Scalability Analysis and Approaches, Hardware Technologies, Processes and Memory Hierarchy, Advanced Processor Technology, Superscalar and Vector Processors, Memory Hierarchy Technology, Virtual Memory Technology.

UNIT III
Bus Cache and Shared memory
Backplane bus systems, Cache Memory organizations, Shared- Memory Organizations, Sequential and weak consistency models, Pipelining and super scalar techniques, Linear Pipeline Processors, Non-Linear Pipeline Processors, Instruction Pipeline design, Arithmetic pipeline design, super scalar pipeline design.

UNIT IV

Parallel and Scalable Architectures

Multiprocessors and Multi computers, Multiprocessor system interconnects, cache coherence and synchronization mechanism, Three Generations of Multi computers, Message-passing Mechanisms, Multi vetor and SIMD computers, Vector Processing Principals, Multi vector Multiprocessors, Compound Vector processing, SIMD computer Organizations, The connection machine CM-5,

UNIT V

Scalable, Multithreaded and Data flow Architectures, Latency-hiding techniques,Principals of Multithreading, Fine-Grain Multi computers, Scalable and multithreaded Architectures, Dataflow and hybrid Architectures.

Text Book:

1. Advanced Computer Architecture Second Edition, Kai Hwang, Tata McGraw Hill Publishers.

Reference Books:

1. Computer Architecture, Fourth edition, J. L. Hennessy and D.A. Patterson. ELSEVIER.
2. Advanced Computer Architectures, S.G. Shiva, Special Indian edition, CRC, Taylor &Francis.
3. Introduction to High Performance Computing for Scientists and Engineers, G. Hager and G. Wellein, CRC Press, Taylor & Francis Group.
4. Advanced Computer Architecture, D. Sima, T. Fountain, P. Kacsuk, Pearson education.
5. Computer Architecture, B. Parhami, Oxford Univ. Press.

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COMPUTER SCIENCE AND ENGINEERING
SOFTWARE TESTING METHODOLOGIES
(D55PE1B)

Semester V **L/T/P C**
3/0/0 3

Course Objective:

To provide students with a deep understanding of the methodologies like flow graphs, path testing, transaction flow testing data flow testing, domain testing and logic base testing adapted in a Software Testing Process.

Course Outcomes:

Upon completion of this course the students will be able to :

1. Examine the purpose of testing and taxonomy of bugs, flow graphs and path testing Process in ensuring software quality and reliability. L4
2. Utilize Transaction Flow Testing techniques and dataflow testing techniques to uncover defects or inconsistencies in software applications. L3
3. Apply Domain and Interface Testing techniques, path products and regular expressions in detecting and addressing potential software defects. L3
4. Apply syntax testing methodologies and logic-based testing techniques to verify software functionality against specified requirements. L3
5. Analyze the testability of software systems using state-based testing methodologies and the structure of a matrix of graphs and its relation to software testing. L4

UNIT I
Introduction:
Purpose of Testing, Dichotomies, Model for Testing, Consequences of Bugs, Taxonomy of Bugs. Flow graphs and Path testing: Basics Concepts of Path Testing, Predicates, Path Predicates and Achievable Paths, Path Sensitizing, Path Instrumentation, Application of Path Testing.

UNIT II
Transaction Flow Testing:
Transaction Flows, Transaction Flow Testing Techniques. Data flow testing: Basics of Dataflow Testing, Strategies in Dataflow Testing, Application of Dataflow Testing.

UNIT III
Domain Testing:
Domains and Paths, Nice & Ugly Domains, Domain testing, Domains and Interfaces Testing, Domain and Interface Testing, Domains and Testability. Paths, Path products, and Regular expressions: Path Products & Path Expression, Reduction Procedure, Applications, Regular Expressions & Flow Anomaly Detection.

UNIT IV
Syntax Testing:
Why What and How, A Grammar for formats, Test Case Generation, Implementation and Application and Testability Tips. Logic-Based Testing: Overview, Decision Tables, Path Expressions, KV Charts, and Specifications.

UNIT V

State, State Graphs, and Transition Testing:

State Graphs, Good & Bad State Graphs, State Testing, and Testability Tips. Graph Matrices and Application:-Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm.

Text Books:

1. Software Testing Techniques, Boris Beizer, Dreamtech, Second Edition.
2. Software Testing Tools- Dr. K.V.K.K.Prasad, Dreamtech.

Reference Books:

1. The craft of software testing- Brain Marick, Pearson Education.
2. Introduction to Software Testing: P. Ammam & J.Offutt. Cambridge Univ. Press.
3. Software Testing M.G.Limaye TMH
4. Foundations of Software Testing, D. Grahm & Others, Cengage Learning.

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COMPUTER SCIENCE & ENGINEERING

FUNDAMENTALS OF DATA SCIENCE
(D55PE1C)

Semester V **L/T/P C**
3/0/0 3

Course objective:

To provide students with a deep understanding of principles of Data Science in everyday business activities and make well-reasoned business and data management decisions.

Course Outcomes:
Upon completion of this course the students will be able to :

1. Apply statistical modeling techniques to analyze data and make inferences using R programming language. L3
2. Apply basic machine learning algorithms as well as data wrangling techniques for collecting and preprocessing data from the web. L3
3. Apply feature generation and selection techniques for extracting meaningful information from data, L3
4. Model the recommendation systems focusing on the role of dimensionality reduction techniques to provide personalized recommendations to users L3
5. Construct effective visualizations of complex datasets by analyzing and extracting insights from social-network graphs. L3

UNIT I
Introduction:
What is Data Science, Big Data and Data Science hype - and getting past the hype, why now – Data classification, Current landscape of perspectives, Skill sets needed. Statistical Inference - Populations and samples, Statistical modelling, probability distributions, fitting a model, Introduction to R. Exploratory Data Analysis and the Data Science Process- Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA, The Data Science Process.

UNIT II
Machine Learning Algorithms:
Linear Regression, k-Nearest Neighbours (k- NN), kmeans, Filtering Spam and Naïve Bayes. Data Wrangling: APIs and other tools for scrapping the Web.

UNIT III
Feature Generation and Feature Selection:
Feature Generation and Feature Selection (Extracting Meaning From Data)- Motivating application: user (customer) retention, Feature Generation (brainstorming, role of domain expertise, and place for imagination), Feature Selection algorithms- Filters, Wrappers, Decision Trees, Random Forests.

UNIT IV
Recommendation Systems:
Building a User-Facing Data Product, Algorithmic ingredients of a Recommendation Engine, Dimensionality Reduction, Singular Value Decomposition, - Principal Component Analysis.

UNIT V

Mining Social-Network Graphs:

Social networks as graphs, Clustering of graphs, Direct discovery of communities in graphs, Partitioning of graphs, Neighborhood properties in graphs.

Data Visualization:

Basic principles, ideas and tools for data visualization, Examples of inspiring (industry) projects, Exercise: create your own visualization of a complex dataset.

Text Book:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline.O'Reilly.2004.

Reference Books:

1. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press. 204. (Free online)
2. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. ISBN 0620800. 203.
3. Foster Provost and Tom Fawcett. Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking. ISBN 1449361323.203.
4. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Elements of Statistical Learning, Second Edition. ISBN 087952845. 209. (free online)
5. Avrim Blum, John Hopcroft and Ravindran Kannan. Foundations of Data Science. Mohammed J. Zaki and Wagner Miera Jr.
6. Data Mining and Analysis: Fundamental Concepts and Algorithms. Cambridge University Press.204.
7. Jiawei Han, Micheline Kamber and Jian Pei. Data Mining: Concepts and Techniques, Third Edition. ISBN 023814790.201.

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COMPUTER SCIENCE & ENGINEERING

AGILE METHODOLOGIES
(D55PE1D)

Semester V **L/T/P C**
3/0/0 3

Course Objective:
The aim of this course is to provide students with a deep understanding of agile methodologies, agile principles, values, and practices in software development projects to enhance collaboration, adaptability, and project outcomes.

Course Outcomes:

Upon completion of this course the students will be able to:

1. Apply agile methodologies, values, principles, and practices to facilitate collaborative and adaptive approaches in software development. L3
2. Build effective strategies for project delivery and communication by integrating agile principles into project management practices. L3
3. Apply Scrum methodologies, user stories, velocity, burn down charts and collective commitment strategies to track project progress and to improve project outcomes. L3
4. Utilize XP values and principles and implement incremental design strategies to promote simplicity and adaptability in software systems, L3
5. Apply lean thinking principles and value stream mapping techniques to eliminate waste in processes and utilize Kanban, flow and coaching principles to facilitate organizational change and continuous improvement initiatives. L3

UNIT I
LEARNING AGILE:
Getting Agile into Your Brain, Understanding Agile Values, No Silver Bullet, Agile to the Rescue, Adding Agile Makes a Difference. A Fractured Perspective, How a Fractured Perspective Causes Project Problems. The Agile Manifesto, Purpose Behind Each Practice. Individuals and Interactions Over Processes and Tools, Working Software Over Comprehensive Documentation, Customer Collaboration Over Contract Negotiation, Responding to Change Over Following a Plan, Principles Over Practices. Understanding the Elephant, Methodologies Help You Get It All in Place at Once, Where to Start with a New Methodology.

UNIT II
THE AGILE PRINCIPLES:
The 12 Principles of Agile Software, The Customer Is Always Right...Right? , "Do As I Say, Not As I Said". Delivering the Project, Better Project Delivery for the Ebook Reader Project. Communicating and Working Together, Better Communication for the Ebook Reader Project. Project Execution—Moving the Project Along, A Better Working Environment for the Ebook Reader Project Team. Constantly Improving the Project and the Team. The Agile Project: Bringing All the Principles Together

UNIT III

SCRUM AND SELF-ORGANIZING TEAMS:

The Rules of Scrum, Act I: I Can Haz Scrum?,

Everyone on a Scrum Team Owns the Project, The Scrum Master Guides the Team's Decisions, The Product Owner Helps the Team Understand the Value of the Software, Everyone Owns the Project, Scrum Has Its Own Set of Values ,Status Updates Are for Social Networks!, The Whole Team Uses the Daily Scrum, Feedback and the Visibility-Inspection- Adaptation Cycle, The Last Responsible Moment, How to Hold an Effective Daily Scrum. Sprinting into a Wall, Sprints, Planning, and Retrospectives, Iterative or Incremental?, The Product Owner Makes or Breaks the Sprint, Visibility and Value, How to Plan and Run an Effective Scrum Sprint.

SCRUM PLANNING AND COLLECTIVE COMMITMENT:

Not Quite Expecting the Unexpected, User Stories, Velocity, and Generally Accepted Scrum Practices, Make Your Software Useful, User Stories Help Build Features Your Users Will Use, Conditions of Satisfaction, Story Points and Velocity, Burndown Charts, Planning and Running a Sprint Using Stories, Points, Tasks, and a Task Board. Victory Lap, Scrum Values Revisited, Practices Do Work Without the Values (Just Don't Call It Scrum), Is Your Company's Culture Compatible with Scrum Values?

UNIT IV

XP AND EMBRACING CHANGE:

Going into Overtime, The Primary Practices of XP, Programming Practices, Integration Practices, Planning Practices, Team Practices, Why Teams Resist Changes, and How the Practices Help. The Game Plan Changed, but We're Still Losing, The XP Values Help the Team Change Their Mindset, XP Helps Developers Learn to Work with Users, Practices Only "Stick" When the Team Truly Believes in Them, An Effective Mindset Starts with the XP Values, The XP Values, Paved with Good Intentions. The Momentum Shifts, Understanding the XP Principles Helps You Embrace Change, The Principles of XP, XP Principles Help You Understand Planning, XP Principles Help You Understand Practices—and Vice Versa, Feedback Loops.

XP, SIMPLICITY, AND INCREMENTAL DESIGN:

Code and Design, Code Smells and Antipatterns (or, How to Tell If You're Being Too Clever), XP Teams Look for Code Smells and Fix Them, Hooks, Edge Cases, and Code That Does Too Much. Make Code and Design Decisions at the Last Responsible Moment, Fix Technical Debt by Refactoring Mercilessly, Use Continuous Integration to Find Design Problems, Avoid Monolithic Design, Incremental Design and the Holistic XP Practices. Teams Work Best When They Feel Like They Have Time to Think, Team Members Trust Each Other and Make Decisions Together. The XP Design, Planning, Team, and Holistic Practices Form an Ecosystem Incremental Design Versus Designing for Reuse, When Units Interact in a Simple Way, the System Can Grow Incrementally, Great Design Emerges from Simple Interactions, Final Score.

UNIT V

LEAN, ELIMINATING WASTE, AND SEEING THE WHOLE:

Lean Thinking,Commitment, Options Thinking, and Set-Based Development, Creating Heroes and Magical Thinking, Eliminate Waste, Use a Value Stream Map to Help See Waste Clearly, Gain a Deeper Understanding of the Product, See the Whole, Find the Root Cause of Problems That You Discover. Deliver As Fast As Possible, Use an Area Chart to Visualize Work in Progress, Control Bottlenecks by Limiting Work in Progress.

KANBAN, FLOW AND CONSTANTLY IMPROVING: The Principles of Kanban, Find a Starting Point and Evolve Experimentally from There. Stories Go into the System; Code Comes Out, Improving Your Process with Kanban, Visualize the Workflow, Limit Work in Progress. Measure and Manage Flow, Managing Flow with WIP Limits Naturally Creates Slack. Make Process Policies Explicit So Everyone Is on the Same Page. Emergent Behavior with Kanban.

THE AGILE COACH: Coaches Understand Why People Don't Always Want to Change. The Principles of Coaching.

Text Books:

1.Andrew Stellman, Jill Alison Hart, Learning Agile, O'Reilly, 2015.

Reference Books:

1. Andrew stellman, Jennifer Green, Head first Agile, O'Reilly, 2017.
2. Rubin K , Essential Scrum : A practical guide to the most popular Agile process, Addison

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COMPUTER SCIENCE AND ENGINEERING

INFORMATION RETRIEVAL SYSTEMS
(D55PE2A)

Semester V **L/T/P C**
3/0/0 3

Course Objective:
To understand the concepts, algorithms, and data/file structures essential for the design and implementation of Information Retrieval (IR) systems.

Course Outcomes:
Upon completion of this course the students will be able to :
1. Identify the functionalities, capabilities and role of Information Retrieval System in Digital Libraries and Data Warehouses L3
2. Analyze the indexing process and techniques, Compare various data structures and apply hidden Markov models in indexing and data structuring. L4
3. Utilize the classes of automatic indexing, Hypertext Linkages, principles and methodologies behind document and term clustering in information organization and retrieval. L3
4. Analyze various search techniques for targeted information retrieval and information visualization technologies to understand user interaction with visualized data in different contexts. L4
5. Analyze the principles and techniques of search systems in retrieving the textual information and applicability of retrieval methods in retrieving multimedia content. L4

UNIT I
Introduction to Information Retrieval Systems:
Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management Systems, Digital Libraries and Data Warehouses.
Information Retrieval System Capabilities:
Search Capabilities, Browse Capabilities, Miscellaneous Capabilities

UNIT II
Cataloging and Indexing:
History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction Data Structure: Introduction to Data Structure, Stemming Algorithms, Inverted File Structure, N-Gram Data Structures, PAT Data Structure, Signature File Structure, Hypertext and XML Data Structures, Hidden Markov Models

UNIT III
Automatic Indexing:
Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages
Document and Term Clustering:
Introduction to Clustering, Thesaurus Generation, Item Clustering, Hierarchy of Clusters

UNIT IV

User Search Techniques:

Search Statements and Binding, Similarity Measures and Ranking, Relevance Feedback, Selective Dissemination of Information Search, Weighted Searches of Boolean Systems, Searching the INTERNET and Hypertext

Information Visualization:

Introduction to Information Visualization, Cognition and Perception,
Information Visualization Technologies

UNIT V

Text Search Algorithms:

Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems

Multimedia Information Retrieval:

Spoken Language Audio Retrieval, Non-Speech Audio Retrieval, Graph Retrieval, Imagery Retrieval, Video Retrieval

Text Books:

1. Information Storage and Retrieval Systems – Theory and Implementation, Second Edition, Gerald J. Kowalski, Mark T. Maybury, Springer

References Books:

1. Frakes, W.B., Ricardo Baeza-Yates: Information Retrieval Data Structures and Algorithms, Prentice Hall, 1992.
2. Information Storage & Retrieval By Robert Korfhage – John Wiley & Sons.
3. Modern Information Retrieval By Yates and Neto Pearson Education.

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COMPUTER SCIENCE AND ENGINEERING

DATA WRANGLING & VISUALIZATION
(D55PE2B)

Semester V **L/T/P C**
3/0/0 3

Course Objective:
To Learn Concepts, Techniques And Tools, Needed To Deal With Various Facets Of Data Science Practice, Including Data Collection And Integration, Data Reduction And Data Visualization Techniques

Course Outcomes:
Upon Completion Of This Course The Students Will Be Able To:
1. Construct Scraping Of Data From Multiple Data Resources. L3
2. Apply Data Transformation Techniques, Handle Missing Values In The Data.. L3
3. Construct And Analyze Interactive Plots For Effective Decision Making From The Given Data. L4
4. Construct Heat Map For Finding The Correlations Among Various Feature Vectors To Identify Data Transformation. L3
5. Analyze Visualizations For Continuous Data By Generating Different Kinds Of Plotting Techniques. . L4

UNIT I
Importing Data- Reading:
Data From Text Files, Reading Data From Excel Files, Scraping Data- Importing Tabular And Excel Files Stored Online, Scraping Html Text, Scraping Html Table Data.
Exporting Data:
Writing Data To Text Files, Writing Data To Excel Files, Excel Package, Saving Data As An R Object File.

UNIT II
Managing Data Structures In R Using Packages:
Data Structure Basics, Managing Vectors, Managing Lists, Managing Matrices, Managing Data Frames, Dealing With Missing Values, Reshaping Data With Tidyr Package, Transforming Data With Dplyr Package.

UNIT III
Basic And Interactive Plots:
Scatter Plot-Scatter Plots With Texts, Labels, And Lines , Connecting Points In a Scatter Plot Generating An Interactive Scatter Plot Bar Plot- A Simple Bar Plot , An Interactive Bar Plot Line Plot-A Simple Line Plot Line Plot To Tell An Effective Story. Generating An Interactive Gantt/Timeline Chart In R , Merging Histograms , Making An Interactive Bubble Plot.

UNIT IV
Heat Maps And Dendrograms:
Introduction, Constructing a Simple Dendrogram, Creating Dendrograms With Colors And Labels, Creating a Heat Map, Generating a Heat Map With Customized Colors , Generating An Integrated Dendrogram And a Heat Map, Creating a Three- Dimensional Heat Map And a Stereo Map , Constructing a Tree Map In R.

UNIT V

Visualizing Continuous Data:

Introduction- Generating a Candlestick Plot, Generating Interactive Candlestick Plots, Generating a Decomposed Time Series , Plotting a Regression Line Constructing a Box And Whiskers Plot , Generating a Violin Plot , Generating a Quantile- Quantile Plot (Qq Plot), Generating a Density Plot ,Generating a Simple Correlation Plot.

Text Books:

1. Data Wrangling With R- Bradley C. Boehmke,Springer Publisher
2. R Data Visualization Cookbook- Atmajitsinh Gohi, Packt Publishing

Reference Books:

1. Brain S. Everitt, “A Handbook Of Statistical Analysis Using R”, Second Edition, 4 Llc, 2014.
2. R For Datascience, Hadley Wickham, Garrett Grolemund , O'Reilly Media
3. Paul Teetor, “R Cookbook”, O’Reilly, 2011.

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COMPUTER SCIENCE AND ENGINEERING

ARTIFICIAL INTELLIGENCE
(D55PE2C)

Semester V **L/T/P C**
3/0/0 3

Course Objective:
To understand state space representation, search algorithms, knowledge representation techniques and applications of artificial intelligence in different domains.

Course Outcomes:
Upon completion of this course the students will be able to :
1. Apply theoretical knowledge to practical problem-solving scenarios across various domains, fostering critical thinking and problem-solving skills. L3
2. Utilize propositional theorem proving techniques such as resolution, horn clauses, and definite clauses to derive logical conclusions and make inferences. L3
3. Apply the principles of logic and knowledge representation using First-Order Logic to model and solve problems in various domains. L3
4. Analyze the strengths and limitations of different planning approaches using the factors: problem complexity, resource constraints, and domain dynamics. L4
5. Utilize inference techniques using full joint distributions, independence, and Bayes' rule to perform probabilistic reasoning and make probabilistic predictions. L3

UNIT I
Introduction:
To AI, Intelligent Agents, problem-Solving Agents, Searching for Solutions, Uninformed Search Strategies: Breadth-first search, Uniform cost search, Depth-first search, Iterative deepening Depth-first search, Bidirectional search.
Heuristic Search Strategies:
Greedy best-first, search, A* search, Heuristic Functions, Beyond Classical Search: Hill-climbing search, Simulated annealing search, Local Search in Continuous Spaces

UNIT II
Problem Solving by Search-II and Propositional Logic Adversarial Search:
Games, Optimal Decisions in Games, Alpha–Beta Pruning, Imperfect Real-Time Decisions.
Constraint Satisfaction Problems:
Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.
Propositional Logic:
Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses, Forward and backward chaining, Effective Propositional Model Checking, Agents Based on Propositional Logic.

UNIT III
Logic and Knowledge Representation First-Order Logic:
Representation, Syntax and Semantics of First-Order Logic, Using First- Order Logic,
Knowledge Engineering in First-Order Logic:
Inference in First-Order Logic, Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.

UNIT IV

Knowledge Representation:

Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information.

Classical Planning:

Definition of Classical Planning, Algorithms for Planning with State- Space Search, Planning Graphs, other Classical Planning Approaches, Analysis of Planning approaches.

UNIT V

Uncertain knowledge and Learning Uncertainty:

Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule and its use.

Probabilistic Reasoning:

Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Approximate Inference in Bayesian Networks, Relational and First-Order Probability, Other Approaches to Uncertain Reasoning; Dempster-Shafer theory.

Text Book:

1. Artificial Intelligence: A Modern Approach, Third Edition, Stuart Russell and Peter Norvig, Pearson Education.

Reference Books:

1. Artificial Intelligence, 3rd Edn, E. Rich and K. Knight (TMH)
2. Artificial Intelligence, 3rd Edn., Patrick Henry Winston, Pearson Education.
3. Artificial Intelligence, Shivani Goel, Pearson Education.
4. Artificial Intelligence and Expert systems – Patterson, Pearson Education

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COMPUTER SCIENCE AND ENGINEERING

DESIGN PATTERNS
(D55PE2D)

Semester V **L/T/P C**
3/0/0 3

Course Objective:
To equip students with a comprehensive understanding of design patterns and their applications in software development.

Course Outcomes:
Upon completion of this course the students will be able to :
1. Apply design patterns effectively to solve common design problems. L3
2. Analyze the design problems associated with developing a document editor software and creational patterns to the design and implementation of software systems. L4
3. Analyze the structural problems that Adapter, Bridge, Composite patterns, Decorator, acade, flyweight and proxy patterns aim to solve. L4
4. Apply Chain of Responsibility, Command, Interpreter, Iterator patterns Mediator, Memento, and Observer patterns in promoting loose coupling and enhancing maintainability. L3
5. Analyze the effectiveness of State, Strategy, Template Method, and Visitor patterns in managing complex behavioural variations. L4

UNIT I
Introduction:
What is a Design Pattern? Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design patterns, Organizing the Catalog, How Design patterns solve Design problems, How to select a Design Pattern, How to use a Design Pattern.

UNIT II
Case Study:
Designing a Document Editor, Design Problems, Document Structure, Formatting Embellishing the User Interface, Supporting Multiple Look and Feel Standards, Supporting Multiple Window systems, User Operations Spelling Checking and Hyphenation, Summary.
Creational Patterns:
Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns.

UNIT III
Structural Pattern Part – I: Adaptor, Bridgeand Composite. Structural
Pattern Part – II: Decorator, acade, flyweight, proxy.

UNIT IV
Behavior Patterns Part – I: Chain of Responsibility, Command, Interpreter, and Iterator. Behavior
Patterns Part – II: Mediator, Memento, Observer.

UNIT V

Behavior Patterns Part – II(cont'd): State, strategy, Template Method, Visitor, Discussion of Behavioral Patterns. What to Expect from Design Patterns, A brief History, and the Pattern Community an Invitation, A Parting Thought.

Text Book:

1. Design Patterns by Erich Gamma, Pearson Education.

Reference Books:

1. Pattern's in JAVA Vol-I By Mark Grand, Wiley DreamTech.
2. Peeling Design Patterns, Prof Meda Srinivasa Rao, Narsimha Karumanchi,CareerMonk Publication.
3. Design Patterns Explained By Alan Shallowy, PearsonEducation.
4. Pattern Oriented Software Architecture, af.Buschman& others, John Wiley &Sons.

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COMPUTER SCIENCE AND ENGINEERING

OPERATING SYSTEMS LAB
(D55PC15)

Semester V **L/T/P C**
0/0/2 1

Course Objectives:
To equip students with a comprehensive understanding of design aspects of operating system concepts through simulation.

Course Outcomes:
Upon completion of this course the students will be able to :
1. Develop programs for various CPU scheduling algorithms and IPC mechanisms. L3
2. Develop programs for implementing process synchronization using semaphores and for dead lock detection and recovery. L3
3. Develop programs for memory allocation methods, page replacement algorithms and Disk Scheduling techniques. L3

List of Experiments:
1. Write C programs to simulate the following CPU Scheduling algorithms :
a) FCFS b) SJF
2. Write C programs to simulate the following CPU Scheduling algorithms: Shortest Remaining Time First and Priority scheduling.
3. Write C programs to simulate the following CPU Scheduling algorithms : Round Robin and Longest Job First
4. Write C programs to illustrate the following IPC mechanisms a) Pipes b) FIFOs
5. Write C programs to illustrate the following IPC mechanisms a) Message Queues b) Shared Memory
6. Write a program for Producer-Consumer Problem using Semaphores.
7. Write a program for Reader Writer Problem using Semaphores.
8. Simulate algorithm for deadlock prevention and detection.
9. Simulate the algorithm for deadlock avoidance and deadlock recovery.
10. Simulate memory allocation methods: (i) Best Fit (ii) Worst Fit (iii)Next Fit
11. Simulate page replacement algorithms: FIFO, LRU and Optimal.
12. Implement Disk Scheduling using FCFS, SCAN and C-SCAN algorithms.
13. Implementation of Disk Scheduling using Shortest Seek Time First (SSTF) algorithm.

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COMPUTER SCIENCE AND ENGINEERING

DATA WAREHOUSING AND DATA MINING LAB
(D55PC16)

Semester V **L/T/P C**
0/0/2 1

Course Objective:
To equip students with a comprehensive understanding of various kinds of tools, classification and clusters in large data sets.

Course Outcomes:
Upon completion of this course the students will be able to :
1. Analyze data from files and other sources. L4
2. Apply various data manipulation tasks on various datasets. L3
3. Apply data mining techniques on real time data sets. L3

TASK I:
A. Build Data Warehouse and Explore WEKA
Build a Data Warehouse/Data Mart (using open source tools like Pentaho Data Integration tool, Pentoaho Business Analytics; or other data warehouse tools like Microsoft-SSIS,Informatica, Business Objects etc.).
1. Identify source tables and populate sample data
2. Design multi-dimensional data models namely Star, snowflake and Fact constellation schemas for anyone enterprise (ex. Banking, Insurance, Finance, Healthcare,Manufacturing, Automobile, etc.).
3. Write ETL scripts and implement using data warehouse tools
4. Perform various OLAP operations such as slice, dice, roll up, drill up and pivot
5. Explore visualization features ofthe tool for analysis like identifying trends etc.

B. Explore WEKA Data Mining/Machine Learning Toolkit
1. Downloading and/or installation of WEKA data mining toolkit,
2. Understand the features of WEKA toolkit such as Explorer, Knowledge Flow interface, Experimenter, command-line interface.
3. Navigate the options available in the WEKA (ex. Select attributes panel, Preprocess panel, Classify panel, Cluster panel, Associate panel and Visualize panel) Study the arff file format
4. Explore the available data sets in WEKA.
5. Load a data set (ex. Weather dataset, Iris dataset,etc.)
6. Load each dataset and observe the following:
i. List the attribute names and their types
ii. Number of records in each dataset
iii. Identify the class attribute (if any)
iv. Plot Histogram
v. Determine the number of records for each class.
vi. Visualize the data in various dimensions

TASK II:
Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets
1. Explore various options available in Weka for preprocessing data and apply (like Discretization Filters, Resample filter, etc.) on each dataset

2. Load each dataset into Weka and run Apriori algorithm with different support and confidence values. Studythe rules generated.
3. Apply different discretization filters on numerical attributes and run the Apriori association rule algorithm. Study the rules generated. Derive interesting insights and observe the effect of discretization in the rule generation process.

TASK III:
Demonstrate performing classification on data sets
1. Load each dataset into Weka and run Id3, J48 classification algorithm. Study the classifier output. Compute entropy values, Kapp a statistic.
2. Extract if-then rules from the decision tree generated by the classifier, Observe the confusion matrix and derive Accuracy, F-measure, TPrate, FPrate, Precision and Recall values. Apply a cross-validation strategy with various fold levels and compare the accuracy results.
3. Load each dataset into Weka and perform Naïve-Bayes classification and k-Nearest Neighbour classification. Interpret the results obtained.
4. Plot RoC Curves
5. Compare classification results of ID3, J48, Naïve-Bayes and k-NN classifiers for each dataset, and deduce which classifier is performing best and poor for each dataset and justify.

TASK IV:
Demonstrate performing clustering on data sets
1. Load each dataset into Weka and run a simple k-means clustering algorithm with different values of k (number of desired clusters). Study the clusters formed. Observe the sum of squared errors and centroids, and derive insights.
2. Explore other clustering techniques available in Weka.
3. Explore visualization features of Weka to visualize the clusters. Derive interesting insights and explanations.

TASK V:
Demonstrate performing Regression on datasets
1. Load each dataset into Weka and build a Linear Regression model. Study the clusters formed. Use the Training set option. Interpret the regression model and derive patterns and conclusions from the regression results.
2. Use options cross-validation and percentage split and repeat running the Linear Regression Model. Observe the results and derive meaningful results.
3. Explore a Simple linear regression technique that only looks at one variable.

Resource Sites:
1. http://www.pentaho.com/
2. http://www.cs.waikato.ac.nz/ml/weka/

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COMPUTER SCIENCE AND ENGINEERING

ENVIRONMENTAL SCIENCE (MC002)

Semester V **L/T/P C**
0/0/0 0

Course Objectives:
To equip students with a comprehensive understanding of technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development

Course Outcomes:
Upon completion of this course the students will be able to :
1. Understand the importance of ecological balance for sustainable development. L2
2. Understand the impacts of developmental activities and mitigation measures L2
3. Understand the environmental policies and regulations L2

UNIT I
Ecosystems:
Definition, Scope, and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Bio magnification, ecosystem value, services and carrying capacity, Field visits.

UNIT II
Natural Resources:
Classification of Resources: Living and Non-Living resources, water resources: use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, Land resources: Forest resources, Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

UNIT III
Biodiversity And Biotic Resources:
Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT IV
Environmental Pollution and Control Technologies:
Environmental Pollution: Classification of pollution, Air Pollution: Primary and secondary pollutants, Automobile and Industrial pollution, Ambient mair quality standards. Water pollution: Sources and types of pollution, drinking water quality standards. Soil Pollution: Sources and types, Impacts of modern agriculture, degradation of soil. Noise Pollution: Sources and Health hazards, standards, Solid waste: Municipal Solid Waste management, composition and characteristics of e-Waste and its management. Pollution control technologies: Wastewater Treatment methods: Primary, secondary and Tertiary.

Overview of air pollution control technologies, Concepts of bioremediation. Global Environmental Issues and Global Efforts: Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol. NAPCC - GoI Initiatives.

UNIT V

Environmental Policy, Legislation & EIA:

Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). Towards Sustainable Future: Concept of Sustainable Development Goals, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

Text Books:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

Reference Books:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS. Publications.

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COMPUTER SCIENCE AND ENGINEERING

DEVOPS (D56PC17)

Semester VI **L/T/P C**
3/0/0 3

Course Objectives:
To equip students with a comprehensive understanding of skill sets and high-functioning teams involved in Agile, DevOps and related methods to reach a continuous delivery capability.

Course Outcomes:
Upon completion of this course the students will be able to:
1. Apply DevOps principles and methodologies to identify, analyze, and address challenges in software development and delivery processes. L3
2. Apply DevOps principles, implement continuous testing practices, and shape resilient software architecture to enhance business agility in software development models. L3
3. Apply source code control practices, understand the history and roles associated with source code management, and effectively utilize Git-based tools and platforms in project development. L3
4. Analyze complex build systems, demonstrate advanced proficiency in configuring and optimizing Jenkins servers, critically strategize build dependency management, and design sophisticated pipelines for effective system integration. L4
5. Analyze testing types, evaluate test automation, demonstrate proficiency in Selenium for frontend testing and JavaScript for backend integration, apply test-driven development principles, and assess deployment strategies using virtualization, configuration management, and container orchestration. L4

UNIT I
Introduction to DevOps:
Introduction, Agile development model, DevOps and ITIL, DevOps process and Continuous Delivery, Release management, Scrum, Kanban, delivery pipeline, identifying bottlenecks.

UNIT II
Software development models and DevOps:
DevOps Lifecycle for Business Agility, DevOps, and Continuous Testing.DevOps influence on Architecture: Introducing software architecture, The monolithic scenario, Architecture rules of thumb, The separation of concerns, Handling database migrations, Micro services and the data tier, DevOps, architecture, and resilience.

UNIT III
Introduction to project management:
The need for source code control, the history of source code management, Roles and code, source code management system and migrations, shared authentication, Hosted Git servers, Different Git server implementations, Docker intermission, Gerrit, The pull request model, GitLab.

UNIT IV

Integrating the system:

Build systems, Jenkins build server, Managing build dependencies, Jenkins plugins, and file system layout, The host server, Buildslaves, Software on the host, Triggers, Job chaining and build pipelines, Build servers and infrastructure as code, Building by dependency order, Build phases, Alternative build servers, Collating quality measures.

UNIT V

Testing Tools and Deployment:

Various types of testing, Automation of testing Pros and cons, Selenium - Introduction, Selenium features, JavaScript testing, Testing backend integration points, Test-driven development, REPL-driven development. Deployment of the system: Deployment systems, Virtualization stacks, code execution at the client, Puppet master and agents, Ansible, Deployment tools: Chef, Salt Stack and Docker.

Textbooks:

1. JoakimVerona., Practical DevOps, PacktPublishing, 2016.

Reference Books:

1. Deepak Gaikwad, ViralThakkar. DevOps Tools from Practitioner's Viewpoint. Wiley publications.
2. LenBass, IngoWeber, LimingZhu, DevOps:A Software Architect's Perspective, AddisonWesley

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COMPUTER SCIENCE AND ENGINEERING

COMPILER DESIGN
(D55PC18)

Semester VI **L/T/P C**
3/0/0 3

Course Objective:

To equip students with a comprehensive understanding of the process involved in designing a compiler for a high level programming language.

Course Outcomes:

Upon completion of this course the students will be able to :

1. Utilize the knowledge of patterns, tokens & regular expressions for developing a Lexical Analyzer Generator. L3
2. Analyze the suitability of bottom up and top down parsing techniques for a programming language with a specific context-free grammar. L4
3. Build Syntax Directed Translation Schemes to map syntactic structures to semantic actions and generate intermediate code for various control flow structures. L3
4. Analyze the significance of storage organization techniques and identify the key issues in the design of a code generator. L4
5. Analyze machine-independent optimization techniques using the concepts of dataflow analysis in the design of a compiler. L4

UNIT I

Introduction:

Language Processors, the structure of a compiler, programming language basics. Lexical Analysis: The Role of the Lexical Analyzer, Input Buffering, Recognition of Tokens, The Lexical- Analyzer Generator Lex, Finite Automata, From Regular Expressions to Automata, Design of a Lexical-Analyzer Generator, Optimization of DFA-Based Pattern Matchers.

UNIT II

Syntax Analysis:

Introduction, Context-Free Grammars, Writing a Grammar, Top-Down Parsing, Bottom-Up Parsing, Introduction to LR Parsing: Simple LR, /More Powerful LR Parsers, Using Ambiguous Grammars, Parser Generators.

UNIT III

Syntax – Directed Translation:

Syntax – Directed Definitions, Evaluation Orders for SDD's, Applications of Syntax-Directed Translation, Syntax-Directed Translation Schemes, and Implementing L – Attributed SDD's.

Intermediate-Code Generation:

Variants of Syntax Trees, Three – Address Code, Types and Declarations, Type Checking, Control Flow, Back patching, Switch – Statements, Intermediate Code for Procedures.

UNIT IV

Run-Time Environments:

Storage organization, Stack Allocation of Space, Access to Nonlocal Data on the Stack, Heap Management, Introduction to Garbage Collection, Introduction to Trace Based Collection.

Code Generation:

Issues in the Design of a Code Generator, The Target Language, Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, A Simple Code Generator, Peephole Optimization, Register Allocation and Assignment, Dynamic Programming Code-Generation.

UNIT V

Machine-Independent Optimizations:

The Principle Sources of Optimization, Introduction to Data – Flow Analysis, Foundations of Data-Flow Analysis, Constant Propagation, Partial Redundancy Elimination, Loops in Flow Graphs.

Text Books:

1. Compilers: Principles, Techniques and Tools, Second Edition, Alfred V. Aho, MonicaS. Lam, Ravi Sethi, Jeffry D. Ullman, Pearson.

Reference Books:

1. Compiler Construction-Principles and Practice, Kenneth C Louden, Cengage Learning.
2. Modern compiler implementation in C, Andrew W Appel, Revised edition, Cambridge University Press.
3. The Theory and Practice of Compiler writing, J. P. Tremblay and P. G. Sorenson, TMH Writing compilers and interpreters, R. Mak, 3rd edition, Wiley student edition. Lex & yacc – John R. Levine, Tony Mason, Doug Brown, O'reilly.

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COMPUTER SCIENCE AND ENGINEERING

MACHINE LEARNING (D56PC19)

Semester VI **L/T/P C**
3/0/0 3

Course Objective

To equip students with a comprehensive understanding of fundamental principles , supervised, unsupervised , probability based machine learning techniques and practical applications of machine learning.

Course Outcomes:

Upon completion of this course the students will be able to :

1. Apply supervised learning techniques and utilize the principles of concept learning and linear discriminants to design effective machine learning systems. L3
2. Implement multi-layer perceptron's and SVM, and apply back propagation and radial basis function techniques to develop solutions for machine learning problems. L3
3. Construct decision trees and apply ensemble learning techniques, including boosting and bagging, to analyze data using both supervised and unsupervised learning methods. L3
4. Implement dimensionality reduction techniques and apply genetic algorithms, including various genetic operators, to optimize machine learning models and solutions. L3
5. Utilize reinforcement learning principles, Markov Chain Monte Carlo methods, and construct graphical models, including Bayesian networks and Hidden Markov Models, to solve complex tracking and decision-making problems. L3

UNIT I

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

Multi-layer Perceptron

Going Forwards – Going Backwards: Back Propagation Error – 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

Learning with Trees:

Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms

UNIT IV

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

UNIT V

Reinforcement Learning:

Overview – Getting Lost Example Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

Text Books:

1. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

Reference Books:

1. Tom M Mitchell, ―Machine Learning, First Edition, McGraw Hill Education, 2013.
2. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.
3. Jason Bell, ―Machine learning – Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014
4. Ethem Alpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014

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COMPUTER SCIENCE AND ENGINEERING

FULL STACK DEVELOPMENT
(D56PE3A)

Semester VI **L/T/P C**
3/0/0 3

Course Objectives:
To equip students with a comprehensive understanding of front end and backend technologies to design, develop, and deploy dynamic web applications proficiently and to meet the demands of modern web development.

Course Outcomes:
Upon completion of this course the students will be able to :
1. Apply HTML concepts, UNIX CLI commands, Git and GitHub techniques in creating structured and visually appealing web content. L3
2. Utilize OOP aspects of JavaScript, AJAX (Asynchronous JavaScript and XML) techniques jQuery framework ,Query events, UI components to design interactive web interfaces. L3
3. Apply advanced React JS concepts including React Router, Single Page Applications form management, Flow architecture, Redux state management, Client-Server communication approaches in data management and predictable state updates of React applications. L3
4. Make use of MVC architecture, spring framework, automation tool Maven in building dynamic and interactive web applications. L3
5. Apply normalization techniques , advanced SQL features , Agile development principles in database design and application development and deploying applications in cloud. L3

UNIT I
Web Development Basics:
Web development Basics - HTML & Web servers Shell - UNIX CLI Version control - Git & GitHub HTML, CSS

UNIT II
Frontend Development:
JavaScript basics OOPS Aspects of JavaScript, Memory usage and Functions in JS AJAX for data exchange with server jQuery Framework, jQuery events, UI components etc. JSON data format.

UNIT III
REACTJS:
Introduction to React Router and Single Page Applications React Forms, Flow Architecture and Introduction to Redux More Redux and Client-Server Communication.

UNIT IV
Java Web Development:
JAVA PROGRAMMING BASICS, Model View Controller (MVC) Pattern MVC Architecture using Spring RESTful API using Spring Framework Building an application using Maven.

UNIT V
Databases & Deployment:
Relational schemas and normalization Structured Query Language (SQL) Data persistence using Spring JDBC Agile development principles and deploying application in Cloud.

Text Books:

1. Web Design with HTML, CSS, JavaScript and JQuery Set Book by Jon Duckett Professional JavaScript for Web Developers Book by Nicholas C. Zakas.
2. Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites by Robin Nixon.
3. Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB. Copyright © 2015 azatmardan.

Reference Books:

1. Full-Stack JavaScript Development by Eric Bush.
2. Mastering Full Stack React Web Development Paperback – April 28, 2017 Tomasz Dyl , Kamil Przeorski, Maciej Czarnecki.

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COMPUTER SCIENCE AND ENGINEERING

BIG DATA ANALYTICS (D56PE3B)

Semester VI **L/T/P C**
3/0/0 3

Course objectives:
To equip students with a comprehensive understanding of the tools, technologies & programming languages which is used in day to day analytics cycle.

Course outcomes:
Upon completion of this course the students will be able to :
1. Analyze the characteristics of Big data by making use of data collection, preparation, and visualization. L4
2. Apply Bigdata patterns in their applications to solve problems encountered in the domain of big data analytics. L3
3. Analyze Data Acquisition and Big Data Storage by exploring HDFS, SCALA and SPARK L4
4. Apply high level APIs, using resilent distributed data sets and perform batch analysis applications using Apache L3
5. Make use of Relational and Non Relational data bases to develop web application models emphasizing on Django Framework. L3

UNIT I
Introduction to Big Data:
What is Analytics, What is Big Data, Characteristics of Big Data, Domain Specific Examples of Big Data, and Analytics flow for Big Data-Data Collection, Data Preparation, Analysis Types, Analysis Modes, Visualizations, Big Data Stack.

UNIT II
Big data Patterns:
Analytics architecture components & Design styles-Load Leveling with Queues, Load Balancing with Multiple Consumers, Leader Election, Sharding, CAP, Lambda Architecture, Scheduler Agent Supervisor, Pipes & Filters, MapReduce Patterns.

UNIT III
Big Data Analytics Implementations Data Acquisition:
Data Acquisition Considerations**,** Publish -Subscribe Messaging Frameworks**,** Big Data Collection Systems.
Big Data Storage:
HDFS- Architecture

UNIT IV
Batch Analysis:
Hadoop and Map Reduce, Hadoop – Map Reduce Examples, Pig, Case Study: Batch Analysis of News Articles, Apache Oozie, and Apache Spark.

UNIT V
Serving Databases and Web frameworks:
Relational (SQL) Databases, Non-Relational (NoSQL) Databases, and Python Web Application Framework– Django. **NoSQL**:Key-Value Databases, Document Databases, Column Family Databases, Graph Databases.

Text Books:

1. Big Data Science and Analytics AHands-on Approach. By Arshdeep Bahga,Vijay Madisetti

Reference Books:

1. Data Science & Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data EMC Education Services.

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COMPUTER SCIENCE AND ENGINEERING

MOBILE AD HOC NETWORKS
(D56PE3C)

Semester VI **L/T/P C**
3/0/0 3

Course Objective:

To understand and analyze various design issues and challenges involved in the layered architecture of Ad hoc wireless networks

Course Outcomes:
Upon completion of this course the students will be able to :

1. Analyze the principles of wireless ahdoc networks and compare MAC protocols based on their characteristics and functionalities in wireless networks. L4
2. Analyze routing and multicast routing protocols based on their characteristics in meeting Quality of Service (QoS) requirements and energy constraints of ad hoc networks. L4
3. Analyze TCP's Challenges, Design Issues , Protocols of Adhoc networks, and QoS solutions considering their effectiveness in providing QoS guarantees in ad hoc networks L4
4. Analyze Energy efficient routing protocols in predicting network lifetime and to optimize and to prolong battery life. L4
5. Identify cross-layer design issues and their applicability in specific network scenarios. L3

UNIT I
Introduction:
Fundamentals of Wireless Networks, Wireless Internet, What Are Ad Hoc Networks?
MAC Layer Protocols: Important Issues and Need for Medium Access, Classification of MAC Protocols

UNIT II
Routing Protocols:
Design Issues of Routing Protocols for Ad Hoc, Classification of Routing Protocols, Proactive Routing Protocols, Hybrid Routing Protocols.
Multi cast Routing Protocols:Issues in Design of Multicast Routing Protocols, Classification of Multicast Routing Protocols, QoS Routing, Energy-Efficient Multicast Routing Protocols, Location Based Multicast Routing Protocols

UNIT III
Transport Protocols:
TCP's Challenges and Design Issues in Ad Hoc Networks, TCP Performance over MANETs, Ad Hoc Transport Protocols,
Quality of Service:
Challenges, Classification of QoS Solutions, QoS-Enabled Ad Hoc on-Demand Distance Vector Routing Protocol, QoS Frameworks for Ad Hoc Wireless Networks, INSIGNIA, INORA

UNIT IV

Energy Management Systems:

Introduction, Energy-Efficient Routing Protocol, Transmission Power Management Schemes, Transmission Power Control, AODV Protocol, Local Energy-Aware Routing Based on AODV, Power-Aware Routing Based on AODV, Lifetime Prediction Routing Based on AODV

UNIT V

Cross-Layer Design Issues:

A Definition of Cross-Layer Design, Cross-Layer Design Principle, Proposals Involving Cross-Layer Design, Proposals for Implementing Cross-Layer Interactions, Cross Layer Design: Is It Worth Applying It?, Pitfalls of the Cross-Layer Design Approach, Performance Objectives.

Applications and Recent Developments: Typical Applications, Applications and Opportunities, Challenges, Most Recent Developments in the Field.

Text Books:

1. Ad hoc Mobile Wireless Networks principles, Protocols, and Applications 2ed, Subir Kumar, T.G. Basavaraj, C.Puttamaddappa CRC publications

Reference Books:

1. C.Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architecture and Protocols, 2nd edition, Pearson Edition, 2007.
2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.
3. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile ad- hoc networking,
Wiley-IEEE press, 2004.
4. Mohammad Ilyas, The handbook of ad-hoc wireless networks, CRC press, 2002.
5. T. Camp, J. Boleng, and V. Davies ― A Survey of Mobility Models for Ad-hocNetwork‖
6. Research, ―Wireless Communication, and Mobile comp. Special Issue on Mobile Adhoc Networking Research, Trends and Applications, Vol. 2, no. 5, 2002, pp-502.

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COMPUTER SCIENCE AND ENGINEERING

SERVICE ORIENTED ARCHITECTURE
(D56PE3D)

Semester VI **L/T/P C**
3/0/0 3

Course Objective:

To Understand service-oriented architectures, XML, importance of web services, WS standards and technologies for developing SOA based applications.

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Course Outcomes:

Upon completion of this course the students will be able to :

1. Analyze XML document structures and apply suitable parsing technique for data manipulation and retrieval. L4
2. Analyze and compare the characteristics, benefits &designing of Service-Oriented Architecture (SOA) with Client-Server and Distributed architecture L4
3. Utilize service descriptions, service discovery mechanisms and service-level interaction patterns in coordinating the development and deployment of web services. L3
4. Apply WS policies, messaging schemes, security mechanisms and coordination techniques to ensure data privacy and enhancing web service functionality and reliability. L3
5. Apply service-oriented design principles in modelling business process designs to achieve desired business outcomes. L3

UNIT I
XML
XML document structure – Well-formed and valid documents – DTD – XML Schema – Parsing XML using DOM, SAX – XPath – XML Transformation and XSL – Xquery

UNIT II
SERVICE ORIENTED ARCHITECTURE (SOA) BASICS
Characteristics of SOA, Benefits of SOA , Comparing SOA with Client-Server and Distributed architectures — Principles of Service Orientation – Service layers

UNIT III
WEB SERVICES (WS) AND STANDARDS:
Web Services Platform – Service descriptions – WSDL – Messaging with SOAP – Service discovery – UDDI – Service-Level Interaction Patterns – Orchestration and Choreography

UNIT IV
WEB SERVICES EXTENSIONS:
WS-Addressing – WS-Reliable Messaging – WS-Policy – WS-Coordination – WS -Transactions – WS-Security – Examples

UNIT V
SERVICE ORIENTED ANALYSIS AND DESIGN:
SOA delivery strategies – Service oriented analysis – Service Modelling – Service oriented design – Standards and composition guidelines — Service design – Business process design – Case Study

Text Books:

1. Thomas Erl, ― Service Oriented Architecture: Concepts, Technology, and Design, Pearson Education, 2005
2. Sandeep Chatterjee and James Webber, ―Developing Enterprise Web Services: An Architect's Guide, Prentice Hall, 2004

References:

1. James McGovern, Sameer Tyagi, Michael E Stevens, Sunil Mathew, ―Java We Services Architecture, Elsevier, 2003.
2. Ron Schmelzer et al. ― XML and Web Services, Pearson Education, 2002. Frank P.Coyle, ―XML, Web Services and the Data Revolution, Pearson Education, 2002

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COMPUTER SCIENCE AND ENGINEERING
INTERNET OF THINGS (D56PE4A)

Semester VI **L/T/P C**
3/0/0 3

Course Objectives:
To Explore the interconnection and integration of the physical world and the cyber space and design & development steps of IoT Devices.

Course Outcomes:
Upon completion of this course the students will be able to :,
1. Apply the basic concepts of IoT by designing and constructing both physical and logical IoT systems, incorporating enabling technologies and appropriate deployment templates. L3
2. Analyze the management of IoT systems using NETCONF and YANG, addressing the need for system management, network operator requirements, and the application of the Simple Network Management Protocol (SNMP) in IoT environments. L4
3. Apply Python programming concepts including data types, functions, modules, file handling, Exception and packages to design and implement logical components of IoT systems. L3
4. Apply programming techniques on IoT physical devices and analyze the integration of IoT physical devices with cloud offerings to enhance the functionality of IoT systems. L3
5. Analyze the effectiveness of IoT solutions in real-world case studies, identifying challenges and optimizing system performance for home automation, environmental monitoring, and agriculture. L4

UNIT I
Introduction to Internet of Things
Definition and Characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels and Deployment Templates Domain Specific IoTs – Home automation, Environment, Agriculture, Health and Lifestyle

UNIT II
IoT and M2M
M2M, Difference between IoT and M2M, SDN and NFV for IoT, IoT System Management with NETCOZF, YANG- Need for IoT system Management, Simple Network management protocol, Network operator requirements, NETCONF, YANG, IoT Systems Management with NETCONF-YANG

UNIT III
IoT Systems
Logical design using Python-Introduction to Python – Python Data types & Data structures, Control flow, Functions, Modules, Packaging, File handling, Data/Time operations, Classes, Exception, Python packages of Interest for IoT

UNIT IV
IoT Physical Devices and Endpoints:
Raspberry Pi, Linux on Raspberry Pi, Raspberry Pi Interfaces, Programming Raspberry PI with Python, Other IoT devices. IoT Physical Servers and Cloud Offerings – Introduction to Cloud Storage models and communication APIs, WAMP-AutoBahn for IoT, Xively Cloud for IoT, Python web application framework –Django, Designing a RESTful web API

UNIT V

Case studies:

Home Automation, Environment-weather monitoring-weather reporting- air pollution monitoring, Agriculture.

Text Book:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547.

Reference Book:

1. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.

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COMPUTER SCIENCE AND ENGINEERING

MOBILE COMPUTING
(D56PE4B)

Semester VI **L/T/P C**
3/0/0 3

Course Objective:
To provide students with a thorough understanding of mobile communication principles, functionalities of mobile devices, and the various protocols and services involved in mobile networks.

Course Outcomes:
Upon completion of this course the students will be able to :
1. Identify mobile communication principles and functionalities of mobile devices for data dissemination. L3
2. Identify the services and protocols of GSM, and various MAC protocols for wireless communication scenarios. L3
3. Identify he functionalities of IP and Mobile IP network layers and alternative transport layer protocols for specific mobile network scenarios. L3
4. Classify database hoarding, delivery techniques and analyze the context aware and power aware mobile computing techniques for broadcasting the data. L4
5. Identify the principles of MANETs, wireless LANs, wireless application protocols and application development platforms to make informed decisions in mobile application development. L3

UNIT I
MOBILE COMMUNICATIONS
Mobile Communication, Mobile Computing, Mobile Computing Architecture, Mobile Devices, Mobile System Networks, Data Dissemination, Mobility Management, Security.
MOBILE DEVICES AND SYSTEMS:
Cellular Networks and Frequency Reuse, Mobile Smart phones, Smart Mobiles, and Systems, Handheld pocket Computers, Handheld Devices, Smart Systems, Limitations of Mobile Devices.

UNIT II
GSM AND OTHER 2G ARCHITECTURES:
GSM – Services, System Architecture, Radio Interfaces, Protocols, Localization, Calling, Handover, Security, New Data Services, GPRS, CSHSD, DECT.
Medium Access Control (MAC):
Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA,.

UNIT III
Mobile IP Network Layer:
IP and Mobile IP Network Layers, Packet Delivery and Handover Management, Location Management, Registration, Tunneling and Encapsulation, Route Optimization, DHCP, VoIP, TCP over 2.5G/3G Mobile Networks.
Mobile Transport Layer:
Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other Transport Layer Protocols for Mobile Networks.

UNIT IV

DATABASES AND MOBILE COMPUTING:

Database Hoarding Techniques, Data Caching, Client-Server Computing for Mobile Computing and Adaptation, Adaptation Software for Mobile Computing, Power-aware Mobile Computing, Contextaware Mobile Computing

DATA DISSEMINATION AND SYSTEMS FOR BROADCASTING:

Classification of Data Delivery Mechanisms, Data Dissemination, Digital Audio Broadcasting (DAB), Digital Video Broadcasting.

UNIT V

Mobile Adhoc Networks (MANETs):

Introduction to Mobile Ad-hoc Network, MANET, Routing and Routing Algorithms

MOBILE WIRELESS SHORT-RANGE NETWORKS:

Mobile Wireless LAN, 802.11 Architecture, and Protocol Layers, Wircless Application Protocol (WAP), Wircless Application Protocol-WAP 2.0

MOBILE APPLICATION DEVELOPMENT PLATFORMS:

Windows Mobile and CE, Windows Phone 7, Android, Symbian

Text Books:

1. Mobile Computing by Raj Kamal second edition Oxford Higher Education.

Reference Books:

1. Jochen Schiller, ―Mobile Communications‖, Addison-Wesley, Second Edition, 2004.
2. Stojmenovic and Cacute, ―Handbook of Wireless Networks and Mobile Computing‖, Wiley, 2002, ISBN 0471419028.
3. Reza Behravanfar, ―Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML‖, ISBN: 0521817331, Cambridge University Press, Oct, 2004.
4. Jochen Schiller, ―Mobile Communications‖, Addison-Wesley, Second Edition, 2009.
5. Ad hoc Wireless Networks, Architectures and Protocols, C.Siva Ram Murthy and B.S.Manoj.

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COMPUTER SCIENCE AND ENGINEERING

AUGMENTED REALITY & VIRTUAL REALITY
(D56PE4C)

Semester VI **L/T/P C**
3/0/0 3

Course Objectives:
To provide students with a comprehensive understanding of Augmented Reality (AR) and Virtual Reality (VR) technologies, familiarize with diverse AR concepts, offer historical and contemporary insights into virtual reality, covering the basics of sensation, perception, and the technical and engineering components of VR systems.

Course Outcomes:
Upon completion of this course the students will be able to :

1. Identify the working of AR systems and list the applications of AR	L3
2. Construct the software architectures of AR.	L3
3. Develop the Visual perception and rendering in VR.	L3
4. Compare the interaction, auditory perception and rendering in VR.	L4
5. Distinguish motion in real and Virtual Worlds	L4

UNIT I
Introduction to Augmented Reality:
Augmented Reality - Defining augmented reality, history of augmented reality, Examples, Related fields
Displays:
Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial DisplayModel, Visual Displays
Tracking:
Tracking, Calibration, and Registration, Coordinate Systems, Characteristics of TrackingTechnology, Stationary Tracking Systems, Mobile Sensors.

UNIT II
Computer Vision for Augmented Reality:
Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Outdoor Tracking.
Interaction:
Output Modalities, Input Modalities, Tangible Interfaces, Virtual User Interfaces on RealSurfaces, Augmented Paper, Multi-view Interfaces, Haptic Interaction.
Software Architectures:
AR Application Requirements, Software Engineering Requirements, Distributed Object Systems, Dataflow, Scene Graphs

UNIT III
Introduction to Virtual Reality:
Defining Virtual Reality, History of VR, Human Physiology and Perception
The Geometry of Virtual Worlds:
Geometric Models, Axis-Angle Representations of Rotation, Viewing Transformations
Light and Optics:
Basic Behavior of Light, Lenses, Optical Aberrations, The Human Eye, Cameras, Displays

UNIT IV

The Physiology of Human Vision:

From the Cornea to Photoreceptors, From Photoreceptors to the Visual Cortex, Eye Movements, Implications for VR

Visual Perception:

Visual Perception - Perception of Depth, Perception of Motion, Perception of Color.

Visual Rendering:

Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates, Immersive Photos and Videos

UNIT V

Motion in Real and Virtual Worlds:

Velocities and Accelerations, the Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection

Interaction:

Motor Programs and Remapping, Locomotion, Social Interaction

Audio:

The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering

Text Books:

1. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India;First edition (12 October 2016),ISBN-10: 9332578494.
2. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016

Reference Books:

1. Allan Fowler-AR Game Development‖, 1st Edition, A press Publications, 2018, ISBN 978-1484236178
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009
4. Designing for Mixed Reality, Kharis O'Connell Published by O'Reilly Media, Inc., 2016, ISBN: 9781491962381Sanni Siltanen- Theory and applications of marker-based augmented reality. Julkaisija – Utgivare Publisher. 2012. ISBN 978-951-38-7449-0
5. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.

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COMPUTER SCIENCE AND ENGINEERING

Semester VI **L/T/P C**
3/0/0 3

SOFTWARE PROJECT MANAGEMENT (D56PE4D)

Course Objective:
To equip students with the principles, techniques, methods and tools necessary for model-based management of software projects.

Course Outcomes:
Upon completion of this course the students will be able to :
1. Apply various software development models and economic principles to effectively manage software projects and make informed decisions in real-world project environments. L3
2. Identify the strategies to reduce software product size, improve software processes, enhance team effectiveness, and transition to modern iterative development methodologies. L3
3. Analyze life cycle phases, manage artifacts, and implement model-based software architectures from both managerial and technical perspectives in developing software projects. L4
4. Analyze the software process workflow and apply planning guidelines to effectively organize project tasks and activities. L4
5. Analyze the core metrics, tailor the software development processes and forecast the future trends in software project management. L4

UNIT I
Conventional Software Management
The waterfall model, RAD model, Iterative model, Spiral model, Prototype model and COCOMO model, conventional software management performance.
Evolution of Software Economics: Software economics, pragmatic software cost estimation.

UNIT II
Improving Software Economics
Reducing software product size, improving software process, improving team effectiveness. Improving automation, Achieving required quality, peer inspections. The old way and the new the principles of conventional software engineering. Principles of modern software management, transitioning to an iterative process.

UNIT III
Life Cycle Phases
Engineering and production stages, inception, elaboration, construction, transition phases. Artifactsof the process: the artifact sets. Management artifacts, engineering artifacts, programmatic artifacts. Model based software architectures: A Management perspective and technical perspective.

UNIT IV

Work Flows of the Process

Software process workflow, Inter trans workflows. Checkpoints of the process: Major Mile stones, Minor Milestones, periodic status assessments. Iterative process planning work breakdown structures, planning guidelines, cost and scheduled estimating, interaction, planning process, pragmatic planning. Evolution of Project Organization, Project Organizations and responsibilities, Line-of-Business organization.

UNIT V

Project Control and Process Instrumentation:

The seven core metrics, management indicators, and quality indicators. Life cycle expectations, pragmatic software Metrics, Metrics Automation. Tailoring the Process: Process discriminates, example. Future Software Project Management, Modem project profiles next generation software economics modem process transitions.

Text Books:

1. Software Project Management. Walker Royce, Pearson Education.

Reference Books:

1. Applied Software Project Management, Andrew Stebian, & Jennifer Greene, O'Reilly 206.
2. Software Engineering Project Management. Richard H. Thayer & Edward Yourdon, Second edition, Wiley India, 204.
3. Software Project Management in Practice Pankaj Jalote Pearson education.
4. Software Project Management, Bob Hughes & Mike Cotterell, fourth edition, Tata MC Graw Hill.

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COMPUTER SCIENCE AND ENGINEERING

Semester VI **L/T/P C**
0/0/2 1

DevOps Lab (D56PC20)

Course Objectives:
To equip students with the skills to effectively apply DevOps principles and tools in the software development lifecycle.

Course Outcomes:
Upon completion of this course the students will be able to:

1. Apply DevOps tools for software application development.	L3
2. Apply different project management, integration and development tools	L3
3. Develop Selenium tool for automated testing of application	L3

List of Experiments
1. Write code for a simple user registration form for an event.
2. Explore Git and GitHub commands.
3. Practice Source code management on GitHub. Experiment with the source code in exercise 1.
4. Jenkins installation and setup, explore the environment.
5. Demonstrate continuous integration and development using Jenkins.
6. Explore Docker commands for content management.
7. Develop a simple containerized application using Docker.
8. Integrate Kubernetes and Docker
9. Automate the process of running containerized application for exercise 7 using Kubernetes.
10. Install and Explore Selenium for automated testing.
11. Write a simple program in JavaScript and perform testing using Selenium.
12. Develop test cases for the above containerized application using selenium

Text Books:
1. Joakim Verona., Practical DevOps, Packt Publishing, 2016.

Reference Books:
1. Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's Viewpoint. Wiley Publications.
2. Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addiso Wesley.

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COMPUTER SCIENCE AND ENGINEERING

Semester VI **L/T/P C**
0/0/2 1

MACHINE LEARNING LAB (D56PC21)

Course objectives:
The objective of this course is to provide students with hands-on experience in applying machine learning techniques using Python.

Course outcomes:
Upon completion of this course the students will be able to:
1. Build predictive models from data and analyze their performance L3
2. Implement multiple classification algorithms (logistic regression, decision tree, KNN). L3
3. Apply various functions and methods provided by the libraries Math, NumPy, and SciPy , Pandas for data manipulation and data preprocessing. L3

List of Experiments:
1. Write a python program to compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion: Variance, Standard Deviation
2. Study of Python Basic Libraries such as Statistics, Math, Numpy and Scipy
3. Study of Python Libraries for ML application such as Pandas and Matplotlib
4. Write a Python program to implement Simple Linear Regression
5. Implementation of Multiple Linear Regression for House Price Prediction using sklearn
6. Implementation of Decision tree using sklearn and its parameter tuning
7. Implementation of KNN using sklearn
8. Implementation of Logistic Regression using sklearn
9. Implementation of K-Means Clustering
10. Performance analysis of Classification Algorithms on a specific dataset (Mini Project)

Text Book:
1. Machine Learning – Tom M. Mitchell, - MGH.

Reference Book:
1. Machine Learning: An Algorithmic Perspective, Stephen Marshland, Taylor & Francis.

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COMPUTER SCIENCE & ENGINEERING

Semester VI **L/T/P C**
0/0/0 0

INTELLECTUAL PROPERTY RIGHTS (MC003)

Course objective:
To understand the importance of intellectual property audits in managing and protecting intellectual assets.

Course outcomes:
Upon completion of this course the students will be able to :
1. Identify key organizations, agencies, and treaties related to the protection of intellectual property. L3
2. Analyze methods for selecting, registering, and evaluating trademarks to ensure effective protection. L4
3. Identify the rights granted to copyright holders, such as reproduction and public performance rights. L3
4. Identify issues related to patent ownership rights and transferability. L3
5. Examine legal protections against unfair competition, including rights of publicity and false advertising. L4

UNIT I
Introduction to Intellectual property:
organizations, agencies and treaties, importance of intellectual property rights.

UNIT II
Introduction, types of intellectual property, international Trade Marks:
Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

UNIT III
Law of copy rights:
Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.
Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT IV
Trade Secrets:
Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.
Unfair competition: Misappropriation right of publicity, false advertising.

UNIT V
New development of intellectual property:
new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

Text Books & References:

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata