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<th>Course Code</th>
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**Abbreviations:** L- Lectures, P –Practical, T- Tutorial, ISE- In Semester Exam, ESE - End Semester Exam, ICA- Internal Continuous Assessment, ESE - University Examination (Theory &/ POE &/Oral examination)

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<tr>
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**Abbreviations:** L- Lectures, P –Practical, T- Tutorial, ISE- In Semester Exam, ESE - End Semester Exam, ICA- Internal Continuous Assessment, ESE - University Examination (Theory &/ POE &/Oral examination)
<table>
<thead>
<tr>
<th>Elective I</th>
<th>Elective II</th>
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<tr>
<td>CS414A : Internet of Things</td>
<td>CS415A : Business Intelligence</td>
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<td>CS414B : Wireless Adhoc Networks</td>
<td>CS415B : Data Mining</td>
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<td>CS414C : Artificial Intelligence</td>
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<td>CS424A : Software Testing and Quality Assurance</td>
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<td>CS423B : Human Computer Interaction</td>
<td>CS424B : Cloud Computing</td>
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<td>CS423C : Artificial Neural Network</td>
<td>CS424C : Machine Learning</td>
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**Note:** Appropriate electives may be added or deleted as and when required.

**Note:**
- Batch size for the practical /tutorial shall be of 15 students. On forming the batches, if the strength of remaining student exceeds 7, then a new batch shall be formed.
- Vocational Training (evaluated at B.E. Part-I) of minimum 15 days shall be completed in any vacation after S.E. Part-II but before B.E. Part-I & the report shall be submitted and evaluated in B.E. Part-I.
- Appropriate Elective I & II Subjects may be added when required.
- Curriculum for Humanities and Social Sciences Self Learning Modules is common for all under graduate programmes of faculty of Engineering and Technology.
- Project group for B.E.(CSE) Part I and Part II shall be of size 4 to 5 students.
- Term work assessment shall be a continuous process based on student’s performance in – class tests, assignments, homework, subject seminars, quizzes, laboratory books and their interaction and attendance for theory and lab sessions as applicable.
Introduction
This course introduces the concepts of Advanced Computer Architecture such as parallel computer models, pipelining & superscalar techniques. It also focuses on multiprocessor, multicomputer, data parallel architecture, parallel models, languages and compilers.

COURSE PREREQUISITE:
Students shall have the knowledge of Digital System, Microprocessor and Computer Organization.

COURSE OBJECTIVE:
1. To distinguish multiprocessors and multicomputers.
2. To compare the performance of conventional linear and non linear pipelines.
3. To organize several interconnection models.
4. To classify parallel programming models.

COURSE OUTCOME:
At the end of the course, student will be able to
1. Compare multiprocessors and multicomputer.
2. Elaborate the performance of conventional linear and non linear pipelines.
3. Identify several interconnection model.
4. Compare parallel programming models.

SECTION I
Unit 1: Parallel Computer Models

Unit 2: Processor and Memory Hierarchy

Unit 3: Pipelining and Superscalar Techniques
Linear Pipeline Processors: Asynchronous and Synchronous Models, Clocking and Timing Control, Speedup, Efficiency and Throughput. Nonlinear Pipeline Processor: Reservation and Latency Analysis, Collision-Free Scheduling, Pipeline Schedule Optimization. Superscalar and Super
pipeline Design: Superscalar Pipeline Design, Super pipelined Design, Super symmetry and Design Tradeoffs

SECTION II

Unit 4: Multiprocessors and Multicomputers (8)

Unit 5: Introduction to Data Parallel Architecture and SIMD Architecture (7)
Introduction, Connectivity: Near neighbors, Tree and graphs, The pyramid, The hypercube, Reconfigurable networks. SIMD Architectures: Introduction, Design Space, Fine grained SIMD architectures (Overview, Massively Parallel Processor, Programming and applications), Coarse grained SIMD architecture (Overview, CM5, Programming and applications)

Unit 6: Parallel Models, Languages and Compilers (7)

Internal Continuous Assessment (ICA): In tutorial sessions, students of different batches should be assigned exercise problems and should be guided for the solution.
ICA shall consist of minimum ten assignments from the below list.
1. Explain the architectural evolution from sequential scalar computers to vector processors and parallel computers.
2. Explain Flynn’s classification of computer architecture and Bell’s taxonomy of MIMD computers.
3. Differentiate between CISC and RISC Scalar Processors.
4. Explain the following Page Replacement Policies: Least recently used (LRU), Optimal (OPT), First-in-first-out (FIFO), Least frequently used (LFU), Circular FIFO, Random Replacement.
5. Consider the following reservation table for a four stage pipeline with a clock cycle $\tau = 20$ ns:

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<tr>
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</table>

(a) What are the forbidden latencies and the initial collision vector?
(b) Draw the state transition diagram for scheduling the pipeline.
(c) Determine the MAL associated with the shortest greedy cycle.
(d) Determine the pipeline throughput corresponding to the MAL and given $\tau$.
(e) Determine the lower bound on the MAL for this pipeline. Have you obtained the optimal latency from the above state diagram?
6. Consider the five stage pipelined processor specified by the following reservation table:

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<td>S5</td>
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</table>

(a) List the set of forbidden latencies and collision vector.
(b) Draw the state transition diagram showing all possible initial sequences (cycles) without causing a collision in the pipeline.
(c) List all the simple cycles from the state diagram.
(d) Identify the greedy cycles among the simple cycles.
(e) What is the minimum average latency (MAL) of this pipeline?

7. Explain broadcast capability of an Omega network built with 4x4 switches.
8. Explain the following terms:
   - Network stages, Blocking versus Non blocking Networks, Crossbar Network, Cross point Switch Design, Crossbar limitations and Multiport Memory.
9. With neat diagram explain the different connectivity between the processing elements.
10. With neat diagram explain the Massively Parallel Processor (MPP) processing element and CM5 processing element.
11. With neat diagram explain the two basic mechanisms for inter process communication (IPC)
12. Explain the following three major phases of parallelizing compiler.
   - Flow analysis, Optimizations and Code generation.

Text Books
1. Advanced Computer Architecture - Parallelism, Scalability, Programmability-Kai Hwang-Tata McGraw Hill (Unit 1,2,3,4,6)
2. Advanced Computer Architectures-A design Space Approach-Dezso Sima,Terence Fountain, Peter Karsuk - PEARSON (Unit 5)

Reference Books
2. Computer Architecture - A Quantitative Approach, John L. Hennessy and David A.Patterson, Elsevier
PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
B.E. (COMPUTER SCIENCE & ENGINEERING)
SEMESTER - I
CS 412 : DISTRIBUTED SYSTEMS

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<th>Teaching Scheme</th>
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<td>ICA - 25 Marks</td>
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COURSE OBJECTIVES:
1. Provide the fundamental concepts of Distributed operating systems, its design issues and challenges in modes of communication of distributed systems and their implementation.
2. Expose students to current technology for enhancement of distributed computing infrastructures with various computing principles and paradigms.
3. Provide experience in analyzing a distributed computing model and implementing typical algorithms related to synchronization, deadlock detection and avoidance used in distributed systems.
4. Enhance students’ understanding of key issues related to principles of Distributed file systems and provides case study of stand-alone general purpose distributed file system of Hadoop.

COURSE OUTCOME:
At the end of the course, student will be able to
1. Describe the basics of distributed systems and middleware.
2. Design and simulate distributed system software modules using various methods, strategies, and techniques presented in the course that fulfils requirements for desired properties.
3. Apply principles of distributed systems in a real world setting across multidisciplinary areas.
4. Apply knowledge of Hadoop Distributed File system, its architecture and working for active research at the forefront of these areas.

SECTION I

Unit 1 : Fundamentals

Unit 2: Message Passing
Introduction, Desirable features of Good Message-Passing System, Issues in IPC by Message Passing, Synchronization, Buffering, Multidatagram Messages, Encoding and Decoding of Message Data, Process Addressing, Failure Handling, Group communication, Case Study: RMI, CORBA

Unit 3 : Remote Procedure Calls
Introduction, The RPC Model, Transparency of RPC, Implementing RPC mechanism, Stub Generation, RPC Messages, Marshalling Arguments and Results, Server Management, Parameter-Passing Semantics, Call Semantics, Communication Protocols for RPCs, Client-Server Binding, Exception Handling, Security
Unit 4 : Synchronization in Distributed Systems (6)
Introduction, Process Migration, Threads, Clock Synchronization, Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms, Issues in Designing Distributed System and role of middleware in Distributed System

SECTION – II

Unit 5 : Distributed Mutual Exclusion (5)

Unit 6 : Distributed Deadlock Detection (5)
Introduction, Preliminaries, Deadlock handling strategies in Distributed Systems, Issues in Deadlock Detection and Resolution, Control organizations for distributed deadlock detection, Centralized deadlock detection algorithms, Distributed deadlock detection algorithms, Avoidance and Prevention algorithms, Hierarchical deadlock detection algorithms

Unit 7 : Distributed File Systems (6)

Unit 8 : Distributed Shared Memory (6)
Introduction, Architecture and Motivation, Algorithms for implementing DSM, Memory Coherence, Coherence Protocols, Design issues, Case studies - Linda

Internal Continuous Assessment (ICA):
Minimum 10 assignments on above topics which will ensure assessment of Course outcomes listed.

Text books:
1. Distributed O.S Concepts and Design, P.K.Sinha, PHI (Unit 1,2,3,4)
2. Advanced concepts in Operating Systems, Mukesh Singhal & N.G.Shivaratri, TMH (Unit 5,6,7,8)
3. Distributed Computing, Sunita Mahajan, Seema Shah, OXFORD University Press (Unit 1, Case studies 7,8)

Reference Books:
1. Distributed System Principles and Paradigms, Andrew S. Tanenbaum, 2nd edition, PHI
2. Distributed Systems, Colouris, 3rd Edition
PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR 
B.E. (COMPUTER SCIENCE & ENGINEERING) 
SEMESTER - I 
CS 413 : MODERN DATABASE SYSTEMS 

Teaching Scheme | Examination Scheme 
----------------|----------------- 
Lectures– 4 Hours/week, 4 Credits | ESE – 70 Marks 
Practical – 2 Hour/week, 1 Credit | ESE – 30 Marks 
ISE – 30 Marks 
ICA - 25 Marks 
POE – 50 marks 

COURSE OBJECTIVES: 
1) Introduce different databases like distributed, parallel & object oriented databases. 
2) Acquaint with Query processing and its phases including query optimization. 
3) Illustrate data mining & warehousing with OLAP implementations. 
4) Demonstrate Bigdata with Hadoop & its components. 

COURSE OUTCOME: 
At the end of the course, student will be able to 
1) Differentiate between Distributed & Parallel databases. 
2) Implement object oriented databases, mining concepts. 
3) Implement different query processing algorithms. 
4) Tabulate SQL, NoSQL & New SQL with its applications. 
5) Articulate technologies like Hadoop, MongoDB, Cassandra, Pig , Hive 

SECTION-I 
Unit 1 : Database System architectures (8) 
Centralized & C/S architectures, Server systems, Distributed systems, Distributed databases – homogeneous & heterogeneous databases, Distributed data storage, Distributed transactions, Commit protocols, Concurrency control in distributed databases, Availability, Distributed query processing, Heterogeneous distributed databases 

Unit 2 : Parallel Databases (7) 
Introduction, I/O parallelism, Inter-query parallelism, Intra-query parallelism, Intra-operation parallelism, Inter-operation parallelism 

Unit 3 : Data Analysis and Mining (8) 
Introduction to decision support, OLAP: Multidimensional Data Model, Multidimensional Aggregation Queries, Window Queries in SQL: 1999, Implementation Techniques for OLAP, Data Warehousing, Introduction to data mining, The knowledge Discovery Process, Counting co-occurrences, Mining for rules, Clustering, Similarity search over sequences 

SECTION-II 
Unit 4 : Object Based Databases (6) 
Overview, Complex Data Types, Structured Types and Inheritance in SQL, Table Inheritance, Array and Multisets Types in SQL, Object Identity and Reference Types in SQL, Object Oriented DBMS versus Object Relational DBMS
Unit 5: Query Processing & Optimization (6)
Overview of query processing, Measure of query cost, Selection Operation, Sorting, Join Operation, Other Operation, Evaluation of Expression, Overview of optimization, Transformation of Relational Expressions, Estimating Statistics of Expression Results, Choice of Evaluation plans

Unit 6: BIG data and HADOOP & No SQL (8)
Big data, characteristics of Big data, introduction to HADOOP, High level architecture of HADOOP, HDFS file system architecture, special feature of HADOOP, working with HADOOP commands, working of MAP reduce with an example. Getting started with NoSQL, Key value stores, Document databases, New SQL, Postgre SQL

Internal Continuous Assessment (ICA):
Practical Assignments (minimum 10 to be implemented):
1. Implement 2 PC protocol.
2. Implement join operation on n relations using parallelism approach.
3. Implement the Round Robin partitioning for parallel database environment.
4. Implement the Hash partitioning for parallel database environment.
5. Implement the Range partitioning for parallel database environment.
6. Implement Interquery parallelism in parallel databases.
7. Implementation of intraquery parallelism using multithreading
8. Implement Range partitioning Sort algorithm using intraquery parallelism through interoperation
9. Implementation of Asymmetric fragment & replicate join
10. Write a program to join r1 r2 r3 r4 using Independent Parallelism for Inter-operation parallelism.
11. Implement OLAP queries.
12. Implement algorithm for finding Frequent Itemsets for a given minimum support.
13. Implement algorithm for finding association rules for given minimum support and confidence.
15. Implement queries for type inheritance and table inheritance.

Text Book:

Reference Books:
COURSE OBJECTIVES:
1) To acquaint with Internet of Things.
2) To identify the Architecture and various elements of an IoT System
3) To understand the IoT standards and connectivity protocols
4) To make students aware of security concerns and challenges while implementing IoT solutions

COURSE OUTCOME:
At the end of this course, students will be able to
1) Explain what Internet of Things is
2) Describe components of IoT Architecture and platforms of IoT ecosystem
3) Describe and choose Sensors and Actuators

SECTION – I

Unit 1: Introduction to IoT (6)
Definition, Applications and characteristics of IoT, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technologies, IoT Levels

Unit 2: IoT Architecture and Communication Technologies (7)
IoT Architecture by Oracle, Sources of IoT, M2M Communication, IoT/M2M systems, layers and design standards, Communication Technologies

Unit 3: Elements of IoT (8)
Sensor Technology, Participatory Sensing – Industrial IoT and Automotive IoT, Actuator, Sensor Data Communication Protocols, RFID, WSN Technology

SECTION – II

Unit 4: IoT Standards and Connectivity (8)
Constrained Application Protocols (CoAP), Representational State Transfer (REST), Zigbee / IEEE 802.15.4, Bluetooth and its low energy profile, IEEE 802.15 WPAN, 6LoWPAN

Unit 5: IoT Security and Business model (7)
Introduction to IoT Privacy, Security and Vulnerabilities, Use case and Misuse cases, IoT Security Tomography and Layered attacker model, Business model and business model innovation for IoT, Value Creation in the IoT, Business model scenarios for IoT
Unit 6: Case Studies

Domain Specific IoTs: Home Automation, Smart Cities, Environments, Energy, Agriculture, Industry, Health and Lifestyle

Text Book:
1. Internet of Things: A Hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press (Unit 1 and 6)
2. IoT Architecture and Design Principles, Raj Kamal, McGraw Hill Education (Unit 2, 3 & 5)
3. Building the IoT with IPv6 and MIPv6, Daniel Minoli, Wiley Publication (Unit 4)

Reference Books:
1. The Internet of Things: Applications and Protocols, Wiley publications. Author(s): Oliver Hersent, David Boswarthick, Omar Elloumi
Introduction:
This course introduces Fundamentals and basic knowledge of Wireless networks. It also covers the details MAC protocol, Routing protocol, Multicast routing, TLP, QOS, Energy management of ad-hoc network.

COURSE PREREQUISITE: Students should have knowledge of Data Communication and Computer Network

COURSE OBJECTIVES:
1. To introduce fundamentals of wireless ad-hoc networks.
2. To learn design constraints of MAC and routing protocol for wireless ad-hoc networks.
3. To learn security challenges at transport layer of wireless ad-hoc networks.
4. To learn Quality and energy management parameters in wireless ad-hoc networks.

COURSE OUTCOME:
At the end of this course, students will be able to
1. Explain the concept of ad-hoc and sensor networks, their applications and typical node and network architectures.
2. Explain routing protocol design issues (especially energy-efficiency) and protocol designs for wireless ad-hoc networks
3. Identify the issues in designing Security Protocols for Ad-hoc networks focusing on the working performance of various security protocols.
4. Differentiate protocol designs in terms of their energy-efficiency and Quality of service.

SECTION I
Unit 1: Introduction (6)

Unit 2 : MAC for wireless ad-hoc network (6)

Unit 3 : Routing protocols (6)
Introduction, Issues in designing a routing protocol for ad hoc wireless networks, Classification of routing protocols,
- Table driven protocols :- Destination Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP)
- On-demand routing protocol :- Dynamic Source Routing (DSR), Ad Hoc On-Demand Distance Vector Routing (AODV),
- Hybrid routing protocol :-Zone Routing Protocol (ZRP)
SECTION-II

Unit 4: Multicast Routing in Ad hoc wireless networks

Unit 5: Transport Layer and Security Protocols

Unit 6: Quality of service and Energy management

Text Books:

Reference Books:
1. AdHoc Networking by Charles E. Perkins (Pearson Education)
2. Ad Hoc Wireless Networks – A communication Theoretic perspective by O.K. Tonguz & G. Ferrari, Wiley India.
Introduction:
Artificial Intelligence is a major step forward in how computer systems adapt, evolve, and learn. It has widespread application in almost every industry and is considered to be a big technological shift, similar in scale to past events such as the industrial revolution, the computer age, and the smartphone revolution.

This course will give an opportunity to gain expertise in one of the most fascinating and fastest growing areas of Computer Science through classroom programs that cover fascinating and compelling topics related to human intelligence and its applications in industry, defense, healthcare, agriculture, and many other areas.

Course Prerequisite: Knowledge of Data Structures and Algorithms.

COURSE OBJECTIVE:
The course will give the students a rigorous, advanced, and professional graduate-level foundation in Artificial Intelligence.

COURSE OUTCOMES:
At the end of this course, students will be able to:
1. Build intelligent agents for search and games
2. Learning optimization and inference algorithms for model learning
3. Design and develop programs for an agent to learn and act in a structured environment.

Unit 1 Introduction (03)
Concept of AI, history, current status, scope of agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph, and Search tree.

Unit 2 Search Algorithms (09)
Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search.

Unit 3 Probabilistic Reasoning (12)
Probability, conditional probability, Bayes Rule, Bayesian Networks - representation, construction and inference, temporal model, hidden Markov model.

Unit 4 Markov Decision Process (12)
MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.

Unit 5 Reinforcement Learning (09)
Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning - Q learning.
**Text Books:**

**Reference Books:**
PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
B.E. (COMPUTER SCIENCE & ENGINEERING)
SEMESTER - I
CS 415 A : ELECTIVE – II : BUSINESS INTELLIGENCE

Teaching Scheme
Lectures : 3 Hours /week, 3 credits
Tutorial : 1 Hour/Week, 1 credit

Examination Scheme
ESE : 70 Marks
ISE : 30 Marks
ICA : 25 Marks

COURSE OBJECTIVE:
1. To acquaint the students with advanced database techniques.
2. To develop skills to build business intelligence using data mining
3. To optimize decision making in business.

COURSE OUTCOME:
At the end of the course, student will be able to
1. Demonstrate concepts of business intelligence and data mining.
2. Apply theoretical and practical skills to address different data types.
3. Apply data mining techniques in business context.
4. Design a data model and use relevant techniques for data analysis.
5. Implement conventional data mining software, and evaluate its strength and limitations.

SECTION – I

Unit 1 : Introduction to Business Intelligence:
Effective and timely decisions, role of mathematical models, BI architectures, ethics on BI.
Introduction to data warehouse, architecture, OLAP

Unit 2 : Decision Support System:
Representation of decision making system, evolution of information system, definition and
development of decision support system, mathematical models for decision making.

Unit 3 : Analysis of Data Mining:
Definition and applications of data mining, data mining process, analysis methodologies, data
preparation, data validation, data transformation, data reduction, data exploration, Univariate
analysis, Bivariate analysis, Multivariate analysis.

SECTION – II

Unit 4 : Machine learning and Data analysis
Regression, simple and multiple regression, validation of regression models, time series, evaluating
and analysis of time series, exponential smoothing models, autoregressive models.

Unit 5 : Data mining Techniques for BI:
Classification and its problems, evaluating classification models, classification trees, Bayesian
methods, neural networks, structure of association rules, Apriori algorithm, general association rules,
clustering methods, partition methods and hierarchical methods.

Unit 6 : Business Intelligence Applications:
Marketing models: Relational marketing, Salesforce management, Business case studies, supply
chain optimization, optimization models for logistics planning, revenue management system,
Logistics business case studies.
Text Book:
2. Data Mining and Business Intelligence by S.K. Shinde and Uddagiri Chandrashekhar

Reference Books:
1. Data Warehousing in the Real World – Anahory & Murray, Pearson Edt.
2. Data Warehousing Fundamentals – Ponniah [Wiley Publication]

Term work assessment shall be a continuous process based on student’s performance in – class tests, assignments, homework, subject seminars, quizzes, laboratory books and their interaction during theory
Teaching Scheme
Lectures: 3 Hours/week, 3 credits
Tutorial: 1 Hour/Week, 1 credit

Examination Scheme
ESE: 70 Marks
ISE: 30 Marks
ICA: 25 Marks

COURSE OBJECTIVES:
1. To acquire the basic concepts and techniques of Data Mining
2. To understand the usage of Data Mining
3. To learn different data preprocessing techniques.
4. To learn and analyze different data mining algorithms.
5. To apply the data mining algorithms for problem solving.

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Examine the types of data to be mined for a particular application.
2. Apply preprocessing statistical methods for any given raw data.
3. Select and apply proper data mining algorithms to build analytical applications.
4. Comprehend the roles that data mining plays in various fields and manipulate different data mining techniques.
5. Demonstrate and apply a wide range of clustering, classification, and association rule mining algorithms.

SECTION I
UNIT 1: Introduction
Why data Mining, What is Data Mining?, Basic data mining tasks, What kind of Data can be mined, What kinds of Patterns can be mined?, technological support for data mining, target applications of data mining, major issues in data mining, KDD process, Data mining Vs Knowledge Discovery in Databases.

UNIT 2: Data Preprocessing
Need to Preprocess the data, major tasks in Data Preprocessing, Data Cleaning, Data integration, Data Reduction, Data Transformation and Data Discretization.

UNIT 3: Classification
Issues in Classification, Statistical-Based Algorithms: Regression, Bayesian Classifiers, Distance Based Algorithms: K-Nearest Neighbors Classifiers, Decision Tree Based Algorithms, Neural Network-Based Algorithms, Rule Based Algorithms.

SECTION II
UNIT 4: Cluster Analysis - Basic Concept and Methods

UNIT 5: Association Rules (8)

UNIT 6: Web Mining (4)

Internal Continuous Assessment (ICA):
Minimum 8 to 10 assignment based on above topics.

Text Books:
1. Margaret H. Dunham, “DATA MINING Introductory and Advanced Topics”, PEARSON (Units 3,5,6)
2. Han, Kamber, Pei, “DATA MINING Concept and Techniques”, 3rd Edition, ELSEVIER (Units 1,2,4)
3. Tan, Vipin Kumar, Steinbach, “Introduction to Data Mining”, PEARSON (Unit 3)

Reference Books:
CS 415 C : ELECTIVE – II : OBJECT ORIENTED MODELING & DESIGN

Teaching Scheme
Lectures - 3 Hours/Week, 3 Credits
Tutorial - 1 Hours/Week, 1 Credit

Examination Scheme
ESE - 70 Marks
ISE - 30 Marks
ICA - 25 Marks

COURSE OBJECTIVE:
1. Model and design real world problems.
2. Analyze the risk factor for software development project.
3. Develop the skills to determine which process of object oriented Analysis and design technique should be applied to a given project.

COURSE OUTCOME:
At the end of this course, students will be able to
1. List the objects of Unified Modeling Language for a given problem statement.
2. Explain the working understanding of the object oriented analysis and design.
3. Apply the knowledge of object oriented modeling and design to the given software development project.
4. Devise the real world problem using object oriented modeling technique.

SECTION-I

Unit 1 : Introduction
Object Oriented development and themes, evidence for usefulness, modeling as a Design Technique.

Unit 2 : Object Modeling
Objects, classes, links and associations, generalization and inheritance, grouping constructs, aggregation, abstract classes, generalization as extension and restriction, multiple inheritance, metadata, candidate keys and inheritance.

Unit 3 : Dynamic and Functional Modeling
Events, states, operations, concurrency, nested state diagrams, advanced dynamic modeling concepts, relation of object and dynamic models, DFD, relation of functional to object and dynamic models

Unit 4 : Methodology preview and Analysis

SECTION-II

Unit 5 : Behavioral Modeling using UML
Interactions, Use cases, Use case diagram, Interaction Diagrams and Activity diagrams, Events and signals, State Machines, Processes and Threads, Time and space, State chart diagrams.

Unit 6 : Architectural Modeling using UML
Components, Deployment, Collaboration, Patterns and Frame works, Component diagrams and Deployment Diagrams
Unit 7 : Implementation of OMT
Use of programming language and database system, Object oriented style, feature of object oriented languages, Applications of OMT like object diagram compiler, Computer animation, Case study of Hotel management system, course management system

Unit 8 : Design Patterns – 1
What is a pattern and what makes a pattern? Pattern categories; Relationships between patterns; Pattern description Communication Patterns: Forwarder-Receiver; Client-Dispatcher-Server;

ICA :
1. Describe object oriented methodology and themes.
2. Prepare a list of objects that you would expect each of the following system to handle also draw the class and object diagram for the same.
   a. Arithmetic expression b. Air transportation system.
3. Dynamic and Functional Modelling
   a. Draw the state diagram for telephone answering machine. The machine should answer after five rings. If the telephone is answered before five rings, the machine should do nothing.
   b. Design functional model for flight simulator.
5. Draw Use case Diagram for Student Registration System.
6. Draw Sequence and collaboration diagram for buying online product.
7. Draw Deployment diagram for Home Network. (Hint: Modern homes usually have a network of interconnected devices of different kinds and with various types of connections and communication protocols. It contains cable modem, wireless router, various computers and devices.)
8. Draw Component diagram for online examination system.
9. What is a Design pattern and what makes a pattern? Describe Pattern categories and Relationships between patterns.

Textbook:
1. Object oriented Modeling and Design: Rambaugh, Premerlani, Eddy, Lorenson (PHI )

Reference Books:
CS 416 : PROGRAMMING WITH PYTHON

Teaching Scheme
Lectures: 2 Hours/Week, 2 Credit
Practical: 2 Hours/Week, 1 Credit

Examination Scheme
POE: 50 Marks
ICA: 25 Marks

COURSE OBJECTIVES:
1. Introduce procedural and object-oriented style for writing Python scripts.
2. Introduce standard library packages and modules in Python.
3. To teach debugging and profiling of Python scripts.

COURSE OUTCOME:
At the end of this course, students will be able to
1. Use Python standard library modules in writing Python scripts for problem solving.
2. Write Python scripts in procedural and object-oriented style.
3. Write Python scripts to perform database, network and web related operations.
4. Debug and profile Python scripts.

SECTION - I

Unit 1: Introduction to Python
Introducing the Python Interpreter, Program Execution, Execution Model Variations, The Interactive Prompt, System Command Lines and Files. Syntactic and semantic differences between Python 2.x and Python 3.x.

Unit 2: Introduction to procedural programming in Python
Data types, Collection data types, Control structures and functions, Exception Handling, Custom Functions

Unit 3: Modules and packages
String handling, command line programming, time and dates, JSON handling, File and directory handling, Create, read, write delete, and rename files, Traverse directories, Concurrent Execution, Internationalization, PyPI: Python Package Index, pypi.python.org/pypi, Using pip to install python packages from PyPI

SECTION - II

Unit 4: Object oriented programming
Classes, Instance Objects, Method Objects, Class and Instance Variables, Attributes and methods, Inheritance and polymorphism

Unit 5: Database connectivity in Python
DBM databases, Executing Queries, SQL databases

Unit 6: Network and Web Programming
Networking and Interprocess Communication, Interacting with HTTP services as a client, Creating TCP, UDP Server, Creating Simple REST based interface, Authenticating Clients, Understanding Event-Driven I/O.
Unit 7: Testing, Debugging and exceptions (05)
Testing output, Unit tests in Python, Handling Multiple exceptions, creating custom exceptions, Debugging programs, Unit testing and profiling

ISE Evaluation:
ISE Evaluation for the course will consists of three programming tests based on above topics.

ICA:
Minimum 20 assignments based on above topics.
- Students should undertake minimum of 20 practical assignments based on each above topic.
- The assignments should test and develop student’s practical proficiency and ability to use Python standard library modules and packages efficiently in writing effective code for varied applications scenarios & requirements, use cases.
- Use of IDEs like PyCharm, Eclipse with PyDev, Jupyter Notebook for Interactive development and debugging of Python applications is highly recommend to enhance hands on skills in Python Programming of Students.
- Every assignment shall be performed under Python 2.x or 3.x runtime environment configured using any of the following tools 1) pyenv 2) virtualenv 3) Anaconda

Text Book:
1. e-Resource : Python 2.7.16 documentation https://docs.python.org/2/
2. e-Resource : Python 3.7.3 documentation https://docs.python.org/3/

Reference Books:
2. Learning Python FIFTH EDITION Mark Lutz
3. Programming Python (English) 4th Edition Mark Lutz
COURSE OBJECTIVES:

1. To understand basic infrastructure and strategy for information systems.
2. To make student learn professional ethical codes of conduct as appropriate to industry and organizational environments.
3. To introduce the Communication Technology required for IT.
4. To make student learn to develop secure information system.

COURSE OUTCOME:

At the end of this course, students will be able to

1. Elaborate basic infrastructure and strategies used in information systems.
2. Apply professional ethical codes of conduct as appropriate to industry and organizational environments.
3. Design information systems using principles of Communication Technologies.
4. Develop secure information systems.

SECTION-I

Unit 1: Information Systems in Global Business Today  (08)
The Role of Information Systems in Business Today, How information systems are transforming business, What is new in information system, Business Processes and Information systems, Systems for collaboration and social business, Tools and technologies for collaboration and social business.

Unit 2: Information Systems, Organizations, and Strategy (06)
Organizations and it’s features, How Information Systems Impact on Organizations, Competitive strategies using information systems, Challenges posed by strategic information systems.

Unit 3: Ethical and Social Issues in Information Systems (06)
Understanding Ethical, Social, political issues raised by information systems, principles for conduct in ethical decisions, Contemporary information systems technology, Challenges to the protection individual privacy and intellectual property.

SECTION-II

Unit 4: IT Infrastructure and Emerging Technologies (05)
IT Infrastructure, Infrastructure Components, Contemporary Hardware Platform Trends, Contemporary Software Platform Trends, Management Issues.

Unit 5: Foundations of Business Intelligence: Databases and Information Management (08)
Organizing Data in a Traditional File Environment, Major Capabilities of Database Management Systems, Using Databases to Improve Business Performance and Decision Making, Managing Data Resources, Telecommunications, the internet, and Wireless Technology: Principles Components of
Telecommunications Network & Ket Networking Technologies, Different types of networks, principle technologies and standards for wireless networking, communication, internet access.

**Unit 6: Securing Information Systems**
(06)
System Vulnerability and Abuse, Business Value of Security and Control, Organizational Framework for Security and Control, Technologies and Tools for safeguarding Information Resources

**Unit 7: E-commerce: Digital Markets, Digital Goods**
(06)

**Internal Continuous Assessment (ICA)**:
Teacher should prepare a group of 4-5 students (or based on their project group) assign them any case study based on the above chapters and tell them to collect and present that case study in the form of seminar. Evaluation will be done by teacher by considering different factors. These are few topics for case study, teacher can suggest any other topic for case study
1. **IT application in Management: BSNL CDR project (Call-Data-Record)**
2. **Information System Software: Case study on DSS for ITC, Big Bazaar, Raymond Clothing’s**
3. **Application of MIS in different Functional Area: AADHAR Based Biometric Attendance System implemented in all government organizations: [www.attendance.gov.in](http://www.attendance.gov.in)**
4. **Information system resource management: IRCTC next Generation Ticketing System**
5. **Ecommerce: A comprehensive case study on FLIPKART, SNAPDEAL, MYNTRA etc**
6. **ERP: One Case study on each module of ERP**
7. **Mc Donald’s supply chain management (SCM)**
8. **Cognizant implementation of People soft (Human Resource Management System)**
9. **Tata Motors CRM DMS Project (CRM)**
10. **AICTE, New Delhi (SAP CRM Project)**
11. **VRL Implementation of SCM (Logistics & Supply Chain Management)**

**Text Book:**

**Reference Books:**
2. Management Information Systems: Shubhalakshmi Joshi, Smita Vaze, Biztantra

**Note:** Teacher can make a group of 4-5 students (or based on their project group) & assign Case Study given in the textbook (Sr.No.1) Evaluation will be done by teacher by considering different factors.
CS 422 – INFORMATION and CYBER SECURITY

Teaching Scheme
Lectures: 3 Hours/Week, 3 credits
Practical: 2 Hours/Week, 1 credit

Examination Scheme
ESE: 70 Marks
ISE: 30 Marks
ICA: 25 Marks
POE: 50 Marks

COURSE OBJECTIVES:
1. Provide an understanding of principal concepts, major issues, technologies, and basic approaches in information security.
2. Provide concept-level hands-on experience in specific topic area.
3. Provide the ability to examine and analyze real-life security cases.

COURSE OUTCOME:
At the end of this course, students will be able to
1. Explain different security technology and policies
2. Identify & evaluate Information security threats & vulnerabilities in information system and apply security measures to real time scenario
3. Demonstrate the use of standards and cyber laws to enhance information security in the development process and infrastructure protection
4. Demonstrate application of block chain technology

SECTION – I

Unit 1: Symmetric Ciphers

Unit 2: Block Cipher and Data Encryption Standard
Simplified DES, Block Cipher principles, The Data Encryption Standard, The strength of DES, Differential and Linear Cryptanalysis, Block Cipher design principles, Block Cipher Mode of Operation.

Unit 3: Public Key Cryptography
Public Key Cryptography and RSA – Principles of Public Key Cryptosystems, The RSA Algorithm, Key management - Other public key cryptosystems – Key Management, Diffie-Hellman Key Exchange.

Unit 4: Message Authentication and HASH Functions:

SECTION – II

Unit 5: IP Security and E-Mail Security
Layer Security.
Electronic Mail Security – Secure Electronic Transaction, Pretty Good Privacy, S/MIME

**Unit 6: Introduction to block chain** (7)
Overview of block chain, public ledgers, bit coin, smart contracts, block in a block chain, transactions, DISTRIBUTED CONSENSUS, public vs private clock chain, understanding cryptocurrency in block chain, permissioned model of block chain, overview of security aspect of block chain

**Unit 7: Cyber law and forensic** (7)
Introduction, Cyber security regulation, role of International law, the state and private sector in cyberspace, cyber security standards, the Indian cyberspace
Introduction to forensic, cyber evidence, web attack investigation, internet crime investigation, internet forensics

**Internal Continuous Assessment (ICA):**
It should consist of the 08-10 practical based on following guidelines
1) Implementation of Substitution Cipher
2) Implementation of Poly alphabetic Cipher (Vigenere Cipher and Vernam Cipher)
3) Implementation of Transposition Cipher
4) Implementation of Play fair Cipher
5) Implementation of Secure file transfer in Client/Server environment (use any one of above method for encryption and decryption).
6) Write a program to simulate RSA algorithm.
7) Install and understand docker container.
8) Create and deploy a block chain network
9) Study different cybercrimes and implement a system to detect any one cyber crime

**Text Book:**
1. Williams Stallings–Cryptography and Network security principles and practices. Pearson Education (LPE) (Unit I to V)
3. Neena godbole “information system security”

**Reference Books:**
COURSE OBJECTIVES:
1) Explain need for Big Data Analytics
2) Develop ability to analyze and process Big Data.
3) Build necessary skills to write Map Reduce programs for analyzing Big Data problems.

COURSE OUTCOME:
At the end of this course, students will be able to
1) Identify need for Big Data analysis
2) Analyze and identify Big data processing technology for analyzing the Big data.
3) Write Map Reduce programs to process Big Data by identifying the use case.

SECTION – I

Unit 1: Introduction to Types of Digital Data
Classification of Digital Data, Structured Data, Sources of structured data, Ease with Structured data, Semi-Structured data, sources of semi-structured data, Unstructured data, sources of unstructured data, Issues with terminology, Dealing with unstructured data, Place me in the basket.

Unit 2: Introduction to Big Data
Big data, What is big data? Why big data?, Other characteristics of data which are not definitional traits of big data, Challenges with big data, Big data stack, Exercises - Puzzle, Fill in the blanks.

Unit 3: Big Data Analytics
Big Data Analytics, Analytics 1.0, Analytics 2.0, Analytics 3.0, Traditional BI vs. Big Data Environment, Terminologies used in Big Data Environment, Big Data Technology Landscape, NoSQL Databases, NoSQL Vs. RDBMS, NewSQL, Hadoop, Hadoop 1.0 vs. Hadoop 2.0, Exercises, Data Science is multidisciplinary, Data Scientist - Your new best friend.

Unit 4: Introduction to Hadoop

SECTION – II

Unit 5: Introduction to MongoDB
Recap of NoSQL databases, MongoDB – CRUD, MongoDB- Arrays, Java Scripts, Cursors, Map Reduce Programming, Aggregations.
Unit 6: Introduction to Cassandra
Features of Cassandra, CQLSH - CRUD, Collections, Counter, List, Set, Map, Tracing.

Unit 7: Introduction to Hive

Unit 8: Introduction to Pig
Introducing Pig, History and Anatomy of Pig, Pig on Hadoop, Pig Philosophy, ETL Processing, Pig Latin Overview, Word count example using Pig.

Internal Continuous Assessment (ICA):
1. Objective of assignments should be to test students understanding and assess their ability to put into practice the concepts and terminologies learned.
2. Assignments must be of nature, which require students to identify the use case scenarios for using technologies mentioned in syllabus.

Text Book:
1. Big Data and Analytics, Seema Acharya, Subhashini Chellappan, - Wiley India Pvt. Ltd.
5. Programming Pig, by Alan Gates - O'reilly Media.

Reference Book:
1. Big Data For Dummies, Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, by Wiley Brand.
2. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses (Wiley CIO), Michael Minelli, Michele Chambers, Ambiga Dhiraj : John Wiley & Sons.
PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
B.E. (COMPUTER SCIENCE & ENGINEERING)
SEMESTER - II
CS 423 B : ELECTIVE – III : HUMAN COMPUTER INTERACTION

Teaching Scheme Examination Scheme
Lectures : 3 Hours /week Theory: 70 Marks
Tutorial : 1 Hour/Week ISE: 30 marks
ICA : 25 Marks

COURSE OBJECTIVES:
1) Know how to analyze and consider user’s need in the interaction system 2) Understand various interaction design techniques and models 3) Understand the theory and framework of HCI 4) Understand and analyze the cognitive aspects of human – machine interaction

COURSE OUTCOME :
At the end of this course, students will be able to
1) To develop good design for human machine interaction system
2) Analyze the user’s need in interaction system
3) To design new interaction model to satisfy all types of customers
4) Evaluate the usability and effectiveness of various products
5) To know how to apply interaction techniques for systems

SECTION-I

Unit 1 (5)

Unit 2 (5)
Design Process - Interaction design basics, HCI in the software process, Design rules, Implementation support, Evaluation techniques, Universal design, User support

Unit 3 (5)
Models and Theories0 Cognitive models, Socio-organizational issues and stakeholder requirements, Communication and collaboration models, Task analysis, Dialogue notations and design, Models of the system, Modelling rich interaction

Unit 4 (6)
Interaction Styles- Direct Manipulation and Virtual Environments, Menu Selection, Form Filling and Dialog Boxes, Command and Natural Languages, Interaction Devices, Collaboration and Social Media Participation

SECTION-II

Unit 5 (5)
Design Issues- Quality of Service, Balancing Function and Fashion, User Documentation and Online Help, Information Search, Information Visualization

Unit 6 (5)
Outside the Box- Group ware, Ubiquitous computing and augmented realities, Hypertext, multimedia, and the world wide web Text
Unit 7  
Information Search and visualization - Introduction, Search in Textual Documents and Database Querying, Multimedia Document Searches, Advanced Filtering and Search Interfaces, Information Visualization, OAI Model for Website Design.

Unit 8  
Hypertext, Multimedia and the world wide web, Introduction, Understanding hypertext, Web technology and issues, Static web content, dynamic web content

Internal Continuous Assessment (ICA) :
Minimum 10 to 12 assignments based on above topics.

Text Books :
1. Human Computer Interaction, Alan Dix, Janet Finlay, Gregory Abowd and Russel Beale, Prentice Hall Publication

Reference Book :
PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
B.E. (COMPUTER SCIENCE & ENGINEERING)
SEMESTER - II
CS 423 C : ELECTIVE – III : ARTIFICIAL NEURAL NETWORKS
Teaching Scheme
Lecture : 3 Hours /week
Tutorial : 1 Hour/Week

Examination Scheme
Theory: 70 Marks
ISE: 30 marks
ICA : 25 Marks

COURSE OBJECTIVES:
1. To study different learning rules and compare them.
2. To calculate the performance of neural networks.
3. To apply different optimization techniques to improve learning.
4. To create prototype applications of real world using artificial neural networks.

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Demonstrate different learning rules and compare them.
2. Calculate the performance of neural networks using defined parameters.
3. Apply different optimization techniques to achieve better results of learning.
4. Create prototype applications of real world with the use of artificial neural networks.

SECTION – I
Unit 1 Introduction (4)
Biological neuron, Models of artificial neural networks, neural processing, neural network learning rules

Unit 2 Learning & adaptation (5)
Classification Neural learning rules-Hebbian, perception, Delta, Widrow Hoof, Winner take all outstar learning rule.

Unit 3 Perceptron (4)
Discrete perception as a classifier, Decision and discriminant functions, Linearly non separable patterns. Perceptron training for two class and multiclass dichotomizer.

Unit 4 Multilayer networks (4)
Delta learning rule for multiperceptron layer, Generalized Delta learning rule, Feed forward recall and error back-propagation, Training algorithm.

Unit 5 Performance (4)
Madeline, Network pruning, Marchands, Neural tree and filing algorithm, Prediction network

SECTION – II
Unit 6 Unsupervised learning (5)
Winner take all networks, Hamming networks, Max net, competitive learning K-means clustering and LVQ algorithms, Adaptive resonance theory, ARTI, ALGORITHM, SELF ORGANIZING Kohanens map, Naocognitron.
Unit 7 Associative memories (5)

Unit 8 Optimization techniques (5)

Unit 9 Application of ANN (4)
Character recognition, Speech recognition, Signature verification application, Human face recognition

Internal Continuous Assessment (ICA):
Minimum 8 to 10 assignments on the above topics.

Text Books :
1. Introduction to Artificial Neural Systems – Zurada (JAICO)
2. Elements of Artificial Neural Networks – Mehrotra, Hohan, Ranka (PENRAM)
3. Introduction to Artificial Neural Networks – B. Yegnanarayana (PHI)

Ref. Books :
1. An introduction to ANN by Anderson (PHI)
2. Neural Networks a comprehensive foundation by Haykin (PHI)
3. Elements of ANN by Mohan Ranka (Pearam International)
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**B.E. (COMPUTER SCIENCE & ENGINEERING)**  
**SEMESTER - II**  
**CS 424 A : Elective-IV : 1. SOFTWARE TESTING & QUALITY ASSURANCE**

<table>
<thead>
<tr>
<th>Teaching Scheme</th>
<th>Examination Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures : 3 Hours /Week, 3 Credits</td>
<td>ESE – 70 Marks</td>
</tr>
<tr>
<td>Practical : 2 Hours/ Week, 1 Credit</td>
<td>ISE – 30 Marks</td>
</tr>
<tr>
<td>ICA – 25 Marks</td>
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**COURSE OBJECTIVES :**
1. To learn the principles, techniques and tools of software testing in order to improve the quality of software product.
2. To gain knowledge of the software testing process, various methods of testing, different levels of testing, software quality concepts, assurance & standards.
3. To learn generation and execution of test plan, cases & scripts.
4. To learn manual and automatic software testing & various kinds of testing tools.
5. To discover correctness, completeness and quality of software.
6. To recognize the importance of software testing in Software Development Life Cycle.

**COURSE OUTCOME :**
At the end of this course, students will be able to:
1. Identify what a software bug is, how serious they can be, and why they occur.
2. Test software to meet quality objectives & requirements.
3. Apply testing skills to common testing tasks.
4. Perform the planning and documentation of test efforts.
5. Describe software quality concepts, assurance & standards.
6. Use testing tools to test software in order to improve test efficiency with automation.

**SECTION – I**

**Unit-1: Fundamentals of Software Testing**  

**Unit-2: Methods of Testing**
Software Verification and Validation, Black-Box and White-Box Testing, Static and Dynamic Testing, Black-Box Testing Techniques-Equivalence Partitioning, Data Testing, State Testing, Other White Box Test Techniques. White-Box Testing Techniques-Data Coverage, Code Coverage, Other White Box Test Techniques.

**Unit-3: Levels of Testing**

**Unit-4: System Testing**
SECTION – II

Unit 5: Test Planning & Documentation (8)
Test Planning-The goal of Test Planning, Test Planning Topics, Writing and Tracking Test Cases- The Goal of Test Case Planning, Test Case Planning Overview, Test Case Organization and Tracking, Reporting Bugs- Getting Your Bugs Fixed, Isolating and Reproducing Bugs

Unit 6: Quality Concepts & Software Quality Assurance (6)

Unit 7 Formal Approaches to SQA (6)

Unit 8: Automated Testing and Testing Tools (8)

Reference tutorials:

Internal Continuous Assessment (ICA) :
Minimum 8 assignments based on each topic of above syllabus. Additionally two assignments on use of Selenium for software testing.

Text books:

Reference books:
3. Beautiful Testing: Leading Professionals Reveal How They Improve Software By Adam Goucher, Tim Riley, Publisher O’reilly
4. Foundations of Software Testing By Rex Black, Dorothy Graham, Erik Van Veenendaal, Isabel Evans, Published by Cengage Learning India Pvt Ltd.
5. Lessons Learned in Software Testing by Cem Kaner , James Bach , Bret Pettichord, Publisher Wiley
6. Testing Computer Software Cem Kaner, Jack Falk, Hung Q. Nguyen, Publisher Wiley
PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
B.E. (COMPUTER SCIENCE & ENGINEERING)
SEMESTER - II
CS 424 B : Elective-IV : CLOUD COMPUTING

Teaching Scheme
Lectures : 3 Hours / Week, 3 Credits
Practical : 2 Hours/Week, 1 Credit

Examination Scheme
ESE – 70 Marks
ISE – 30 Marks
ICA – 25 Marks

COURSE OBJECTIVES:
1. Develop knowledge about Cloud computing model and associated concepts, terminologies.
2. Develop skills necessary to identify cloud deployment types and deploy them for various use cases.
3. Build necessary cognizance to identify benefits and challenges of cloud Computing for an IT Organizations in building IT solutions.

COURSE OUTCOME:
At the end of this course, students will be able to
1. Explain the concepts, benefits and challenges of Cloud Computing and the various deployment and service models of Cloud Computing
2. Explain about Virtualization and its types
3. Describe Private & public Cloud and its deployment models

SECTION I
Unit 1 : Overview of Cloud Computing

Unit 2 : Virtualization
Basics of virtualization, Server virtualization, VM migration techniques, Role of virtualization in Cloud Computing.

Unit 3 : Working with Private Cloud

SECTION II
Unit 4 : Working with Public Clouds
What is Public Cloud, Why Public Cloud, When to opt for Public Cloud, Public Cloud Service Models, and Public Cloud Vendors and offerings (IaaS, PaaS, SaaS). Basic compute, storage, networking and IAM services of anyone of AWS/Microsoft Azure/Google Cloud platform

Unit 5 : Overview of Cloud Security
Explain the security concerns in Traditional IT, Introduce challenges in Cloud Computing in terms of Application Security, Server Security, and Network Security. Security reference model, Abuse...
and Nefarious Use of Cloud Computing, Insecure Interfaces and APIs, Malicious Insiders, Shared Technology Issues, Data Loss or Leakage, Account or Service Hijacking, Unknown Risk Profile, Shared security model between vendor and customer in IAAS/PAAS/SAAS, Implementing security in AWS.

**Unit 6: Future directions in Cloud Computing**


**Internal Continuous Assessment (ICA):**
Minimum 10 assignments must be of nature, which require students to identify and implement the use case scenarios for Cloud and Cloud enabled technologies mentioned above.

**Text Book:**

**Reference Book:**
2. Cloud computing: Implementation, management and security By Rittinghouse, John, W.
Teaching Scheme
Lectures: 3 Hours/Week, 3 Credits
Practical: 2 Hours/Week, 1 Credit

Examination Scheme
ESE – 70 Marks
ISE – 30 Marks
ICA – 25 Marks

COURSE OBJECTIVES:
1. To teach necessary fundamental concepts and terminologies used in Machine Learning
2. To develop sound understanding of mathematical fundamentals required to build, evaluate and analyze Machine learning models.

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Interpret the need of machine learning and applications of machine learning.
2. Build machine learning models and validate them.
3. Analyze machine learning models to improve their accuracy.

Unit 1: Introduction to Machine Learning

Unit 2: Offerings of Machine Learning
- **Getting Started with Machine Learning:** Understanding How Machine Learning Can Help, Focus on the Business Problem, Requirement of Collaboration in Machine Learning, Executing a Pilot Project, Determining the Best Learning Model.

Unit 3: Basic mathematics for Machine Learning
- **Getting Started With The Math Basics:** Working with Data, Exploring the World of Probabilities, Describing the Use of Statistics, Interpreting Learning As Optimization, Exploring Cost Functions, Descending the Error Curve, Updating by Mini-Batch and Online.

Unit 4: Validating Machine Learning Models
- **Validating Machine Learning:** Checking Out-of-Sample Errors, Getting to Know the Limits of Bias, Keeping Model Complexity in Mind and Solutions Balanced, Training, Validating, and Testing, Resorting to Cross-Validation. Looking for Alternatives in Validation., Optimizing Cross-Validation Choices, Avoiding Sample Bias and Leakage Traps, Discovering the Incredible Perceptron
• Simplest learning strategies to learn from Data: Discovering the Incredible Perceptron, Growing Greedy Classification Trees, Taking a Probabilistic Turn

Unit 5: Improving Machine Learning Models
• Improving Machine Learning Models: Studying Learning Curves, Using Cross-Validation Correctly, Choosing the Right Error or Score Metric, Searching for the Best Hyper-Parameters, Testing Multiple Models, Averaging Models, Stacking Models, Applying Feature Engineering, Selecting Features and Examples, Looking for More Data

Unit 6: Applications of Machine Learning

Internal Continuous Assessment (ICA) :
Minimum 15 assignments requiring students to design implement and validate machine learning models using either R or Python scripts or any other machine learning toolkits and frameworks like MATLAB, Octave.

Text Books:
1. Machine Learning For Dummies, IBM Limited Edition by Judith Hurwitz, Daniel Kirsch (Published by Wiley, First edition)
2. Machine Learning For Dummies by John Paul Mueller, Luca Massaron (Published by For Dummies; First edition)

Reference Books:
PUNYASHLOK AHILYADEVI HOLKAR SOLAPUR UNIVERSITY, SOLAPUR
B.E. (COMPUTER SCIENCE & ENGINEERING)
SEMESTER - II
CS 425 : WEB TECHNOLOGY

Teaching Scheme
Lectures: 2 Hours/week, 2 credits
Practical: 4 Hours/week, 2 credit

Examination Scheme
POE: 50 Marks
ICA: 25 Marks
ISE: 25 Marks

COURSE OBJECTIVES:
1. Inculcate skills necessary to design, develop and style a web based user interfaces.
2. Develop ability to identify use cases for applying client and server side scripting web technologies.
3. Develop skills necessary to develop efficient, scalable, web based APIs and applications.
4. Develop skills required to create light weight browser based web applications using client side scripting.

COURSE OUTCOMES:
At the end of course, students will be able to
1. Design, develop and apply styling to a web based applications.
2. Analyze requirements of developing web applications and choose client or server side scripting technology.
3. Build efficient and scalable web APIs and applications.
4. Develop light weight browser based functionalities leveraging client side scripting frameworks.

SECTION – I

Unit 1: UI Design:  (3)
CSS3: What is CSS3 – Features of CSS3 – Implementation of border radius, box shadow, image border, custom web font, backgrounds - Advanced text effects(shadow) - 2D and 3D Transformations - Transitions to elements - Animations to text and elements

Unit 2: Responsive Web Design (RWD):  (4)
Responsive Design: What is RWD – Introduction to RWD Techniques – Fluid Layout, Fluid Images and Media queries- Introduction to RWD Framework
Twitter Bootstrap – Bootstrap Background and Features - Getting Started with Bootstrap-Demystifying Grids – Off Canvas - Bootstrap Components - JS Plugins – Customization

Unit 3: Introduction to JavaScript  (4)
Introduction - Core features - Data types and Variables - Operators, Expressions and Statements - Functions & Scope - Objects - Array, Date and Math related Objects - Document Object Model - Event Handling –Browser Object Model - Windows and Documents - Form handling and validations.
Object-Oriented Techniques in JavaScript - Classes – Constructors and Prototyping (Sub classes and Super classes) – JSON –Introduction to AJAX.
Unit 4: RESTful Web Services
REST and the Rebirth of HTTP, RESTful Architectural Principles, The Object Model, Model the URIs, Defining the Data Format, Assigning HTTP Methods, JAX-RS.

SECTION – II
Unit 5: Introduction to Server-side JS Framework – Node.js

Unit 6: Introduction to Client-side JS Framework – Basics of Angular 4.0

Unit 7: Introduction to Client-side JS Framework – Forms and Routing in Angular 4.0
Template Driven Forms - Model Driven Forms or Reactive Forms - Custom Validators - Dependency Injection - Services - RxJS Observables - HTTP - Routing

Unit 8: PHP and MySQL
Introduction to PHP 5 and PHP 6, variables and constants, program flow, functions, arrays and files and directories, Forms and Databases, integration with MySQL applications on PHP

Internal Continuous Assessment (ICA):
1. Objective of assignments should be to test students understanding and assess their ability to put into practice the concepts and terminologies learned.
2. Assignments must be of nature, which require students to identify the use case scenarios for using technologies mentioned in syllabus.

Text Books /Reference Books:
8. Nathan Rozentals, “Mastering TypeScript”, April 2015
12. Web link for TypeScript: https://www.typescriptlang.org/
13. Web link for Angular4.0: https://angular.io/
15. Web link for MongoDB: https://www.mongodb.com/