FACULTY OF ENGINEERING

Syllabus

B.E. (Information Technology) 2015 Course

(With effect from Academic Year 2018-2019)

SAVITRIBAI PHULE PUNE UNIVERSITY

The syllabus is prepared by

B.O.S. in Information Technology, Savitribai Phule Pune University
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PROGRAM EDUCATIONAL OBJECTIVES

The students of Information Technology course after passing out will

1. Graduates of the program will possess strong fundamental concepts in mathematics, science, engineering and Technology to address technological challenges with emerging trends.

2. Possess knowledge and skills in the field of Computer Science & Engineering and Information Technology for analyzing, designing and implementing multifaceted engineering problems of any domain with innovative and efficient approaches.

3. Acquire an attitude and aptitude for research, entrepreneurship and higher studies in the field of Computer Science & Engineering and Information Technology.

4. Learn commitment to ethical practices, societal contributions through communities and life-long intellect.

5. Attain better communication, presentation, time management and team work skills leading to responsible & competent professionals and will be able to address challenges in the field of IT at global level.
PROGRAM OUTCOMES

The students in the Information Technology course will attain:

1. An ability to apply knowledge of computing, mathematics including discrete mathematics as well as probability and statistics, science, engineering and technology.

2. An ability to define a problem and provide a systematic solution with the help of conducting experiments, as well as analyzing and interpreting the data.

3. An ability to design, implement, and evaluate a software or a software/hardware co-system, component, or process to meet desired needs within realistic constraints.

4. An ability to identify, formulate, and provide systematic solutions to complex engineering problems.

5. An ability to use the techniques, skills, and modern engineering technologies tools, standard processes necessary for practice as a IT professional.

6. An ability to apply mathematical foundations, algorithmic principles, and Information Technology theory in the modeling and design of computer-based systems with necessary constraints and assumptions.

7. An ability to analyze the local and global impact of computing on individuals, organizations and society.

8. An ability to understand professional, ethical, legal, security and social issues and responsibilities.

9. An ability to function effectively as an individual or as a team member to accomplish a desired goal(s).

10. An ability to engage in life-long learning and continuing professional development to cope up with fast changes in the technologies/tools with the help of electives, professional organizations and extra-curricular activities.

11. An ability to communicate effectively in engineering community at large by means of effective presentations, report writing, paper publications, demonstrations.

12. An ability to understand engineering, management, financial aspects, performance, optimizations and time complexity necessary for professional practice.

13. An ability to apply design and development principles in the construction of software systems of varying complexity.
### SEMESTER-I

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<td>414456C</td>
<td>3. Usability Engineering</td>
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<td>414456D</td>
<td>4. Multicore and Concurrent Systems</td>
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<td>414456E</td>
<td>5. Business Analytics and Intelligence</td>
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#### Elective II

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<td>414457C</td>
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### Abbreviations:
- **TW**: Term Work
- **TH**: Theory
- **OR**: Oral
- **PR**: Practical
- **Sem**: Semester

Computer Laboratory-VII (Information and Cyber Security + Machine Learning and Application)

Computer Laboratory-VIII (Software Design and Modeling)
## SEMESTER – II

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**Abbreviations:** TW: Term Work TH: Theory OR: Oral PR: Practical Sem: Semester Computer Laboratory-IX (Distributed Computing System) Computer Laboratory-X (Ubiquitous Computing)

### Elective III

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<td>414464B</td>
<td>2. Information storage and retrieval</td>
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<td>414464C</td>
<td>3. Multimedia Techniques</td>
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<td>414464D</td>
<td>4. Internet and Web Programming</td>
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<td>414464E</td>
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### Audit Course-VI

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<td>414469D</td>
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# 414453: Information and Cyber Security

## Teaching Scheme:
- **TH:** 03 Hours/Week
- **Credits:** 03

## Examination Scheme:
- In-Sem (Paper): 30 Marks
- End-Sem (Paper): 70 Marks

### Prerequisites:
1. Data Communication.
2. Computer Network.

### Course Objectives:
1. Understand computer, network and information security.
2. To study operating system security and malwares.
3. To study security issues in internet protocols.
4. To study network defence tools.
5. To learn forensics and investigation techniques.

### Course Outcomes:
By the end of the course, students should be able to:
1. Use basic cryptographic techniques in application development.
2. Apply methods for authentication, access control, intrusion detection and prevention.
3. To apply the scientific method to digital forensics and perform forensic investigations.
4. To develop computer forensics awareness.
5. Ability to use computer forensics tools.

## Unit I: SECURITY BASICS (7 Hrs)

## Unit II: SYMMETRIC AND ASYMMETRIC KEY CRYPTOGRAPHY (7 Hrs)

## Unit III: DATA INTEGRITY ALGORITHMS AND SECURITY REQUIREMENTS (7 Hrs)

## Unit IV: LEGAL, ETHICAL, AND PROFESSIONAL ISSUES IN INFORMATION SECURITY, RISK MANAGEMENT (7 Hrs)

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<td>Introduction, Definition and origin, Cybercrime and Information security, Classification of Cybercrimes, The legal perspectives- Indian perspective, Global perspective, Categories of Cybercrime, Types of Attacks, a Social Engineering, Cyber stalking, Cloud Computing and Cybercrime.</td>
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<th>TOOLS AND METHODS USED IN CYBERCRIME</th>
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<td>Introduction, Proxy servers and Anonymizers, Phishing, Password Cracking, Key-loggers and Spywares, Types of Virus, Worms, Dos and DDoS, SQL injection, Cybercrime and Legal perspectives, Cyber laws- Indian context, The Indian IT Act-Challenges, Amendments, Challenges to Indian Law and cybercrime Scenario in India, Indian IT Act and Digital Signatures. study of any two network security scanners: Nmap, Metasploit, OpenVAS, Aircrack, Snort, Wireshark, Nikito, Samurai, Safe 3 etc.</td>
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**Text Books**


**Reference Books**

# Machine Learning and Applications

## Teaching Scheme:
- TH: 04 Hours/Week
- Credits: 04

## Examination Scheme:
- In-Sem (Paper): 30 Marks
- End-Sem (paper): 70 Marks

## Prerequisites:
- Linear Algebra and Calculus
- Probability Basics

## Course Objectives:
1. Understanding Human learning aspects.
2. Understanding primitives and methods in learning process by computer.

## Course Outcomes:
By the end of the course, students should be able to
1. Model the learning primitives.
2. Build the learning model.
3. Tackle real world problems in the domain of Data Mining and Big Data Analytics, Information Retrieval, Computer vision, Linguistics and Bioinformatics.

## Units

### Unit I
**INTRODUCTION TO MACHINE LEARNING**
- 8 Hrs
  - Types of Learning: Supervised, Unsupervised and Semi-Supervised Learning.
  - Dimensionality Reduction: Introduction to Dimensionality Reduction, Subset Selection, Introduction to Principal Component Analysis.

### Unit II
**CLASSIFICATION**
- 8 Hrs
  - Binary and Multiclass Classification: Assessing Classification Performance, Handling more than two classes, Multiclass Classification-One vs One, One vs Rest
  - Linear Models: Perceptron, Support Vector Machines (SVM), Soft Margin SVM, Kernel methods for non-linearity

### Unit III
**REGRESSION AND GENERALIZATION**
- 8 Hrs
  - Regression: Assessing performance of Regression – Error measures, Overfitting and Underfitting, Catalysts for Overfitting, VC Dimensions
  - Linear Models: Least Square method, Univariate Regression, Multivariate Linear Regression, Regularized Regression - Ridge Regression and Lasso

### Unit IV
**LOGIC BASED AND ALGEBRAIC MODELS**
- 8 Hrs
Distance Based Models: Neighbors and Examples, Nearest Neighbor Classification, Distance based clustering algorithms - K-means and K-medoids, Hierarchical clustering.
Rule Based Models: Rule learning for subgroup discovery, Association rules mining – Apriori Algorithm, Confidence and Support parameters.
Tree Based Models: Decision Trees, Minority Class, Impurity Measures – Gini Index and Entropy, Best Split.

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<td>Deep Learning: The Neuron, Expressing Linear Perceptron as Neurons, Feed Forward Neural Networks, Linear Neurons and their Limitations, Sigmoid, Tanh and ReLU Neurons</td>
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**Text Books**


**Reference Books**

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414455: Software Design and Modeling

Teaching Scheme:
TH: 03 Hours/Week

Credits: 03

Examination Scheme:
In-Sem (Paper): 30 Marks
End-Sem (paper): 70 Marks

Prerequisites:
2. Software Engineering and Project Management.
3. Database Management System.

Course Objectives:
1. To teach the student the fundamental aspects of different object oriented methodologies and unified approach along with Unified Modeling Language (UML), in terms of “how to use” it for the purpose of specifying and developing software.
2. Explore and analyze use case modeling, domain/class modeling.
3. To teach the student Interaction and behaviour modeling.
4. Aware students with design process in software development.
5. Orient students with the software design principles and patterns.
6. Enable students to learn the architectural design guidelines in various type of application development.

Course Outcomes:
By the end of the course, students should be able to
2. Understand analysis process, use case modeling, domain/class modeling
3. Understand interaction and behavior modeling.
4. Understand design process and business, access and view layer class design
5. Get started on study of GRASP principles and GoF design patterns.
6. Get started on study of architectural design principles and guidelines in the various type of application development.

Unit I | OBJECT ORIENTED METHODOLOGIES, UML | 7 Hrs
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<td>a Formal Use Cases, Use Case realizations.</td>
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<td>Designing Business Layer : Object Oriented</td>
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<td>Constraints Language (OCL), Designing</td>
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<td>Business Classes : The Process, Designing</td>
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<td>Well Defined Class Visibility, Attribute</td>
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<td>Refinement, Method Design Using UML</td>
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<td>Activity Diagram, Packaging and Managing</td>
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<td>Classes.</td>
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<td>Designing Access Layer: Object Relational</td>
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<td>Systems, Object Relation Mapping, Table Class</td>
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<td>Mapping, Table – Inherited Classes Mapping,</td>
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<td>Designing the Access Layer Classes: The</td>
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<td>Process, Designing View Layer: View Layer</td>
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<td>Classes Design, Identifying View Classes by</td>
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<td>Analyzing Use Cases, Macro-Level Design</td>
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<td>Process, and Prototyping the User Interface.</td>
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<td>Component and Deployment Design using</td>
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<td>Component and Deployment Diagram.</td>
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<td><strong>Unit V</strong></td>
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<td></td>
<td><strong>DESIGN PRINCIPLES AND PATTERNS</strong></td>
<td>7 Hrs</td>
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<td><strong>Unit V</strong></td>
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<td></td>
<td>Introduction to Patterns</td>
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<td>General Responsibility Assignment Software</td>
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<td></td>
<td>Patterns (GRASP) : Introduction, Creator,</td>
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<td></td>
<td>Information Expert, Low coupling, Controller,</td>
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<tr>
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<td>High Cohesion, Polymorphism, Pure fabrication,</td>
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<td>Indirection, Protected Variations.</td>
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<td>Gang of Four (GoF): Introduction, Categories</td>
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<td>of Patterns (Creational, Structural and</td>
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<td>Behavioral Patterns), Singleton, Adapter,</td>
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<td>State, and Strategy.</td>
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<td><strong>Unit VI</strong></td>
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<td></td>
<td><strong>ARCHITECTURAL DESIGN</strong></td>
<td>7 Hrs</td>
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<td><strong>Overview of software Architecture, Designing</strong></td>
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<td>Client / Server Software Architectures,</td>
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<td>Designing Service Oriented Software Architectures,</td>
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<td>Designing Component Based Software Architectures,</td>
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<td>Designing Concurrent and Real-Time Software Architectures,</td>
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<td>Designing Product Line Architectures, Related Case Studies.</td>
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### Reference Books

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<tr>
<th></th>
<th>Author(s)</th>
<th>Title</th>
<th>Publisher</th>
<th>Edition</th>
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<tbody>
<tr>
<td>1</td>
<td>Martin Fowler</td>
<td><em>UML Distilled</em></td>
<td>Pearson</td>
<td>Third</td>
<td>978-81-317-1565-9</td>
</tr>
<tr>
<td>3</td>
<td>Roger S. Pressman</td>
<td><em>Software Engineering: A Practitioner’s Approach</em></td>
<td>McGraw Hill</td>
<td>Seventh</td>
<td>9339212088, 978939212087</td>
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Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414456A: Elective-I
Wireless Communications

Teaching Scheme: TH:03 Hours/Week
Credits: 03
Examination Scheme:
In-Sem (Paper): 30 Marks
End-Sem (paper): 70 Marks

Prerequisites:
2. Computer Network Technology.

Course Objectives:
1. To provide fundamental knowledge that forms the basis for wireless communication systems and Networks.
2. For creating foundation of cellular concepts which will be useful for understanding the fundamentals of cellular mobile communication systems design.
3. To provide knowledge about the Mobile Radio Propagation models and various wireless channel effects.
4. To Study various Multiple Access techniques.
5. Give Students the exposure to recent emerging trends in wireless communication like Software Defined Radio as well.
6. To Provide overview of recent trends like wireless communication like Wi-Fi, Wi-MAX, bee, UWB Radio and Wireless Adhoc Networks.

Course Outcomes:
By the end of the course, students should be able to
1. Understand the basics of propagation of radio signals.
2. Understand the basic concepts of basic Cellular System and the design requirements.
3. Have an understanding of the basic principles behind radio resource management techniques such as power control, channel allocation and handoffs.
4. Gain insights into various mobile radio propagation models and how the diversity can be exploited to improve performance.
5. Gain knowledge and awareness of the technologies for how to effectively share spectrum through multiple access techniques i.e. TDMA, CDMA, FDMA etc.
6. Have in-depth understanding of the design consideration and architecture for different Wireless Systems like GSM, CDMA, GPRS etc.
7. Understanding of the emerging trends in Wireless communication like WiFi, WiMAX, Software Defined Radio (SDR) and related issues and challenges.

Unit I
INTRODUCTION TO WIRELESS COMMUNICATION SYSTEM
7 Hrs

Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless Communication System, Comparison of Common wireless system, Trend in Cellular radio and personal communication. Second generation Cellular Networks, Third Generation (3G) Wireless Networks, Wireless Local Loop(WLL), Wireless Local Area network(WLAN), Bluetooth and
### Personal Area Networks

#### Unit II  
**THE CELLULAR CONCEPT- SYSTEM DESIGN FUNDAMENTALS**  
7 Hrs

Cellular system, Hexagonal geometry cell and concept of frequency reuse, Channel Assignment Strategies  
Distance to frequency reuse ratio, Channel & co-channel interference reduction factor,  
S/I ratio consideration and calculation for Minimum Co-channel and adjacent interference,  
Handoff Strategies, Umbrella Cell Concept, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular System-cell splitting, Cell sectorization, Repeaters, Micro cell zone concept,  
Channel antenna system design considerations.

#### Unit III  
**MOBILE RADIO PROPAGATION MODEL, SMALL SCALE FADING AND DIVERSITY**  
7 Hrs

Large scale path loss: Free Space Propagation loss equation, Path-loss of NLOS and LOS systems,  
Reflection, Ray ground reflection model, Diffraction, Scattering, Link budget design, Max. Distance Coverage formula, Empirical formula for path loss, Indoor and outdoor propagation models, Small scale multipath propagation, Impulse model for multipath channel, Delay spread, Feher’s delay spread, upper bound Small scale, Multipath Measurement parameters of multipath channels, Types of small scale Fading, Rayleigh and rician distribution, Statistical for models multipath fading channels and diversity techniques.

#### Unit IV  
**MULTIPLE ACCESS TECHNIQUES**  
7 Hrs


#### Unit V  
**WIRELESS SYSTEMS**  
7 Hrs

GSM system architecture, Radio interface, Protocols, Localization and calling, Handover,  
Authentication and security in GSM, GSM speech coding, Concept of spread spectrum, Architecture of IS-95 CDMA system, Air interface, CDMA forward channels, CDMA reverse channels, Soft handoff, CDMA features, Power control in CDMA, Performance of CDMA System,  
RAKE Receiver, CDMA2000 cellular technology, GPRS system architecture.

#### Unit VI  
**RECENT TRENDS**  
7 Hrs


### Text Books

3. Wireless digital communication, KamiloFeher, PHI.  
Reference Books

5. Mobile and personal Communication system and services by Rajpandya, IEEE press (PHI).
6. Wireless Communications-T.L.Singh-TMH.
**Savitribai Phule Pune University**  
Fourth Year of Information Technology (2015 Course)  
414456B: Elective-I  
Natural Language Processing

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<thead>
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<th>Examination Scheme:</th>
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<td>TH:03 Hours/Week</td>
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<td>In-Sem (Paper): 30 Marks</td>
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<td>End-Sem (paper): 70 Marks</td>
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**Prerequisites:**
1. Basic understanding of probability theory.
2. Basic knowledge of finite automata.

**Course Objectives:**
1. To understand the core concepts of Natural language processing and levels of language analysis.
2. To understand the computational properties of natural languages and the commonly used algorithms for processing linguistic information.

**Course Outcomes:**
By the end of the course, students should be able to
1. Understand automatic processing of human languages using computers.
2. Understand various applications of natural language processing.

**Unit I**  
**INTRODUCTION**  
7 Hrs

**Unit II**  
**GRAMMARS**  
7 Hrs

**Unit III**  
**EFFICIENT PARSING**  
7 Hrs

**Unit IV**  
**AMBIGUITY RESOLUTION**  
7 Hrs
Part-of-Speech Tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best-First Parsing, Semantics and Logical Form, Word Senses and Ambiguity, Encoding Ambiguity in Logical Form, Verbs and States in Logical Form.
# Unit V: Linking Syntax and Semantics

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<th>Topic</th>
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# Unit VI: Knowledge Representation

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<th>Topic</th>
<th>Hours</th>
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<tr>
<td>Handling Natural Language Quantification, Time and Aspectual Classes of Verbs, Automating Deduction in Logic-Based Representations, Procedural Semantics and Question Answering, Hybrid Knowledge Representations, Using World Knowledge, Establishing Coherence, Matching Against Expectations, Reference and Matching Expectations, Using Knowledge About Action and Casualty.</td>
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## Text Books


## Reference Books

# Usability Engineering

**Teaching Scheme:**
- TH: 03 Hours/Week
- Credits: 03

**Examination Scheme:**
- In-Sem (Paper): 30 Marks
- End-Sem (paper): 70 Marks

**Prerequisites:**

**Course Objectives:**
1. To explain usability engineering lifecycle for designing a user-friendly software.
2. Discuss usability design guidelines, their foundations, assumptions, advantages, and weaknesses.
3. To develop usability evaluation skills for software testing.
4. To explain industry standards for designing and evaluating use-interfaces.
5. To make aware of the current trends in usability engineering.

**Course Outcomes:**
By the end of the course, students should be able to
1. Justify the theory and practice of usability evaluation approaches, methods and techniques.
2. Compare and evaluate strengths and weaknesses of various approaches, methods and techniques for evaluating usability.
3. Design and implement a usability test plan, based on modelling or requirements specification.
4. Choose appropriate approaches, methods and techniques to evaluate the usability of a specified interactive system.

## Unit I
**INTRODUCTION**
7 Hrs
What is Usability: Usability and Other Considerations, Definition of Usability, Example: Measuring the Usability of Icons, Usability Trade-Offs, Categories of Users and Individual User Differences.
Generations of User Interfaces: Batch Systems, Line-Oriented Interfaces, Full-Screen Interfaces, Graphical User Interfaces, Next-Generation Interfaces, Long-Term Trends in Usability.

## Unit II
**THE USABILITY ENGINEERING LIFECYCLE**
7 Hrs

## Unit III
**USABILITY HEURISTICS**
7 Hrs
### Unit IV  USABILITY TESTING  7 Hrs


Usability Assessment Methods beyond Testing: Observation, Questionnaires and Interviews, Focus Groups, Logging Actual Use, User Feedback, Choosing Usability Methods.

### Unit V  INTERFACE STANDARDS  7 Hrs


### Unit VI  FUTURE DEVELOPMENTS  7 Hrs


Case Study: Usability Issues in Organizations, Organizational Roles and Structures, Ethics of Usability, Web Analytics.

### Text Books


### Reference Books


## Multicore and Concurrent Systems

<table>
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<th>Teaching Scheme:</th>
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<td>TH:03 Hours/Week</td>
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<td>In-Sem (Paper): 30 Marks</td>
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<td>End-Sem (paper): 70 Marks</td>
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### Prerequisites:
2. Processor Architecture and Interfacing.
3. Operating System.
4. Programming Language and Problem Solving.

### Course Objectives:
1. To understand the multicore and concurrent systems.
2. To understand the multicore and concurrent programming aspects.
3. To understand concept of distributed and shared memory programming.
4. To recognize differences in between different concurrent processing approaches and identifying correct one according to architectural and application needs.
5. To know the applications of multicore and concurrent systems and use its programming concepts for new application development.
6. To explore recent trends in multicore and concurrent system programming.

### Course Outcomes:
By the end of the course, students should be able to
1. Know types of parallel machine and to know multicore and concurrent systems in detail.
2. Know the ways to measure the performance of multicore systems.
3. Understand need of multicore and concurrent system programming.
4. Know the different approaches for multicore and concurrent programming.
5. Use and apply the approaches learned, for application development.
6. Understand and explore recent trends in multicore and concurrent system programming.

### Unit I
**INTRODUCTION**
7 Hrs


### Unit II
**MULTICORE AND CONCURRENT PROGRAM DESIGN**
7 Hrs

The PCAM methodology, Decomposition patterns: Task parallelism, Divide-and-conquer decomposition.
### Unit III  
**SHARED-MEMORY PROGRAMMING: THREADS**  
7 Hrs  
Threads, Design concerns, Semaphores, Applying semaphores in classical problems, Monitors, Applying monitors in classical problems, Dynamic vs. static thread management, Debugging multithreaded applications, Higher-level constructs: multithreaded programming without threads: Concurrent Map, Map-Reduce, Concurrent filter, Filter-reduce.

### Unit IV  
**SHARED-MEMORY PROGRAMMING: OPENMP**  
7 Hrs  

### Unit V  
**DISTRIBUTED MEMORY PROGRAMMING**  
7 Hrs  
Communicating processes, MPI, Core Concepts, Program architecture, Point-to-Point communication, Buffered communications, Non-blocking communications, Error reporting and handling, Collective communications, Communicating objects, Node management: communicators and groups, One-sided communications, I/O considerations, Combining MPI processes with threads, Timing and performance measurements, Debugging and profiling MPI programs, The Boost MPI library.

### Unit VI  
**GPU PROGRAMMING**  
7 Hrs  
CUDA's programming model: threads, blocks, and grids, CUDA's execution model: streaming multiprocessors and warps, CUDA compilation process, Memory hierarchy, Optimization techniques, Dynamic parallelism, Debugging CUDA programs, Profiling CUDA programs, CUDA and MPI.

### Text Books


### Reference Books

7. Michael J Quinn, “Parallel programming in C with MPI and OpenMP”, Tata McGraw
Savitribai Phule Pune University  
Fourth Year of Information Technology Engineering (2015 Course)  
414456E: Elective-I  
Business Analytics and Intelligence

Teaching Scheme:  
TH: 03 Hours/Week  
Credits: 03  
Examination Scheme:  
In-Sem (Paper): 30 Marks  
End-Sem (Paper): 70 Marks

Prerequisites:  

Course Objectives:  
1. Apply conceptual knowledge on how business intelligence is used within organizations.  
2. Evaluate organization’s abilities to create and mobilize corporate knowledge.  
3. Select software tools for knowledge management systems in business organizations  
4. Suggest design systems to provide business intelligence.

Course Outcomes:  
By the end of the course, students should be able to  
1. Comprehend the Information Systems and development approaches of Intelligent Systems.  
2. Evaluate and rethink business processes using information systems.  
4. Get acquainted with the Theories, techniques, and considerations for capturing organizational intelligence.  
5. Align business intelligence with business strategy.  
6. Apply the techniques for implementing business intelligence systems.

Unit I  
Decision Making and Decision Support Systems  
7 Hrs

The role of computerized support for decision making and its importance. Types of decisions managers face, and the process through which they make decisions. Decision making styles, the four stages of Simon’s decision making process, and common strategies and approaches of decision makers. The role of Decision Support Systems (DSS), its main components, the various DSS types and classification, and how DSS have changed over time. How DSS supports each phase of decision making and summarize the evolution of DSS applications, and on how they have changed over time.

Unit II  
Business Intelligence Concepts and Platform Capabilities  
7 Hrs

Definition of business intelligence (BI), BI architecture, and its components, and relation with DSS. The main components of BI platforms, their capabilities, and the competitive landscape of BI platforms. The building blocks of business reports, the types of business reports, and the components and structure of business reporting systems. Role of Mathematical model in BI, Factors Responsible for successful BI Project, Obstacle to Business Intelligence in an Organization Different types of OLAP and their applications, and the differences between OLAP and OLTP.
### Unit II

Data Visualization and Dashboard Design

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<tr>
<td>The top job responsibilities of BI analysts by focusing on creating data visualizations and dashboards. The importance of data visualization and different types of data that can be visually represented. The types of basic and composite charts. This will help you to determine which visualization is most effective to display data for a given data set, and to identify best practices for designing data visualizations. Common characteristics of dashboard, the types of dashboards, and the list attributes of metrics usually included in dashboards. The guidelines for designing dashboard and the common pitfalls of dashboard design.</td>
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### Unit IV

Business Performance Management Systems

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<tr>
<td>This module focuses on how BI is used for Business Performance Management (BPM). The main components of BPM as well as the four phases of BPM cycle and how organizations typically deploy BPM. The purpose of Performance Measurement System and how organizations need to define the key performance indicators (KPIs) for their performance management system. Four balanced scorecards perspectives and the differences between dashboards and scorecards. The benefits of using balanced scorecard versus using Six Sigma in a performance measurement system.</td>
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### Unit V

Role of Business Intelligence and Analytics in Business

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<tr>
<td>The role of visual and business analytics (BA) in BI and how various forms of BA are supported in practice. ERP and Business Intelligence, BI Applications in CRM, BI Applications in Marketing, BI Applications in Logistics and Production, Role of BI in Finance, BI Applications in Banking, BI Applications in Telecommunications, BI Applications in Fraud Detection, BI Applications in Retail Industry</td>
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### Unit VI

BI Maturity, Strategy and Modern Trends in BI

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<th>Description</th>
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<tr>
<td>BI maturity and strategy. Different levels of BI maturity, the factors that impact BI maturity within an organization, and the main challenges and the potential solutions for a pervasive BI maturity within an organization. The critical success factors for implementing a BI strategy, BI framework, and BI implementation targets. Open Source BI. Big Data systems. Social BI systems, Geographic BI systems. Customer Experience based BI.</td>
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## Text Books


## Reference Books

# Elective-II
Software Defined Networks

## Teaching Scheme:
- **TH:** 03 Hours/Week
- **Credits:** 03

## Examination Scheme:
- **In-Sem (Paper):** 30 Marks
- **End-Sem (paper):** 70 Marks

### Prerequisites:
1. Prior knowledge of fundamentals of computer network.

### Course Objectives:
1. To understand the limitations of the current technology and need and evolution of SDN.
2. To comprehend role of data, control, and management planes and their separation.
3. To recognize how SDN is coupled with the Open Flow protocol and how green ICT can help improve environmental sustainability.
4. To understand network virtualization and network function virtualization.
5. To know in detail data and control plane in SDN.
6. To study use-cases of SDN.

### Course Outcomes:
By the end of the course, students should be able to
1. Acquire fundamental knowledge of SDN exploring the need, characteristics, and architecture of SDN.
2. Recognize OpenFlow protocols and its forwarding, pipeline model.
3. Understand different methodologies for sustainable SDN.
4. Comprehend IT Infrastructure for SDN.
5. Acquiring knowledge of OpenFlow protocols, visualization.

## Units

<table>
<thead>
<tr>
<th>Unit I</th>
<th>INTRODUCTION TO SDN: AN OVERVIEW</th>
<th>7 Hrs</th>
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<tbody>
<tr>
<td><strong>Introduction:</strong> The Modern Data Center, Roles and Separation of data, control and management planes, Advantages and Disadvantages. Need of SDN, Genesis of SDN. Working of SDN: Fundamental characteristics, SDN Devices, SDN controllers, Applications.</td>
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<tr>
<th>Unit II</th>
<th>OPEN FLOW PROTOCOLS</th>
<th>7 Hrs</th>
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<tr>
<td><strong>Introduction:</strong> Definition, OpenFlow architecture, Flow &amp; Group Tables, types, Hybrid Approaches, The OpenFlow forwarding and pipeline model. OpenFlow Advantages and Limitations, OpenFlow Protocol. Use Case: FloodLight, Mininet,</td>
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<th>Unit III</th>
<th>NETWORK VIRTUALIZATION (NV)</th>
<th>7 Hrs</th>
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<tr>
<td><strong>Definition, Concepts, Benefits of Network Virtualization, Components of a Virtual Network, Applications, Existing Network Virtualization Framework (VMWare and others), Network as a Service (NaaS).</strong></td>
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<td>Unit IV</td>
<td>CONTROL PLANE</td>
<td>7 Hrs</td>
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<tr>
<th>Unit V</th>
<th>DATA PLANE</th>
<th>7 Hrs</th>
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<tr>
<td>Data Plane: Software-based and Hardware-based; Programmable Network, Hardware. Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs.</td>
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<tr>
<th>Unit VI</th>
<th>NETWORK FUNCTIONS VIRTUALIZATION (NFV)</th>
<th>7 Hrs</th>
</tr>
</thead>
</table>

**Text Books**


**Reference Books**

1. Vivek Tiwari, SDN and OpenFlow for Beginners, Digital Services, 10: 1-940686-00-8 13: 978-1-940686-00-4
5. Online Reading, http://www.nec-labs.com/~lume/sdn-reading-list.html,
# Savitribai Phule Pune University

**Fourth Year of Information Technology (2015 Course)**

## 414457B: Elective-II

**Soft Computing**

<table>
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<th>Teaching Scheme:</th>
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<td>TH:03 Hours/Week</td>
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<td>In-Sem (Paper): 30 Marks</td>
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<td>End-Sem (paper): 70 Marks</td>
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## Prerequisites:

1. Linear Algebra and Calculus.
2. Probability Theory.

## Course Objectives:

1. Identifying Soft computing techniques and their roles in problem solving.
2. Generate an ability to build neural networks for solving real life problems.
3. Conceptualize fuzzy logic and its implementation for various real world applications.
4. Apply evolutionary algorithms and Fuzzy logic to solve the problems.
5. Design soft computing systems by hybridizing various other techniques.

## Course Outcomes:

By the end of the course, students should be able to

1. Tackle problems of interdisciplinary nature.
2. Find an alternate solution, which may offer more adaptability, resilience and optimization.
3. Gain knowledge of soft computing domain which opens up a whole new career option.
4. Tackle real world research problems.

## Unit I

### INTRODUCTION


## Unit II

### NEURAL NETWORKS OVERVIEW


## Unit III

### NEURAL NETWORK ARCHITECTURES


## Unit IV

### FUZZY LOGIC AND FUZZY SYSTEMS

7 Hrs

<table>
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<tr>
<th>Unit V</th>
<th>GENETIC ALGORITHMS</th>
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<tr>
<td></td>
<td>Introduction, Encoding, Operators of Genetic Algorithm, Basic Genetic Algorithm, Simple GA, Crossover and Mutation, Multi-objective Genetic Algorithm (MOGA). Genetic algorithms in search and optimization, Ant colony optimization (ACO), Particle Swarm Optimization (PSO). Applications of GA for Clustering.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit VI</th>
<th>ADVANCES IN SOFT COMPUTING</th>
<th>7 Hrs</th>
</tr>
</thead>
</table>

**Text Books**


**Reference Books**

###第四年信息技术（2015课程）

####414457C: 选修II

**软件测试与质量保证**

<table>
<thead>
<tr>
<th>教学方案</th>
<th>时数/周</th>
<th>信用</th>
<th>考试方案</th>
</tr>
</thead>
</table>
| TH:03 | | 03 | 内部学期（论文）: 30分
|  |  |  | 结束学期（论文）: 70分 |

####先决条件
1. 软件工程。

####课程目标
1. 学习应用测试策略和方法在项目中。
2. 了解测试管理策略和工具。
3. 对软件测试和维护中的开放问题有敏锐的意识。
4. 解释质量保证和用于质量管理的各种工具。
5. 了解各种质量保证模型。
6. 了解实现质量的审计和评估程序。

####课程成果
到课程结束时，学生应该能够
1. 测试软件，应用测试技术以交付无错误的产品。
2. 调查场景并选择合适的测试技术。
3. 探索测试自动化概念和工具，以及基于标准度量的成本和时间的估计。
4. 了解如何检测，分类，防止和移除缺陷。
5. 选择合适的质量保证模型并开发质量。
6. 能够进行正式检查，记录和评估检查结果。

####单元I

**软件测试基础**
7小时

测试作为工程活动，过程在软件质量中的角色，测试作为一个过程，基本定义，软件测试原则，测试人员在软件开发组织中的角色，缺陷的起源，缺陷类别，缺陷存储库和测试设计，开发人员/测试人员支持开发缺陷存储库。

####单元II

**测试技术与测试级别**
7小时

采用白盒方法进行测试设计 - 静态测试与结构测试，代码功能测试，覆盖率和控制流图，使用黑盒方法进行测试案例设计，随机测试，基于需求的测试，决策表，基于状态的测试，原因-效应图，错误猜测，兼容性测试，测试级别的测试 - 单元测试，集成测试，缺陷批次消除。系统测试 - 可用性与可访问性测试，配置测试，兼容性测试。

####单元II

**测试技术与测试级别**
7小时

采用白盒方法进行测试设计 - 静态测试与结构测试，代码功能测试，覆盖率和控制流图，使用黑盒方法进行测试案例设计，随机测试，基于需求的测试，决策表，基于状态的测试，原因-效应图，错误猜测，兼容性测试，测试级别的测试 - 单元测试，集成测试，缺陷批次消除。系统测试 - 可用性与可访问性测试，配置测试，兼容性测试。

**Unit III**  
SOFTWARE TEST AUTOMATION AND QUALITY METRICS


**Unit IV**  
FUNDAMENTALS OF SOFTWARE QUALITY ASSURANCE  
7 Hrs

SQA basics, Components of the Software Quality Assurance System, software quality in business context, planning for software quality assurance, product quality and process quality, software process models, 7 QC Tools and Modern Tools.

**Unit V**  
QUALITY ASSURANCE MODELS  
7 Hrs

Models for Quality Assurance, ISO-9000 series, CMM, CMMI, Test Maturity Models, SPICE, Malcolm Baldrige Model - P-CMM.

**Unit VI**  
SOFTWARE QUALITY ASSURANCE TRENDS  
7 Hrs


**Text Books**


**Reference Books**

7. S.A.Kelkar, Software quality and Testing, PHI Learning, Pvt, Ltd.
8. Watts S Humphrey, Managing the Software Process, Pearson Education Inc.
Savitribai Phule Pune University  
Fourth Year of Information Technology (2015 Course)  
414457D: Elective-II  
Compiler Construction

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Credits: 03</th>
<th>Examination Scheme:</th>
</tr>
</thead>
<tbody>
<tr>
<td>TH:03 Hours/Week</td>
<td></td>
<td>In-Sem (Paper): 30 Marks</td>
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<tr>
<td></td>
<td></td>
<td>End-Sem (paper): 70 Marks</td>
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</tbody>
</table>

**Prerequisites:**
1. Fundamentals of System Programming.
2. Computer Organization and architecture.
5. Theory of Computation: DFA, NFA, Regular expressions, Grammars

**Course Objectives:**
1. The aim of this module is to show how to apply the theory of language translation introduced in the prerequisite courses to build compilers and interpreters.
2. It covers the building of translators both from scratch and using compiler generators. In the process, the module also identifies and explores the main and advanced issues of the design of translators.
3. The construction of a compiler/interpreter for a small language is a necessary component of this module, so students can obtain the necessary skills.

**Course Outcomes:**
By the end of the course, students should be able to
1. Understand the structure of compilers.
2. Understand the basic and advanced techniques used in compiler construction.
3. Understand the basic data structures used in compiler construction such as abstract syntax.
4. Cognitive skills (thinking and analysis)- Design and implement a compiler using a software engineering approach.
5. Communication skills (personal and academic).
6. Practical and subject specific skills (Transferable Skills) - Use generators (e.g. Lex and Yacc).

**Unit I FUNDAMENTALS OF COMPILATION 7 Hrs**
Lexical Analysis: Input buffering, Regular Expression, Automata; Parsing: [Limited to] Context free grammar, Predictive parser, LR parsing, Parser generator, error recovery; Syntax and semantics analysis: [Limited to] S and L attributes, dependency graph, DAG and Activation records.

**Unit II MEMORY UTILIZATION 7 Hrs**
Intermediate representations, translation into trees, canonical trees, taming conditional branches, algorithms for instruction selection; Register allocation: coloring by simplification, coalescing, precolored nodes, graph coloring implementation, register allocation for trees;

<table>
<thead>
<tr>
<th>Unit III</th>
<th>OBJECT ORIENTED AND FUNCTIONAL PROGRAMMING LANGUAGE</th>
<th>7 Hrs</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Classes, single inheritance of data field, multiple inheritance, testing class membership, private fields and methods, classless languages, optimizing object oriented programs; Functional Language: closure, Immutable variables, Inline expansion, closure conversion, efficient tail recursion, lazy evaluation.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit IV</th>
<th>POLYMORPHIC TYPES AND DATA FLOW ANALYSIS</th>
<th>7 Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Representation of polymorphic variables, parametric polymorphism, type inference, resolution of static overloading; Data flow analysis: Intermediate representation for flow analysis, various data flow analysis, transformations using data flow analysis, methods/mechanisms for speeding up data flow analysis, alias analysis.</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit V</th>
<th>STATIC SINGLE ASSIGNMENT FORM</th>
<th>7 Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Loop Optimization: Dominators, loop invariant computations, induction variables, array-bounds check, loop unrolling; SSA: Definition of SSA, Informal Semantics of SSA, Comparison with Classical Data-flow Analysis, SSA in Context, Benefits of SSA, Fallacies about SSA, Properties: Preliminaries, Def-Use and Use-Def Chains, Minimality, Optimization algorithms using SSA, converting to and back from SSA form, control dependency.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit VI</th>
<th>PIPELINING AND SCHEDULING</th>
<th>7 Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Loop scheduling without resource bound, resource bounded loop pipelining, branch prediction, cache organization and block alignment, loop interchange, blocking and garbage collection. Modern Compiler in ML: ML-Lex, ML-YACC, Tiger Compiler.</td>
<td></td>
</tr>
</tbody>
</table>

Text Books


Reference Books

# Elective-II
## Gamification

### Teaching Scheme:
- **TH:** 03 Hours/Week
- **Credits:** 03

### Examination Scheme:
- **In-Sem (Paper):** 30 Marks
- **End-Sem (paper):** 70 Marks

### Prerequisites:
1. Discrete Structures.

### Course Objectives:
1. To develop problem solving abilities using gamification.
2. Students will understand gamification paradigm.

### Course Outcomes:
By the end of the course, students should be able to
1. Write programs to solve problems using gamification and open source tools.
2. Apply gamification for Mobile and Web Applications.
3. Solve problems for multi-core or distributed, concurrent/Parallel environments.

### Units
<table>
<thead>
<tr>
<th>Unit</th>
<th>Description</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit I</strong></td>
<td>Gaming Foundations</td>
<td>7 Hrs</td>
</tr>
<tr>
<td><strong>Unit II</strong></td>
<td>Developing Thinking</td>
<td>7 Hrs</td>
</tr>
<tr>
<td><strong>Unit III</strong></td>
<td>Opponent Moves in Gamification</td>
<td>7 Hrs</td>
</tr>
<tr>
<td><strong>Unit IV</strong></td>
<td>Game Design</td>
<td>7 Hrs</td>
</tr>
<tr>
<td><strong>Unit V</strong></td>
<td>Advanced tools, techniques</td>
<td>7 Hrs</td>
</tr>
<tr>
<td><strong>Unit VI</strong></td>
<td>Applications</td>
<td>7 Hrs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Text Books</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mathias Fuchs, Sonia Fizek, Paolo Ruffino, Niklas Schrape, Rethinking Gamification.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference Books</th>
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</thead>
</table>
Savitribai Phule Pune University  
Fourth Year of Information Technology (2015 Course)  
414458: Computer Laboratory VII

Teaching Scheme:  
Practical: 04 Hours/Week  
Credits: 02  
Examination Scheme:  
TW: 50 Marks  
PR: 50 Marks

Prerequisites:  
Knowledge of Programming Languages  
1. Java.  
2. R.  
3. Python.  
4. C++.

Course Objectives:  
1. To Understand the Security issues in networks and Applications software.  
2. To understand the machine learning principles and analytics of learning algorithms.

Course Outcomes:  
By the end of the course, students should be able to  
1. The students will be able to implement and port controlled and secured access to software systems and networks.  
2. The students will be able to build learning software in various domains.

List of Laboratory Assignments  
PART – A (ICS) – (All Mandatory)

Assignment 1  
Write a program in C++ or Java to implement RSA algorithm for key generation and cipher verification.

Assignment 2  
Develop and program in C++ or Java based on number theory such as Chinese remainder.

Assignment 3  
Write a program in C++ or java to implement SHA1 algorithm using libraries (API)

Assignment 4  
Configure and demonstrate use of vulnerability assessment tool such as Snort tool for intrusion or SSL Web security.

PART – B (MLA) (Any Six)

Assignment 1  
Study of platform for Implementation of Assignments  
Download the open source software of your interest. Document the distinct features and functionality of the software platform. You may choose WEKA and R and Python

Assignment 2
Supervised Learning - Regression (Using R)
Generate a proper 2-D data set of N points. Split the data set into Training Data set and Test Data set. i) Perform linear regression analysis with Least Squares Method. ii) Plot the graphs for Training MSE and Test MSE and comment on Curve Fitting and Generalization Error. iii) Verify the Effect of Data Set Size and Bias-Variance Tradeoff. iv) Apply Cross Validation and plot the graphs for errors. v) Apply Subset Selection Method and plot the graphs for errors. vi) Describe your findings in each case

**Assignment 3**
Create Association Rules for the Market Basket Analysis for the given Threshold. (Using R)

**Assignment 4**
Implement K-Means algorithm for clustering to create a Cluster on the given data. (Using Python)

**Assignment 5**
Implement SVM for performing classification and find its accuracy on the given data. (Using Python)

**Assignment 6**
Creating & Visualizing Neural Network for the given data. (Using Python)

**Assignment 7**
On the given data perform the performance measurements using Simple Naïve Bayes algorithm such as Accuracy, Error rate, precision, Recall, TPR, FPR, TNR, FPR etc. (Using Weka API through JAVA)

**Assignment 8**
Principal Component Analysis-Finding Principal Components, Variance and Standard Deviation calculations of principal components. (Using R)

**Reference Books**
1. Open source software-WEKA and R and Python.
2. JAVA 6.1 or more (for RJava Package).
### Teaching Scheme:
- **Practical:** 04 Hours/Week
- **Credits:** 02

### Examination Scheme:
- **TW:** 50 Marks
- **OR:** 50 Marks

### Prerequisites:
2. Software Engineering and Project Management.

### Course Objectives:
1. To teach the student Unified Modeling Language (UML 2.0), in terms of “how to use” it for the purpose of specifying and developing software.
2. To teach the student how to identify different software artifacts at analysis and design phase.
3. To explore and analyze use case modeling.
4. To explore and analyze domain/class modeling.
5. To teach the student Interaction and Behavior Modeling.
6. To Orient students with the software design principles and patterns.

### Course Outcomes:
By the end of the course, students should be able to
1. Draw, discuss different UML 2.0 diagrams, their concepts, notation, advanced notation, forward and reverse engineering aspects.
2. Identify different software artifacts used to develop analysis and design model from requirements.
3. Develop use case model.
4. Develop, implement analysis model and design model.
5. Develop, implement Interaction and behavior Model.
6. Implement an appropriate design pattern to solve a design problem.

### List of Laboratory Assignments

**Assignment 1: Write Problem Statement for System / Project**
Identify Project of enough complexity, which has at least 4-5 major functionalities. Identify stakeholders, actors and write detail problem statement for your system.

**Assignment 2: Prepare Use Case Model**
Identify Major Use Cases, Identify actors.
Write Use Case specification for all major Use Cases.
Draw detail Use Case Diagram using UML2.0 notations.

**Assignment 3: Prepare Activity Model**
Identify Activity states and Action states.
Draw Activity diagram with Swim lanes using UML2.0 Notations for major Use Cases

**Assignment 4: Prepare Analysis Model-Class Model**
Identify Analysis Classes and assign responsibilities.
Prepare Data Dictionary.
### Assignment 5: Prepare a Design Model from Analysis Model

- Study in detail working of system/Project.
- Identify Design classes/ Evolve Analysis Model. Use advanced relationships.
- Draw Design class Model using OCL and UML2.0 Notations.
- Implement the design model with a suitable object-oriented language.

### Assignment 6: Prepare Sequence Model.

- Identify at least 5 major scenarios (sequence flow) for your system.
- Draw Sequence Diagram for every scenario by using advanced notations using UML2.0.
- Implement these scenarios by taking reference of design model implementation using suitable object-oriented language.

### Assignment 7: Prepare a State Model

- Identify States and events for your system.
- Study state transitions and identify Guard conditions.
- Draw State chart diagram with advanced UML 2 notations.
- Implement the state model with a suitable object-oriented language.

### Assignment 8: Identification and Implementation of GRASP pattern

- Apply any two GRASP pattern to refine the Design Model for a given problem description.
- Using effective UML 2 diagrams and implement them with a suitable object oriented language.

### Assignment 9: Identification and Implementation of GOF pattern

- Apply any two GOF pattern to refine Design Model for a given problem description.
- Using effective UML 2 diagrams and implement them with a suitable object oriented language.

### Reference Books

1. UML2 Bible by Tom Pender, Wiley India Pvt. Limited 2011
4. Design Patterns: Elements of Reusable Object Oriented Software, Erich Gamma, Pearson
5. Design Patterns in Java Second Edition by Steven John Metsker, Pearson

All the assignments should be conducted on Latest version of Open Source Operating Systems, tools and Multi-core CPU supporting Virtualization and Multi-.Threading.
Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414460: Project Phase-I

Teaching Scheme: 
TUT: 02 Hours/Week 
Credits: 02 
Examination Scheme: 
OR: 50 Marks

Prerequisites:
1. Project Based Seminar.

Course Objectives:
1. Student should be able implement their ideas/real time industrial problem/ current applications from their engineering domain.
2. Students should be able to develop plans with help of team members to achieve the project's goals.
3. Student should be able to break work down into tasks and determine appropriate procedures.
4. Student should be able to estimate and cost the human and physical resources required, and make plans to obtain the necessary resources.
5. Student should be able allocate roles with clear lines of responsibility and accountability and learn team work ethics.
6. Student should be able to apply communication skills to effectively promote ideas, goals or products.

Course Outcomes:
By the end of the course, students should be able to
1. To show preparedness to study independently in chosen domain of Information Technology and programming languages and apply their acquired knowledge to variety of real time problem scenarios.
2. To function effectively as a team to accomplish a desired goal.
3. An understanding of professional, ethical, legal, security and social issues and responsibilities related to Information Technology Project.

Contents
Project Based Seminar (PBS) helped students to gather, organize, summarize and interpret technical literature with the purpose of formulating a project proposal in third year. Students had also submitted a technical report summarizing state-of-the-art on an identified domain and topic in third year. B.E. Projects can be application oriented and/or will be based on some innovative/ theoretical work. In Project Phase-I the student will undertake project over the academic year, which will involve the analysis, design of a system or sub system in the area identified earlier in the field of Information Technology and Computer Science and Engineering. In some cases; if earlier identified project is not feasible; a new topic must be formulated in consultation with the guide and project coordinator. The project will be undertaken preferably by a group of 3-4 students who will jointly work and implement the project. The group will select a project which is based on seminar delivered in relevant domain in Project based Seminar activity with approval from a committee formed by the department of senior faculty to check the feasibility and approve the topic.
Guidelines for Students and Faculty

- The Head of the department/Project coordinator shall constitute a review committee for project group; project guide would be one member of that committee by default.
- There shall be two reviews in Project phase –I in semester-I by the review committee.
- The Project Review committee will be responsible for evaluating the timely progress of the projects.
- As far as possible Students should finalize the same project title taken for Project Based Seminar (PBS).
- Student should identify Project of enough complexity, which has at least 4-5 major functionalities
- Student should identify stakeholders, actors and write detail problem statement for system
- Review committee should revisit “Feasibility Review” conducted by Examiners during Oral examination in Third year in first week after commencement of the term.
- Review committee should finalize the scope of the project.
- If change in project topic is unavoidable then the students should complete the process of
- Project approval by submitting synopsis along with the review of important papers. This new
- Project topic should be approved by review committee.
- The students or project group shall make presentation on the progress made by them before the committee.
- The record of the remarks/suggestions of the review committee should be properly maintained and should be made available at the time of examination.
- Each student/group is required to give presentation as part of review for 10 to 15 minutes followed by a detailed discussion.
- Students should Revisit and Reassess the problem statement mentioned in the project-based seminar activity.

Review 1: Synopsis –
Deliverables:
1. The precise problem statement/title based on literature survey and feasibility study.
2. Purpose, objectives and scope of the project.
3. List of required hardware, software or other equipment for executing the project, test Environment/tools, cost and human efforts in hours.
4. System overview- proposed system and proposed outcomes.
5. Architecture and initial phase of design (DFD).
6. Project plan 1.0.

Review 2: SRS –
Deliverables:
1. SRS and High level design
2. Detail architecture/System design/algorithms/techniques
3. At least 30-40% coding documentation with at least 3 to 4 working modules
4. Test Results
5. Project plan 2.0
One paper should be published in reputed International conference/International journal based on project work done.

**Project report contains the details as Follows:**

- Contents
- List of Abbreviations
- List of Figures
- List of Graphs
- List of Tables
  1. Introduction and aims/motivation and objectives
  2. Literature Survey
  3. Problem Statement/definition
  4. Project Requirement specification
  5. Systems Proposed Architecture
  6. High level design of the project(DFD/UML)
  7. System implementation-code documentation-algorithm, methodologies, protocols used.
  8. GUI/Working modules/Experimental Results
  9. Project Plan
  10. Conclusions
  11. Bibliography in IEEE format

**Appendices**

- A. Plagiarism Report of Paper and Project report from any open source tool
- B. Base Paper(s)
- C. Tools used
- D. Papers Published/Certificates

➢ Use appropriate plagiarism tools, reference managers, Latex Lyx/latest Word for efficient and effective project writing.

**Term Work:**

➢ The term work will consist of a report and presentation prepared by the student on the project allotted to them.

**Reference Books**

1. UML2 Bible by Tom Pender, Wiley India Pvt. Limited 2011
4. Design Patterns: Elements of Reusable Object Oriented Software, Erich Gamma, Pearson
5. Design Patterns in Java Second Edition by Steven John Metsker, Pearson

All the assignments should be conducted on Latest version of Open Source Operating Systems, tools and Multi-core CPU supporting Virtualization and Multi-Threading
In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement their knowledge and skills. Student will be awarded the bachelor's degree if he/she earns credits and clears all the audit courses specified in the syllabus. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

**Criteria**

The student registered for audit course shall be awarded the grade PP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'PP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA.

**Guidelines for Conduction and Assessment (Any one or more of following but not limited to)**

1. Lectures/ Guest Lectures
2. Visits (Social/Field) and reports
3. Demonstrations
4. Surveys
5. Mini Project
6. Hands on experience on Specific focused topic

**Guidelines for Assessment (Any one or more of following but not limited to)**

1. Written Test
2. Demonstrations/ Practical Test
3. Presentations
4. IPR/Publication
5. Report

**Audit Course V Options**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Audit Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>414461A</td>
<td>1. Emotional Intelligence</td>
</tr>
<tr>
<td>414461B</td>
<td>2. Green Computing</td>
</tr>
<tr>
<td>414461C</td>
<td>3. Critical Thinking</td>
</tr>
<tr>
<td>414461D</td>
<td>4. Statistical Learning model using R.</td>
</tr>
</tbody>
</table>
This Emotional Intelligence (EI) training course will focus on the five core competencies of emotional intelligence: self-awareness, self-regulation, motivation, empathy and interpersonal skills. Participants will learn to develop and implement these to enhance their relationships in work and life by increasing their understanding of social and emotional behaviors, and learning how to adapt and manage their responses to particular situations. Various models of emotional intelligence will be covered.

**Course Objectives:**
1) To develop an awareness of EI models.
2) To recognize the benefits of EI.
3) To understand how you use emotion to facilitate thought and behaviour.
4) To know and utilize the difference between reaction and considered response.

**Course Outcomes:**
By the end of the course, students should be able to,
1) Expand your knowledge of emotional patterns in yourself and others.
2) Discover how you can manage your emotions, and positively influence yourself and others.
3) Build more effective relationships with people at work and at home.
4) Positively influence and motivate colleagues, team members, and managers.
5) Increase your leadership effectiveness by creating an atmosphere that engages others.
6) Apply EI behaviours and supports high performance.

**Unit I**  
Introduction to Emotional Intelligence (EI)

Emotional Intelligence and various EI models, The EQ competencies of self-awareness, self-regulation, motivation, empathy, and interpersonal skills, Understand EQ and its importance in life and the workplace

**Unit II**  
Know and manage your emotions

Emotions, The different levels of emotional awareness, Increase your emotional knowledge of yourself, Recognize ‘negative’ and ‘positive’ emotions. The relationship between emotions, thought and behavior, Discover the importance of values, The impact of not managing and processing ‘negative’ emotions, Techniques to manage your emotions in challenging situations.

**Unit III**  
Recognize Emotions in others

The universality of emotional expression, Learn tools to enhance your ability to recognize and appropriately respond to others' emotions, Perceiving emotions accurately in others to build empathy

**Unit IV**  
Relate to others

Applying EI in the workplace, the role of empathy and trust in relationships, Increase your ability to create effective working relationships with others (peers, subordinates, managers, clients, Find out how to deal with conflict, Tools to lead, motivate others and create a high performing team.

**Books**
Green computing is the study and practice of using computing resources efficiently. Green computing or green IT, refers to environmentally sustainable computing or IT. The goals of green computing are similar to green chemistry; reduce the use of hazardous materials, Maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of defunct products and factory waste.

Course Objectives:
1) To acquire knowledge to adopt green computing practices to minimize negative impacts on the environment.
2) To examine technology tools that can reduce paper waste and carbon footprint by user.
3) To understand how to minimize equipment disposal requirements.
4) To gain skill in energy saving practices in their use of hardware.

Course Outcomes:
By the end of the course, students should be able to,
1) Understand the concept of green IT and relate it to sustainable development.
2) Apply the green computing practices to save energy.
3) Discuss how the choice of hardware and software can facilitate a more sustainable operation.
4) Use methods and tools to measure energy consumption.

Unit I | Fundamentals of Green IT
---|---

Unit II | Green Assets and Power Problems
---|---

Unit III | Green Information Systems
---|---
Initial Improvement Calculations, Selecting Metrics, Tracking Progress, Change Business Processes, Customer Interaction, Paper Reduction, Green Supply Chain, Improve Technology Infrastructure, Reduce PCs and Servers, Shared Services, Hardware Costs, Cooling.

Unit IV | Green Grid Framework
---|---
Virtualizing of IT systems, Role of electric utilities, Telecommuting, teleconferencing and teleporting, Materials recycling, Best ways for Green PC, Green Data center Case Studies, Applying Green IT Strategies and Applications to a Home Hospital, Packaging Industry and Telecom Sector.

Reference Books
2. Alvin Galea, Michael Schaefer, Mike Ebbers, “Green Data Center: steps for the Journey”,
<table>
<thead>
<tr>
<th>Reference</th>
<th>Author</th>
<th>Title</th>
<th>Publisher</th>
<th>ISBN</th>
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</table>
Thinking about one's thinking in a manner designed to organize and clarify, raise the efficiency of, and recognize errors and biases in one's own thinking. Critical thinking is not 'hard' thinking nor is it directed at solving problems (other than 'improving' one's own thinking). Critical thinking is inward-directed with the intent of maximizing the rationality of the thinker. One does not use critical thinking to solve problems—one uses critical thinking to improve one's process of thinking.

**Course Objectives:**

1) Critical thinking is considered among the most important “higher order cognitive skills” expected from students graduating with professional degrees (e.g. engineering, management, etc.)

2) This course will make you a better thinker; it will sharpen your mind, clarify your thoughts, and help you make smarter decisions (especially about your career). It will help you argue assertively and hence make you a forceful communicator – both in public speaking and in one-on-one situations.

3) Most employers complain that fresh graduates need too much of direction and they are incapable of “independent decision making”. We intend to overcome this shortcoming.

**Course Outcomes:**

By the end of the course, students should be able to,

1) If students whole-heartedly participate in the course, they can expect to be smarter, stronger and more confident thinkers.

2) They can embark on a life-long journey of “self-directed learning”.

---

**Unit I**

**Introduction to Critical Thinking**

What is Critical Thinking o It’s role in problem solving o The difference between a critical thinker and one who is not, Barriers that prevent us from thinking critically

---

**Unit II**

**Importance of being logical**

Key concepts of “Thinking fast and slow” - Logical fallacies & Mistakes we make when do not think “statistically”

---

**Unit III**

**Pattern in deductive logic**

Hypothetical syllogism - Categorical syllogism( Set theory concepts), Argument by elimination, based on maths, based on definition, Evaluating deductive arguments validity & soundness

---

**Unit IV**

**Argumentation – Foundation of Critical Thinking**

Recognizing arguments and their structural components & indicator words Analysis of arguments, Categorical logic - VENN Diagrams to test logical “validity”, Propositional logic - Complex statements & arguments, Truth Tables – to test validity of complex statements

---

**Reference Books**


Statistical learning theory is a framework for machine learning drawing from the fields of statistics and functional analysis. Statistical learning theory deals with the problem of finding a predictive function based on data. Statistical learning theory has led to successful applications in fields such as computer vision, speech recognition, bioinformatics and baseball.

### Course Objectives:

1. To get familiar with the explosion of “Big Data” problems, statistical learning /machine learning has become a very hot field.
2. To learn statistical learning and modelling skills which are in high demand also cover basic concepts of statistical learning / modelling methods that have widespread use in business and scientific research.
3. To get hands on the applications and the underlying statistical / mathematical concepts that are relevant to modelling techniques. The course are designed to familiarize students in implementing the statistical learning methods using the highly popular statistical software package R.

### Course Outcomes:

By the end of the course, students should be able to,

1. Students will be familiar with concepts related to “data science”, “analytics”, “machine learning”, etc. These are important topics, and will enable students to embark on highly rewarding careers.
2. Students will capable of learning “big data” concepts on their own

<table>
<thead>
<tr>
<th>Unit I</th>
<th>Introduction to Statistical Learning</th>
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<tbody>
<tr>
<td></td>
<td>What is Statistical Learning, Various issues to consider while “modeling”</td>
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<table>
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<tr>
<th>Unit II</th>
<th>Getting started with R programming</th>
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<tr>
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<td>Introduction to the R-Studio, user-interface, Basic commands, Data Structures in R, Graphics, Reading data into R.</td>
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<table>
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<tr>
<th>Unit III</th>
<th>Linear Regression models including Lab</th>
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<tbody>
<tr>
<td></td>
<td>Instructor should select a problem statement and design the assignment for Linear Regression.</td>
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<tr>
<th>Unit IV</th>
<th>Classification models (Logistic Regression and LDA) with Lab</th>
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<tbody>
<tr>
<td></td>
<td>Instructor should select a problem statement and design the assignment for Logistic Regression and LDA.</td>
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<tr>
<th>Unit VI</th>
<th>Tree based methods (regression trees, classification tree) with Lab</th>
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<tbody>
<tr>
<td></td>
<td>Instructor should select a problem statement and design the assignment for Tree based methods (regression trees, classification tree) with lab.</td>
</tr>
</tbody>
</table>

### Reference Books

1. An Introduction to Statistical Learning with Applications in R Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani – 6th edition- Springer Publications.
SEMESTER-II
Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414462: Distributed Computing System

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Credits: 03</th>
<th>Examination Scheme:</th>
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</thead>
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<td>TH:03 Hours/Week</td>
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<td>In-Sem (Paper): 30 Marks</td>
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<td>End-Sem (paper): 70 Marks</td>
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</table>

Prerequisites:
1. Web Technology.
2. Computer Network Technology.
3. Operating System.

Course Objectives:
1. To understand the fundamentals and knowledge of the architectures of distributed systems.
2. To gain knowledge of working components and fault tolerance of distributed systems.
3. To make students aware about security issues and protection mechanism for distributed environment.

Course Outcomes:
By the end of the course, students should be able to
1. Understand the principles and desired properties of distributed systems based on different application areas.
2. Understand and apply the basic theoretical concepts and algorithms of distributed systems in problem solving.
3. Recognize the inherent difficulties that arise due to distributed-ness of computing resources.
4. Identify the challenges in developing distributed applications.

UNIT I  FUNDAMENTALS AND ARCHITECTURES  7 Hrs
Introduction: Characteristics and examples of distributed systems, Design goals, Types of distributed systems, Trends in distributed systems, Focus on Resource Sharing, Challenges. Architectures: Architectural styles, middleware and middleware organization, system architectures, Example architectures.
Case Study: The World Wide Web

UNIT II  COMMUNICATION AND COORDINATION  7 Hrs
Communication: Introduction, Layered protocols, Types of communication, Inter-process Communication, Remote Procedure Call (RPC), Message oriented communication, Multicast Communication, Network Virtualization: Overlay Network Coordination: Clock Synchronization, Logical Clocks, Mutual Exclusion, Election algorithms, Distributed event matching, Gossip Based coordination
Case Study: IBM's Websphere Message-Queuing System

UNIT III  REPLICATION AND FAULT TOLERANCE  7 Hrs

Case Study: Catching and Replication in Web

UNIT IV DISTRIBUTED FILES AND MULTIMEDIA SYSTEMS 7 Hrs

Distributed Multimedia Systems: Characteristics of Multimedia Data, Quality of Service Management, Resource management, Stream Adaptation.

Case Study: BitTorrent and End System Multicast.

UNIT V DISTRIBUTED WEB BASED SYSTEM 7 Hrs

Case Study: HyperText Transfer Protocol (HTTP)

UNIT VI SECURITY IN DISTRIBUTED SYSTEMS 7 Hrs

Secure Channels: Authentication, Message Integrity and Confidentiality, Secure Group Communication,


Emerging Trends In Distributed Systems: Grid Computing, Service Oriented Architectures (SOA).

Case Study: Kerberos.

Text Books

Reference Books
Savitribai Phule Pune University

Fourth Year of Information Technology (2015 Course)

414463: Ubiquitous Computing

<table>
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<tr>
<th>Teaching Scheme:</th>
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<td></td>
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<td>End-Sem (paper): 70 Marks</td>
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</table>

Prerequisites:
2. Computer Network Technology.

Course Objectives:
1. To describe ubiquitous computing, its properties applications and architectural design.
2. To explain various smart devices and services used in ubiquitous computing.
3. To teach the role of sensors and actuators in designing real time applications using Ubicomp.
4. To explore the concept of human computer interaction in the context of Ubicomp.
5. To explain Ubicomp privacy and challenges to privacy.
6. To describe Ubicomp network with design issues and Ubicomp management.

Course Outcomes:
By the end of the course, students should be able to
1. Demonstrate the knowledge of design of Ubicomp and its applications.
2. Explain smart devices and services used Ubicomp.
3. Describe the significance of actuators and controllers in real time application design.
4. Use the concept of HCI to understand the design of automation applications.
5. Classify Ubicomp privacy and explain the challenges associated with Ubicomp privacy.
6. Get the knowledge of ubiquitous and service oriented networks along with Ubicomp management.

UNIT I  INTRODUCTION TO UBIQUITOUS COMPUTING  7 Hrs

UNIT II  UBIQUITOUS COMPUTING SMART DEVICES AND SERVICES  7 Hrs

UNIT III  ACTUATION AND CONTROL  7 Hrs

UNIT IV  HUMAN COMPUTER INTERACTION  7 Hrs
User Interfaces and Interaction for devices, Abstract user interface through Basic Smart Wearable and Implanted Devices. Human- Centered Design (HCD).

**User Models:** Direct and indirect user input and modelling, modelling users’ planned tasks and multiple tasks-based computing.

### UNIT V  UBIQUITOUS COMPUTING PRIVACY  7 Hrs
Ubiquitous computing privacy definition, Solove’s taxonomy of privacy, legal background, Interpersonal privacy, Ubicomp challenges to privacy: Collection scale, manner and motivation, data types, data accessibility; Case study of privacy solution such as Protecting RFID tags, ways of addressing privacy in Ubicomp.

### UNIT VI  UBIQUITOUS COMMUNICATION AND MANAGEMENT  7 Hrs
Data Networks, Audio Networks, Wireless Data Networks, Ubiquitous Networks, Service oriented networks, network design issues; Configuration and Security management, Service oriented computer and information management, Context awareness.

**Text Books**

**Reference Books**
Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464A: Elective III
Internet of Things (IoT)

Teaching Scheme:
TH:03 Hours/Week

Credits:04

Examination Scheme:
In-Sem (Paper): 30 Marks
End-Sem (paper): 70 Marks

Prerequisites:
2. Computer Network Technology.

Course Objectives:
1. To understand what is Internet of things.
2. Describe architecture, Design, underlying technologies, platforms and cloud interface.

Course Outcomes:
By the end of the course, students should be able to
1. Explain what is internet of things.
2. Explain architecture and design of IoT.
3. Describe the objects connected in IoT.
4. Understand the underlying Technologies.
5. Understand the platforms in IoT.
6. Understand cloud interface to IoT.

UNIT I INTRODUCTION TO INTERNET OF THINGS 8 Hrs

UNIT II IoT NETWORK ARCHITECTURE AND DESIGN 8 Hrs

UNIT III SMART OBJECTS: THE “THINGS” IN IoT 8 Hrs
Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects: Communications Criteria, IoT Access Technologies: IEEE 802.15.4, IEEE 802.15.4g and 802.15.4e, IEEE 1901.2a, LoRaWAN.

UNIT IV ADDRESSING TECHNIQUES FOR THE IoT 8 Hrs

<table>
<thead>
<tr>
<th>UNIT V</th>
<th>IoT PLATFORMS</th>
<th>8 Hrs</th>
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<tbody>
<tr>
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<tr>
<td></td>
<td>What is an IoT Device, Exemplary Devices: Raspberry Pi, Raspberry Pi Interfaces, Other IoT Devices: pcDuino, Beagle Bone Black, CubieBoard, ARDUINO.</td>
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<tr>
<th>UNIT VI</th>
<th>IoT PHYSICAL SERVERS AND CLOUD OFFERINGS</th>
<th>8 Hrs</th>
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<tbody>
<tr>
<td></td>
<td>Introduction to cloud storage models and communication API’s, WAMP-AutoBahn for IoT, Python web application framework, Designing a RESTful web API, AMAZON web services for IoT, SkyNet IoT messaging platform, IoT case studies: Home Automation, Cities, Environment.</td>
<td></td>
</tr>
</tbody>
</table>

**Text Books**


**Reference Books**

1. Smart Internet of things projects Agus Kurniawan Packt - Sep 2016 978-1- 78646- 651-8 2
   The Internet of Things Key Olivier Willy Publication 2nd Edition 978
2. Applications and protocols Hersent s 119- 99435-0, 3 The Internet of Things Connecting Objects to the Web Hakima Chaouchi, Willy Publications 978-1- 84821- 140-7.
Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464A: Elective III
Internet of Things Laboratory

Teaching Scheme: Practical:02 Hours/Week
Credits:04
Examination Scheme:
TW:25 Marks
OR: 25 Marks

Prerequisites:
2. Processor Architecture and Interfacing.

Course Objectives:
1. To study IoT platforms such as Raspberry-Pi/Beagle board/Arduino.
2. To study operating systems for platforms such as Raspberry-Pi/Beagle board/Arduino.
3. To get knowledge for communicating with objects.
4. To explore cloud environment for IoT.
5. To provide knowledge for IoT related protocols such as MQTT / CoAP etc.
6. To design the web interface for IoT.

Course Outcomes:
By the end of the course, students should be able to
1. To understand IoT platforms such as Raspberry-Pi/Beagle board/Arduino.
2. To understand operating systems for platforms such as Raspberry-Pi/Beagle board/Arduino.
3. To communicate with objects using IoT platforms such as Raspberry-Pi/Beagle board/Arduino.
4. To interface cloud environment for IoT application.
5. To implement IoT related protocols such as MQTT / CoAP etc.
6. To implement the web interface for IoT.

Guidelines for Instructor
1. The faculty member should choose a suitable IoT platform from Raspberry-Pi, Beagle board, Arduino for study and implementation.
2. The faculty member should prepare the laboratory manual for all the experiments and it should be made available to students and laboratory instructor/Assistant

List of Assignments

Assignment 1
Study of Raspberry-Pi, Beagle board, Arduino.

Assignment 2
Study of different operating systems for Raspberry-Pi/Beagle board/Arduino. Understanding the process of OS installation on Raspberry-Pi/Beagle board/Arduino.

Assignment 3
| Assignment 4 | Upload data from environmental sensor to cloud server (You can use any public cloud IBM Watson IoT cloud or Google or AWS etc.). |
| Assignment 5 | Introduction to MQTT/ CoAP and sending sensor data to cloud using Raspberry-Pi/Beagle board/Arduino. |
| Assignment 6 | Design a web interface to control connected LEDs remotely using Raspberry-Pi/Beagle board/Arduino. |
| Assignment 7 | Install, configure XMPP server and deployed an application on Raspberry Pi/Beagle board/Arduino. Write client applications to get services from the server application. |
| Assignment 8 | Install, configure APACHE server and deployed an application on Raspberry Pi/Beagle board/Arduino. Write client applications to get services from the server application. |

**Reference Books**

1. The Internet of Things Key applications and protocols Olivier Hersent Willy Publications 2nd Edition 978-1-119- 99435-0.
2. The Internet of Things Connecting Objects to the Web Hakima Chaouchi, Willy Publications 978-1-84821- 140-7.
3. The Internet of Things Donald Norris TAB 4 Smart Internet of Things Projects Agus Kurniawan PACKT.
4. Getting Started with the Internet of Things Cuno Pfister SPD O’REILLY IOT.
**Savitribai Phule Pune University**

**Fourth Year of Information Technology (2015 Course)**

**414464B: Elective III**

**Information Storage and Retrieval**

<table>
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<tr>
<th>Teaching Scheme:</th>
<th>Credits:04</th>
<th>Examination Scheme:</th>
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<td>TH:03 Hours/Week</td>
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<td>In-Sem (Paper): 30 Marks</td>
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<td>End-Sem (paper): 70 Marks</td>
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**Prerequisites:**
1. Data Structures and Files.
2. Database management systems.

**Course Objectives:**
1. To understand information retrieval process.
2. To understand concepts of clustering and how it is related to Information retrieval.
3. To deal Storage, Organization & Access to Information Items.
4. To evaluate the performance of IR system and understand user interfaces for searching.
5. To understand information sharing on semantic web.
6. To understand the various applications of Information Retrieval giving emphasis to multimedia and distributed IR, web Search.

**Course Outcomes:**

By the end of the course, students should be able to:
1. Understand the concept of Information retrieval.
2. Deal with storage and retrieval process of text and multimedia data.
3. Evaluate performance of any information retrieval system.
4. Design user interfaces.
5. Understand importance of recommender system.
6. Understand concept of multimedia and distributed information retrieval.

### UNIT I  **INTRODUCTION**  **8 Hrs**

Basic Concepts of IR, Data Retrieval & Information Retrieval, text mining and IR relation, IR system block diagram.

**Automatic Text Analysis:** Luhn's ideas, Conflation Algorithm, Indexing and Index Term Weighing, Probabilistic Indexing

Inverted file, Suffix trees & suffix arrays, Signature Files, Scatter storage or hash addressing, Clustered files, Hypertext and XML data structures.

### UNIT II  **CLASSIFICATION AND RETRIEVAL SEARCH STRATEGIES**  **8 Hrs**


**Retrieval utilities:** Relevance feedback, Cluster Hypothesis, Clustering Algorithms: Single Pass Algorithm, Single Link Algorithm.
Performance evaluation: Precision and recall, MRR, F-Score, NDCG, user oriented measures, cross fold evaluation.

Visualisation in Information System: Starting points, document context, User relevance judgement, Interface support for search process.

UNIT IV DISTRIBUTED AND MULTIMEDIA IR 8 Hrs

Distributed IR: Introduction, Collection Partitioning, Source Selection, Query Processing, web issues.
MULTIMEDIA IR: Introduction, Data Modeling, Query languages, Generic multimedia indexing approach, One dimensional time series, two dimensional color images, Automatic feature extraction.

UNIT V WEB SEARCHING 8 Hrs

Searching the Web: Challenges, Characterizing the Web, Search Engines, Browsing, Meta-searchers, Web crawlers, Meta-crawler, Web data mining, Finding needle in the Haystack, Searching using Hyperlinks, Page ranking algorithms: Pagerank, Rank SVM.

UNIT VI ADVANCED INFORMATION RETRIEVAL 8 Hrs

Recommendation system: Collaborative Filtering and Content Based Recommendation of Documents and Products.
Information Extraction and Integration: Extracting Data from Text. Collecting and Integrating Specialized Information on the web.

Text Books

Reference Books
5. V. S. Subrahmanian, Satish K. Tripathi , Multimedia information System,Kulwer Academic Publisher.
Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464B:
Information Storage and Retrieval Laboratory

Teaching Scheme:
Practical:02 Hours/Week  Credits:04  Examination Scheme:
TW:25 Marks  OR: 25 Marks

Prerequisites:
1. Data Structures and Files.
2. Database management systems.

Course Objectives:
1. To understand information retrieval process.
2. To understand concepts of clustering and how it is related to Information retrieval.
3. To deal with Storage, Organization & Access to Information Items.
4. To evaluate the performance of IR system and understand user interfaces for searching.
5. To understand information sharing on semantic web.
6. To understand the various applications of Information Retrieval giving emphasis to multimedia and distributed IR, web Search.
7. To apply the gained knowledge in recent fields of advancements in the subject.

Course Outcomes:
By the end of the course, students should be able to,
1. Understand the concept, data structure and preprocessing algorithms of Information retrieval.
2. Deal with storage and retrieval process of text and multimedia data.
3. Evaluate performance of any information retrieval system.
4. Design user interfaces.
5. Understand importance of recommender system (Take decision on design parameters of recommender system).
6. Understand concept of multimedia and distributed information retrieval.
7. Map the concepts of the subject on recent developments in the Information retrieval field.

Guidelines for Instructor
Faculty member should frame Practical Assignments based on below given list of assignments. Students will submit term work in the form of journal containing handwritten write-ups/source code and output. Staff incharge should maintain a record of continuous assessment and produced at the time of oral examination.

List of Assignments

Assignment 1
To implement Conflation Algorithm using File Handling.

Assignment 2
To implement single pass algorithm for clustering.

Assignment 3
To implement a program Retrieval of documents using inverted files.

**Assignment 4**

To implement a program for feature extraction in 2D colour images (any features like colour, texture etc.

**Assignment 5**

To implement a simple Web Crawler in Java.

**Assignment 6**

Extract features from input image and plot histogram for the features.

**Assignment 7**

Write a program to recommend a product / learning course based on person preferences / education details.

**Assignment 8**

Consider set of 25 to 30 documents on 5 to 7 distinct topics. Define 5 queries and map the document that will be retrieved for every query. Write a program using any algorithm to retrieve documents. Evaluate the algorithm using all evaluation methods.

**Assignment 9**

Case study on Image retrieval for ADAS (Advanced Driver Assistance System) (Here students are expected to research the topics like Lane Change Assist (LCA), Driver Drowsiness and inattentiveness, Lane Change Assist, Automatic Parking, ACC etc.)

**Reference Books**

2. C.J. Rijsbergen, "Information Retrieval", ([www.dcs.gla.ac.uk](http://www.dcs.gla.ac.uk)).
### Multimedia Techniques

**Teaching Scheme:**

<table>
<thead>
<tr>
<th>TH:03 Hours/Week</th>
<th>Credits:04</th>
<th>Examination Scheme:</th>
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<td>End-Sem (paper): 70 Marks</td>
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</table>

**Prerequisites:**

1. Data Structures and Files.
2. Basics of computer graphics and animation.

**Course Objectives:**

1. To learn basic components of multimedia (text, image, audio, video and animation).
2. To learn compression techniques for various multimedia components.
3. To learn rendering.
4. To learn animation and gaming.
5. Become acquainted with some advanced topics in multimedia.

**Course Outcomes:**

By the end of the course, students should be able to

1. To create own file formats for specific application.
2. To do some projects based on current trends in multimedia.
3. To use open sources for authoring tool for animation and presentations.
4. Understand some research areas of current multimedia techniques.

### UNIT I | INTRODUCTION TO MULTIMEDIA | 8 Hrs
---|---|---
Goals, objectives, and characteristics of multimedia, Multimedia building blocks, Multimedia architecture, Multimedia Applications Media Entertainment, Media consumption, web-based applications, e-learning and education

### UNIT II | TEXT AND IMAGE PROCESSING | 8 Hrs
---|---|---
**Text:** Text file formats: TXT, DOC; RTF, PDF, PS  
**Text compression:** Huffman coding, LZ & LZW  
**Image:** Basic Image fundamentals, Image File formats - (BMP, TIFF, JPEG, GIF)  
Image processing cycle- Image acquisition, storage, Communication, and display, Image Enhancement, Image Compression: **Types of Compression:** Lossless & Lossy  
**Lossless:** RLE, Shannon - Fano algorithm, Arithmetic coding.  
**Lossy:** Vector quantization, Fractal Compression Technique, Transform coding and Hybrid: JPEG-DCT

### UNIT III | AUDIO AND VIDEO PROCESSING | 8 Hrs
---|---|---
**AUDIO:** Nature of sound waves, characteristics of sound waves, psycho-acoustic, MIDI, digital audio, CD formats.  
**Audio file formats:** WAV, AIFF, VOC, AVI, MPEG Audio File formats, RMF, WMA  
Audio compression techniques: DM, ADPCM and MPEG  
**Video:** Video signal formats, Video transmission standards: EDTV, CCIR, CIF, SIF, HDTV,
digitization of video,

**Video file formats:** MOV, Real Video, H-261, H-263, Cinepack, NeroDigital, Video editing, DVD formats, MPEG.

### UNIT IV: ANIMATION AND VIRTUAL REALITY  
**8 Hrs**

**Animation:** Basics of animation, types of animation, principles of animation, Methods of controlling animation, frame-by-frame animation techniques, real-time animation techniques, Programming aspects in creating simple animation,

**OpenGL:** Open GL over windows/Linux, Extension.

**Virtual Reality:** Concept, Forms of VR, VR applications, VR devices: Hand Gloves, Head mounted tracking system, VR chair, CCD, VCR, 3D Sound system, Head mounted display

### UNIT V: RENDERING  
**8 Hrs**

Introduction, Basics of illumination and shading models, Transparency, Shadows and textures, Ray tracing from the light source, cone, beam and pencil tracing. Point based rendering, Mesh Simplification, Spatial partitioning, Solid Modeling

### UNIT VI: ADVANCES IN MULTIMEDIA  
**8 Hrs**

Multimedia Communication and applications, Study of Multimedia networking, Quality of data transmission, Multimedia over IP, Media on Demand.

**Multimedia in Android:** Android Multimedia Framework Architecture

**Gaming:** Facial Recognition, Voice Recognition, Gesture Control, High-Def Displays, Augmented Reality, Mobile Gaming, Cloud Gaming, On-Demand Gaming.

### Text Books


### Reference Books

Savitribai Phule Pune University  
Fourth Year of Information Technology (2015 Course)  
414464C: Multimedia Techniques Laboratory

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<th>Teaching Scheme:</th>
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Prerequisites:
- 1. Data Structures and Files.
- 2. Basics of computer graphics and animation.

Course Objectives:
- 1. To learn basic components of multimedia (text, image, audio, video and animation).
- 2. To learn compression techniques for various multimedia components.
- 3. To learn rendering.
- 4. To learn animation and gaming.
- 5. Become acquainted with some advanced topics in multimedia.

Course Outcomes:
By the end of the course, students should be able to
- 1. To create own file formats for specific application.
- 2. To do some projects based on current trends in multimedia.
- 3. To use open sources for authoring tool for animation and presentations.

List of Assignments

Assignment 1
Write a program to open and display Images in Python or Java using OpenCV tool.

Assignment 2
Write a program for generating Huffman codes for a gray scale 8-bit image

Assignment 3
Write a program for implementation of ray-tracing algorithm in Java.

Assignment 4
Create a simple animation using OpenGL

Assignment 5
Study of any virtual reality tool/software. (3DS MAX, BLENDER, GOOGLE VR)

Assignment 6
Write a Program to compress image using Python

Assignment 7
Create a short movie clip using open source tool

Assignment 8
Build a Virtual Reality web application using open source tool

Assignment 9
Write a Program to implement basic game in Python
### Reference Books

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Credits:04</th>
<th>Examination Scheme:</th>
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</thead>
<tbody>
<tr>
<td>TH:03 Hours/Week</td>
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<td>In-Sem (Paper): 30 Marks</td>
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<td>End-Sem (paper): 70 Marks</td>
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Prerequisites Courses:
1. Internet and Web Programming.

Course Objectives:
1. To understand Internet and Web Programming basic concepts.
2. To develop client side web programming skills.
3. To develop server side web programming skills.
4. To understand Web Services and Content Management System.
5. To understand mobile web development and develop mobile web development skills.
6. To understand web security and cyber ethics.

Course Outcomes:
By the end of the course, students should be able to
1. Demonstrate static website using basic tools.
2. Develop client side programming skills.
3. Develop server side programming skills.
4. Understand web services and handle content management tools.
5. Develop mobile website using mobile web development tools.
6. Understand aspects of web security and cyber ethics.

UNIT I | INTERNET AND WEB PROGRAMMING ESSENTIALS | 8 Hrs
---|---|---

**Markup Languages**: Introduction to HTML, Static and dynamic HTML, Structure of HTML documents, HTML Elements, Linking in HTML, Anchor Attributes, Image Maps, Meta Information, Image Preliminaries, Layouts, Backgrounds, Colors and Text, Fonts, Tables, Frames and layers, Audio and Video Support with HTML Database integration, , , Forms Control, Form Elements, Applying Styles, values, selectors, class, ids, inheritance, layout, backgrounds, borders, margin, padding, lists, fonts, text formatting, positioning. HTML5. Introduction to Style Sheet, Inserting CSS in an HTML page, CSS selectors, Introduction to XML, XML key component, Transforming XML into XSLT, DTD: Schema, elements, attributes, Introduction to JSON.

UNIT II | CLIENT SIDE PROGRAMMING | 8 Hrs
---|---|---
**JavaScript**: Overview of JavaScript, using JS in an HTML (Embedded, External), Data types, Control Structures, Arrays, Functions and Scopes, Objects in JS, DOM: DOM levels, DOM Objects and their properties and methods, Manipulating DOM, JQuery: Introduction to JQuery, Introduction to AJAX, Working of AJAX, AJAX processing steps, coding AJAX script. Introduction to Angular JS.

UNIT III | SERVER SIDE PROGRAMMING | 8 Hrs
Introduction to Server Side technology and TOMCAT, Servlet: Introduction to Servlet, need and advantages, Servlet Lifecycle, Creating and testing of sample Servlet, session management. JSP: Introduction to JSP, advantages of JSP over Servlet, elements of JSP page: directives, comments, scripting elements, actions and templates, JDBC Connectivity with JSP. PHP: Introduction to PHP, Features, PHP script, PHP syntax, conditions & Loops, Functions, String manipulation, Arrays & Functions, Form handling, Cookies & Sessions, using MySQL with PHP.

UNIT IV | WEB SERVICES AND CONTENT MANAGEMENT SYSTEMS | 8 Hrs
---|---|---

UNIT V | MOBILE WEB DEVELOPMENT | 8 Hrs
---|---|---

UNIT VI | WEB SECURITY AND CYBER ETHICS | 8 Hrs
---|---|---

Text Books

Reference Books
**Teaching Scheme:**
Practical: 02 Hours/Week  
Credits: 04  
Examination Scheme:
TW: 25 Marks  
OR: 25 Marks

**Prerequisites:**
1. Basic Programming Skills.

**Course Objectives:**
1. Making Student familiar with client server architecture.
2. To develop ability for making web application using JavaScript.
3. To develop web applications using Angular JS.
4. To design and implement web services with content management.
5. To understand use of Content Management Tools in Website Development.

**Course Outcomes:**
By the end of the course, students should be able to
1. Use fundamental skills to develop and maintain website and web application.
3. Develop web services to transfer data and add interactive components to website.
4. Combine multiple web technologies to create advanced web components.

**Guidelines for Instructor's Manual**
The instructor's manual is to be developed as hands-on resource and reference. The instructor's manual need to include prologue (about University/program/institute/department/foreword/preface etc.), University syllabus, conduction & Assessment guidelines, topics under consideration - concept, objectives, outcomes, set of typical applications/assignments/guidelines, and references.

**Guidelines for Student Journal**
The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept/technology/tool in brief, design, test cases, conclusion/analysis. Program codes with sample output of all performed assignments are to be submitted as softcopy. As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

**Guidelines for Assessment**
Continuous assessment of laboratory work is done based on overall performance and laboratory assignments performance of student. Each laboratory assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters
for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness

**Guidelines for Practical Examination**

Both internal and external examiners should jointly set problem statements. During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement. The supplementary and relevant questions may be asked at the time of evaluation to test the student’s for advanced learning, understanding of the fundamentals, effective and efficient implementation. So encouraging efforts, transparent evaluation and fair approach of the evaluator will not create any uncertainty or doubt in the minds of the students. So adhering to these principles will consummate our team efforts to the promising start of the student's academics.

**Guidelines for Laboratory Conduction**

The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students. The instructor may set multiple sets of assignments and distribute among batches of students. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments. Use of open source software is to be encouraged. In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

**List of Assignments**

**Assignment 1**

1.1 Using HTML5 layout tags develop informative page with sections which include various images, links to other pages for navigation, make use of all possible formatting (for example font, color etc.).
1.2 Apply CSS properties Border, margins, Padding, Navigation, dropdown list to page created in first assignment.

**Assignment 2**

Design an online registration form for any application and validate it using JQuery.

**Assignment 3**

Design Login Application using PHP and add essence of Ajax in it.

**Assignment 4**

Create any Java Web Service and integrate it with any suitable application.

**Assignment 5**

Create JSP login page and validate it. Make use of Servlets.

**Assignment 6**

Create an application for bill payment using Angular JS.

**Assignment 7**

Develop website using any CMS tool which falls into one of the categories blog, social networking, News updates, Wikipedia, E-commerce store. Website must include home page, and at least 3.

**Assignment 8**
Develop Mini Project using any front end tool with database connectivity.

<table>
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<th>Reference Books</th>
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Computational Optimization

Prerequisites Courses:
1. Mathematical preliminaries like Linear algebra, matrices, Elements of probability theory & Elementary multivariable calculus.
2. Design and Analysis of Algorithms.

Course Objectives:
1. To enable the student to learn and acquire mathematical methods in engineering disciplines.
2. To introduce the methods of optimization to solve a linear programming problem by various methods.
3. To introduce few advanced optimization techniques.

Course Outcomes:
By the end of the course, students should be able to
1. Learn and implement various optimization techniques.
2. Learn model real-world problems in optimization framework.
3. Apply various optimization models to solve optimization problems in computer-science & IT Engineering.

UNIT I  INTRODUCTION  8 Hrs

UNIT II  NETWORK ANALYSIS  8 Hrs
Shortest Path: Dijkstra Algorithm; Floyd Algorithm; Maximal Flow Problem (Ford-Fulkerson); PERT-CPM, network design algorithms.

UNIT III  INVENTORY CONTROL  8 Hrs
Introduction; Economic Order Quantity (EOQ) models, Deterministic and probabilistic Models, Safety Stock, Buffer Stock, Inventory Model of Central Warehouse.

UNIT IV  GAME THEORY  8 Hrs
Introduction ; 2- person Zero – sum Game; Saddle Point ; Mini-Max and Maxi-Min Theorems, Games without saddle point ; Graphical Method ; Principle of Dominance.

UNIT V  QUEUING THEORY  8 Hrs
Introduction; Basic Definitions and Notations; Axiomatic Derivation of the Arrival & Departure (Poisson Queue). Pure Birth and Death Models; Poisson Queue Models: M/M/1: ∞ /FIFO and M/M/1: N/ FIFO.

UNIT VI | ADVANCED OPTIMIZATION TECHNIQUES | 8 Hrs
---|---|---
Direct and indirect search methods, Evolutionary algorithms for optimization and search, Concepts of multi-objective optimization, genetic algorithms and simulated annealing, optimization of machine learning algorithms, ant colony optimization, Applications of IT Engineering: Search Engine Optimization, Smart Grid Optimization.

Text Books

Reference Books
12. kershenbaum A., “ Telecommunication network design algorithms”, TMH
### Teaching Scheme:
Practical: 02 Hours/Week  |  Credits: 04  |  Examination Scheme:
|  |  |  TW: 25 Marks
|  |  |  OR: 25 Marks

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### Prerequisites:
1. Optimization Algorithms.
2. Basics of Problem Solving.

### Course Objectives:
1. To understand how to solve knapsack problem by brute force method.
2. Understand different problem-solving algorithms.

### Course Outcomes:
By the end of the course, students should be able to
1. Understand Transportation problem.
2. Learn different measures in shortest path algorithms.
3. Understand and learn Queuing Model.

### Guidelines for Instructor
Instructor should design and implement at least 08 assignments and 2 study assignments on Computational Optimization.

### List of Assignments

| Assignment 1 | Write a program to solve Transportation problem. |
| Assignment 2 | Write a program to solve Assignment problem. |
| Assignment 3 | Write a program to solve 0/1 knapsack problem using brute force method. |
| Assignment 4 | Write a program to solve 0/1 knapsack problem using dynamic programming. |
| Assignment 5 | Write a program to solve Duality problem. |
| Assignment 6 | Write a program to solve optimization problem using Simplex method. |
| Assignment 7 | Write a program to solve Dijkstra’s and Floyd shortest path algorithm. |
| Assignment 8 | Design and implement Maximal flow problem. |
| Assignment 9 | Write a program to solve PERT/CPM problem. |
| Assignment 10 |  |
Design and implement Mini-Max and Maxi-Min theorem.

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<tr>
<th>Study Assignments</th>
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<tbody>
<tr>
<td><strong>Assignment 1</strong></td>
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<tr>
<td>EOQ Models</td>
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<td><strong>Assignment 2</strong></td>
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<td>Safety stock and buffer stock</td>
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<td><strong>Assignment 3</strong></td>
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<tr>
<td>M/M/1:∞/FIFO</td>
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<td><strong>Assignment 4</strong></td>
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<td>M/M/1:N/FIFO</td>
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Savitribai Phule Pune University  
Fourth Year of Information Technology (2015 Course)  
414465A: Elective IV  
Rural Technologies and Community Development

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<th>Teaching Scheme:</th>
<th>Credits:03</th>
<th>Examination Scheme:</th>
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<td>In-Sem (Paper): 30 Marks</td>
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Course Objectives:
1. Understand theories and practices in the rural development model.
2. Learn and analyse rural life and rural economy.
3. Understand different measures in rural development.
4. Learn different technologies used in upliftment of rural life.
5. To participate in visits and case studies for better understanding for rural development and its impact on overall economy.

Course Outcomes:
By the end of the course, students should be able to
1. Understand rural development model.
2. Learn different measures in rural development and its impact on overall economy.
3. Understand and learn importance of technologies in rural and community development.
4. Understand challenges and opportunities in rural development.

UNIT I  INTRODUCTION  7 Hrs

RURAL DEVELOPMENT - Concepts and connotations, Basic Elements, Growth Vs. Development, Why rural development, Rising expectations and development, Development and Change, Human beings as cause and consequences of development.

RURAL ECONOMY OF INDIA - Introduction, size and structure, The characteristics of rural sector, The role of agricultural sub-sector, The role of non-agricultural sub-sector, Challenges and opportunities.

UNIT II  RURAL DEVELOPMENT - MEASURES AND PARADIGMS  7 Hrs

MEASURES OF DEVELOPMENT - Introduction, Measures of level of rural development, Measures of income distribution, Measures of development simplified, Concepts and measures of rural poverty.


UNIT III  TECHNOLOGIES FOR RURAL DEVELOPMENT  7 Hrs

Using Water Resources - The water cycle, Drinking Water, Water quality testing, Water filtering, Extraction from Groundwater, Pumps Rope and washer pump, Manuel pumps, Treadle pump, Irrigation for agriculture, Channel systems, Sprinkler systems, Drip systems, Water diversion, Water storage


<table>
<thead>
<tr>
<th>UNIT IV</th>
<th>COMMUNITY DEVELOPMENT</th>
<th>7 Hrs</th>
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<tbody>
<tr>
<td>DEVELOPING COMMUNITIES - Introduction, Service Learning and community development, Theory and practice of community development, Community development issues. The diverse meaning of community development, The knowledge base of community development, International community development.</td>
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<thead>
<tr>
<th>UNIT V</th>
<th>COMMUNITY DEVELOPMENT - RURAL ENTREPRENEURSHIP</th>
<th>7 Hrs</th>
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<tbody>
<tr>
<td>Different forms of Rural Entrepreneurship, Significance, Business planning for a new venture: the concept of planning paradigm, Forms of business enterprises-Sole proprietorship, partnership and corporations, Product and Process development, Marketing analysis and competitive analysis, strategies; Financial resources; debt financing, banks and financial institutions and other non-bank financial sources; Government programmes: direct loan assistance and subsidies; Industrial and legal issues for rural enterprises.</td>
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<tr>
<th>UNIT VI</th>
<th>CASE STUDIES AND FIELD VISIT</th>
<th>7 Hrs</th>
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<tbody>
<tr>
<td>Role of Micro-Finance institutions in rural development, Use of ICT in Rural development, Watershed Management - Water-Cup Competition by Paani Foundation, Community Safe Water Solutions, Visit to a 'Woman Self help group' nearby and study of its functioning and its role in development. Visit to model villages in nearby region - Ralegan-Siddhi, Dist - Ahmednagar, Hiware Bazar Dist - Ahmednagar, Tikekarwadi - Dist. - Pune, Buchekarwadi Dist- Pune etc.</td>
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Text Books

Reference Books
### B.E. (Information Technology) Syllabus 2015 Course

#### 414465B: Elective IV Parallel Computing

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<td>End-Sem (paper): 70 Marks</td>
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**Prerequisites Courses:**
1. System Programming.
2. Operating System.

**Course Objectives:**
1. Understand theories and practices in parallel computing.
2. Learning hardware concepts and various languages used in parallel computing.
3. Understand different challenges in parallel computing.

**Course Outcomes:**
By the end of the course, students should be able to
1. Understand fundamentals in parallel computing.
2. Understand and learn importance of technologies including different hardware structures used in parallel computing.
3. Understand challenges and opportunities in parallel computing.

#### UNIT I  FUNDAMENTALS OF PARALLEL COMPUTING  7 Hrs

#### UNIT II  PARALLEL HARDWARE AND LANGUAGES  7 Hrs
Introduction to parallel hardware: Multi-cores and multiprocessors; shared memory and message passing architectures; cache hierarchy and coherence; sequential consistency, Parallel languages and compilers: Language features for parallelism, parallel language constructs, optimizing compilers for parallelism, dependency analysis, code optimization and scheduling, loop parallelization and pipelining.

#### UNIT III  CHALLENGES OF PARALLEL PROGRAMMING  7 Hrs
Identifying Potential Parallelism, Techniques for Parallelizing Programs, Issues, Cache Coherence issues, Memory Consistency Models, Maintaining Memory Consistency, Synchronization Issues, Performance Considerations.

#### UNIT IV  OPENMP PROGRAMMING  7 Hrs
OpenMP Execution Model, Memory Model and Consistency, Open MP Directives, Run Time Library Routines, Handling Data and Functional Parallelism.

#### UNIT V  MPI PROGRAMMING AND PROGRAMMING HETERGENEOUS PROCESSORS  7 Hrs
The MPI Programming Model, Global Operations, Asynchronous Communication, Collective Communication, Other MPI Features, Performance Issues, Combining OpenMP and MPI, GPU Architecture.
## UNIT VI  
**GPU PROGRAMMING**  
7 Hrs

Introduction to GPU programming: GPU architecture; Introduction to CUDA programming, CUDA Threads and Memories, Concept of SIMD and SIMT computation; Thread blocks; Warps; Global memory; Shared memory; Thread divergence in control transfer; Example case studies, CUDA Threads and Memories, Application Development. Introduction to OpenCL.

### Text Books


### Reference Books

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464C: Elective IV
Computer Vision

Teaching Scheme:
TH:03 Hours/Week
Credits:03
Examination Scheme:
In-Sem (Paper): 30 Marks
End-Sem (Paper): 70 Marks

Prerequisites Courses:
1. Students should know vectors, linear algebra (i.e., matrix operations, solution of linear equations).
2. Programming language (e.g., Matlab and/or C).

Course Objectives:
1. To review image processing techniques for computer vision.
2. To understand shape and region analysis.
3. To understand three-dimensional image analysis techniques.
4. To understand Object detection and tracking.
5. To study some applications of computer vision algorithms.

Course Outcomes:
By the end of the course, students should be able to
1. Implement fundamental image processing techniques required for computer vision.
2. Implement boundary tracking techniques.
3. Apply Hough Transform for line, circle, and ellipse detections.
4. Implement motion related techniques.
5. Develop skills to develop applications using computer vision techniques.

UNIT I  FUNDAMENTALS OF DIGITAL IMAGE PROCESSING  7 Hrs
Review of image processing techniques, classical filtering operations, Thresholding techniques, edge detection techniques, corner and interest point detection, mathematical morphology and textures.

UNIT II  SHAPES AND REGIONS  7 Hrs

UNIT III  HOUGH TRANSFORM  7 Hrs

UNIT IV  3D VISION AND MOTION  7 Hrs
Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations –
UNIT IV

OBJECT DETECTION AND TRACKING

7 Hrs

Introduction to Motion Detection, Applications of Motion Detection and Tracking, Background Subtraction (BGS), Basic BGS Algorithms, Mixture of Gaussians (MoG), Block matching for object tracking. Single object and multi-object tracking.

UNIT VI

COMPUTER VISION APPLICATIONS

7 Hrs


Reference Books


ONLINE REFERENCES

1. http://kercd.free.fr/linksKCD.html
Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464D: Elective IV
Social Media Analytics

Teaching Scheme: TH:03 Hours/Week
Credits:03
Examination Scheme:
In-Sem (Paper): 30 Marks
End-Sem (paper): 70 Marks

Prerequisites Courses :
1. Basic knowledge of Graphs.
2. Data mining.
3. Data Analysis.

Course Objectives :
1. To understand foundations of Social Media Analytics.
2. To Visualize and understand the data mining aspects in social networks.
3. To solve mining problems by different algorithms.
4. To understand network measures for social data.
5. To understand behavioral part of web applications for Analysis.
6. To analyze the data available on any social media applications.

Course Outcomes :
By the end of the course, students should be able to
1. Understand the basics of Social Media Analytics.
2. Explain the significance of Data mining in Social media.
3. Demonstrate the algorithms used for text mining.
4. Apply network measures for social media data.
5. Explain Behavior Analytics techniques used for social media data.
6. Apply social media analytics for Facebook and Twitter kind of applications.

UNIT I  ANALYTICS IN SOCIAL MEDIA AND TYPES OF ANALYTICS TOOLS  7 Hrs
The foundation for analytics, Social media data sources, Defining social media data, data sources in social media channels, Estimated Data sources and Factual Data Sources, Public and Private data, data gathering in social media analytics.

UNIT II  VISUALIZING SOCIAL NETWORKS  7 Hrs

UNIT III  TEXT MINING IN SOCIAL NETWORKS  7 Hrs
Introduction, Keyword search, Classification Algorithms, Clustering Algorithms-Greedy Clustering, Hierarchical clustering, k-means clustering, Transfer Learning in heterogeneous Networks, Sampling of online social networks, Comparison of different algorithms used for mining, tools for text mining.

UNIT IV  NETWORK MEASURES  7 Hrs
Centrality: Degree Centrality, Eigenvector Centrality, Katz Centrality, PageRank, Betweenness Centrality, Closeness Centrality, Group Centrality, Transitivity and Reciprocity, Balance and Status, Similarity: Structural Equivalence, Regular Equivalence

UNIT V  BEHAVIOR ANALYTICS  7 Hrs
**Individual Behavior:** Individual Behavior Analysis, Individual Behavior Modeling, Individual Behavior Prediction  
**Collective Behavior:** Collective Behavior Analysis, Collective Behavior Modeling, Collective Behavior Prediction

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<th>UNIT VI</th>
<th>CASE STUDY</th>
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**Mining Twitter:** Overview, Exploring Twitter’s API, Analyzing 140 Characters  
**Mining Facebook:** Overview, Exploring Facebook’s Social Graph API’s, Analyzing Social Graph Connections.

**Text Books**

**Reference Books**
Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414465E: Elective IV
Open Elective

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In this subject, a student can opt from other branch of engineering (preferably Computer Engineering and Electronics & Telecommunication). An institution may design the syllabus of a subject in consultation with a reputed software company/industry. This syllabus should be approved by the University board of Studies (Information Technology) and academic council of SPPU authorities and then students can opt for the same as an open elective.
Teaching Scheme: Practical: 04 Hours/Week  Credits: 02

Examination Scheme:
TW: 50 Marks  PR: 50 Marks

Prerequisites:
2. Computer Network Technology.

Course Objectives:
1. The course aims to provide an understanding of the principles on which the distributed systems are based; their architecture, algorithms and how they meet the demands of Distributed applications.
2. The course covers the building blocks for a study related to the design and the implementation of distributed systems and applications.

Course Outcomes:
Upon successful completion of this course student will be able to
1. Demonstrate knowledge of the core concepts and techniques in distributed systems.
2. Learn how to apply principles of state-of-the-Art Distributed systems in practical application.
3. Design, build and test application programs on distributed systems.

Guidelines:
This Computer Laboratory-IX course has Distributed Systems as a core subject. The problem statements should be framed based on first six assignments mentioned in the syllabus. The teachers will frame the problem statements with due consideration that students have three hours to complete that. The practical examination will comprise of implementation and related theory. All assignments to be performed in Java 9.

Assignment 1
To develop any distributed application through implementing client-server communication programs based on Java Sockets and RMI techniques.

Assignment 2
To develop any distributed application using Message Passing Interface (MPI).

Assignment 3
To develop any distributed application with CORBA program using JAVA IDL.

Assignment 4
To develop any distributed algorithm for leader election.

Assignment 5
To create a simple web service and write any distributed application to consume the web service.

Assignment 6
To develop any distributed application using Messaging System in Publish-Subscribe paradigm.

Assignment 7
To develop Microservices framework based distributed application.
**Term work:**
Staff in-charge will suitably frame the above assignments and flexibility may be incorporated. Students will submit term work in the form of journal. Each assignment has to be well documented with problem definition, code documented with comments. Staff in-charge will assess the assignments continuously and grade or mark each assignment on completion date. All the assignments should be conducted on Latest version of Open Source Operating Systems, tools and Multi-core CPU supporting Virtualization and Multi-Threading.

**Reference books:**

### Teaching Scheme:

<table>
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<th>Practical: 02 Hours/Week</th>
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<td>TW: 25 Marks OR: 25 Marks</td>
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### Prerequisites:

### Course Objectives:
1. To design and implement user interfaces for performing database operations.
2. To design applications for accessing smart devices and data generated through sensors and services.
3. To implement authentication protocols for providing security.

### Course Outcomes:

Upon successful completion of this course student will be able to

1. Set up the Android environment and explain the Evolution of cellular networks.
2. Develop the User Interfaces using pre-built Android UI components.
3. Create applications for performing CURD SQLite database operations using Android.
4. Create the smart android applications using the data captured through sensors.
5. Implement the authentication protocols between two mobile devices for providing security.
6. Analyze the data collected through android sensors using any machine learning algorithm.

### Guidelines:

This Computer Laboratory-X course has ubiquitous computing as a core subject. The problem statements should be framed based on first six assignments mentioned in the syllabus. The teachers will frame the problem statements with due consideration that students have three hours to complete that. The practical examination will comprise of implementation and related theory. All assignments to be performed in Java 9.

### Tools Required:
Android SDK / Android Studio, SQL Lite, Sensors, Arduino kit.

#### Assignment 1
Android development environment. Installing and setting up the environment. Hello world application. Running the emulator. Inserting debug messages.

#### Assignment 2
Android UI Design: Design a User Interface using pre-built UI components such as structured layout objects, UI controls and special interfaces such as dialogs, notifications, and menus. Also make this UI attractive using Android graphics platform OpenGL.

#### Assignment 3
Android-database Connectivity: Create a SQLite Database for an Android Application and perform CRUD (Create, Read, Update and Delete) database operations.

#### Assignment 4
Sensors for building Smart Applications: Use any sensors on the device to add rich location and motion capabilities to your app, from GPS or network location to accelerometer, gyroscope, temperature, barometer, and more.

**Assignment 5**
Develop a Smart Light System (Light that automatically switched on in evening and gets off in morning) using open source Hardware platform like Arduino and some sensors (Light dependent resistor) and actuator (An LED).

**Assignment 6**
Design and Develop a GUI for FAN regulator that uses Android platform.

**Assignment 7**
Develop an Android based FAN regulator using open source Hardware platform like NodeMcu and actuator (a SERVO Motor).

**Assignment 8**
Android and Machine Learning: Mobile multimodal sensing- Draw inferences over the data coming from phone’s sensing hardware (e.g. accelerometer, GPS, microphone), and processing these samples with the help of machine learning. (Any Application: Healthcare, Smart City, Agriculture, etc).

**Assignment 9**
Android API: Implement an application that uses Android APIs like Google Map, recording and playing audio and video, using the built-in camera as an input device.

**Assignment 10**
Wireless Network: Develop an app for a rolling display program of news on computer display. The input strings are supplied by the mobile phone/ by another computer connected through wireless networks.

**Assignment 11**

**Assignment 12**
Case Study: Evolution of cellular networks all the way up to 7G.
**Savitribai Phule Pune University**
**Fourth Year of Information Technology (2015 Course)**
**414468: Project Work**

<table>
<thead>
<tr>
<th>Teaching Scheme:</th>
<th>Credits:06</th>
<th>Examination Scheme:</th>
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<tbody>
<tr>
<td>TUT:06 Hours/Week</td>
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<td>TW:50 Marks</td>
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<td>OR:100 Marks</td>
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**Prerequisites:**
1. BE-Project Phase I – Semester I.
2. Project Based Seminar.

**Course Objectives:**
1. The object of Project Work II & Dissertation is to enable the student to extend further the investigative study taken up under Project stage 1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry.
2. To expose students to product development cycle using industrial experience, use of state of art technologies.
3. To encourage and expose students for participation in National/International paper presentation activities and funding agency for sponsored projects.
4. Exposure to Learning and knowledge access techniques using Conferences, Journal papers and anticipation in research activities.
5. Evaluate the various validation and verification methods.
6. Analyzing professional issues, including ethical, legal and security issues, related to computing projects.

**Course Outcomes:**
By the end of the course, Students will be able to
1. Learn teamwork.
2. Be well aware about Implementation phase.
3. Get exposure of various types of testing methods and tools.
4. Understand the importance of documentation.

**Contents**

**Review 3:**
Based on Implementation (50% implementation expected)

**Review 4:**
Complete Project and Testing
All the groups should try to overcome all the lacunas identified by the external examiner during Project Phase I exam
The group will submit following at the end of semester II.
1. The Workable project.
2. Project report (in Latex/Lyx/latest Word) in the form of bound journal complete in all respect – 1 copy for the Institute, 1 copy for guide and 1 copy of each student in the group for certification.

The project report contains the details.
1. Problem definition  
2. Requirement specification  
3. System design details (UML diagrams)  
5. Test result and procedure – test report as per ATP.  
6. Conclusions.  
7. Appendix  
   a. Tools used  
   b. References  
   c. Papers published/certificates  
   d. Plagiarism Report of paper and project report from any open source tool

One paper should be published in reputed International conference/International.
In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement their knowledge and skills. Student will be awarded the bachelor's degree if he/she earns credits and clears all the audit courses specified in the syllabus. The student may opt for one of the audit courses per semester, starting in second year first semester. Though not mandatory, such a selection of the audit courses helps the learner to explore the subject of interest in greater detail resulting in achieving the very objective of audit course's inclusion. List of options offered is provided. Each student has to choose one audit course from the list per semester. Evaluation of audit course will be done at institute level itself. Method of conduction and method of assessment for audit courses are suggested.

**Criteria**

The student registered for audit course shall be awarded the grade PP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'PP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA.

**Guidelines for Conduction and Assessment (Any one or more of following but not limited to)**

1. Lectures/ Guest Lectures
2. Visits (Social/Field) and reports
3. Demonstrations
4. Surveys
5. Mini Project
6. Hands on experience on Specific focused topic

**Guidelines for Assessment (Any one or more of following but not limited to)**

1. Written Test
2. Demonstrations/ Practical Test
3. Presentations
4. IPR/Publication
5. Report

**Audit Course VI Options**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Audit Course Title</th>
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<tbody>
<tr>
<td>414469A</td>
<td>1. IoT – Application in Engineering Field</td>
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<tr>
<td>414469B</td>
<td>2. Entrepreneurship</td>
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<td>414469C</td>
<td>3. Cognitive Computing</td>
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<td>414469D</td>
<td>4. AI and Robotics</td>
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IOT as a game changer in several fields of applications and poised for phenomenal growth. This course introduces Students to IOT applications in various Engineering disciplines: Civil, Chemical, Electrical, E&TC, Mechanical and Metallurgical Engineering. This 20 hour course is aimed at covering various components involved in IOT, concepts, definitions and mainly Engineering Applications associated with IOT/IIOT.

**Course Objectives:**
1. To get the detailed insight of Internet of Things.
2. To learn the IoT terms in Engineering.
3. To understand how IoT concepts can be implement.
4. To know the protocols, Sensors and other elements for IoT implementation.

**Course Outcomes:**
By the end of the course, students should be able to
1. Expand your knowledge of Internet of Things.
2. Discover how you can use IoT in your Engineering applications.
3. Build more effective hands on with IoT elements.
4. Expand the practical knowledge of using IoT components like sensors, processors.
5. Expand the understanding of using different protocols.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Basics of IOT – Difference between IOT and IIoT</th>
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<tbody>
<tr>
<td>Unit II</td>
<td>Architecture</td>
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<td>Importance, Advantages &amp; Disadvantages.</td>
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<td>Unit III</td>
<td>Sensors, Transducers, Special requirements for IIOT sensors, Actuators, Types of Sensors, Actuators.</td>
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<td>Protocols - HART, MODBUS-Serial &amp; Parallel, Ethernet, BACNet</td>
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<td>Introduction to IIOT Cloud Platform and Security Aspects Importance and likely Risk Elements</td>
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<td>Quiz, Case Studies and Student Presentations</td>
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<td>Illustrative IIOT applications in Engineering Disciplines – Civil, Chemical, Electrical, E &amp; TC, Mechanical and Metallurgical.</td>
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**References**
2. Inside the Internet of Things (IoT), Deloitte University Press.
3. Internet of Things- From Research and Innovation to Market Deployment; By Ovidiu & Peter; River Publishers Series.
4. Five thoughts from the Father of the Internet of Things; by By Phil Wainewright - Kevin Ashton, who coined the word IoT.
**Course Objectives:**
1. To get the detailed about Entrepreneurship.
2. To understand the abilities to become an Entrepreneur.
3. To understand how Business Finance concepts can be implemented.

**Course Outcomes:**
By the end of the course, students should be able to
1. Expand your knowledge of Entrepreneurship & Startups.
2. Discover how you can use Entrepreneur Qualities.
3. Expand the practical knowledge of Finance, Legal-Patents, Intellectual Property, and Business Associations.
4. Expand the understanding of Deliverables & Achieving Target.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Introduction To Entrepreneurship &amp; Favorable Environment for Startups</th>
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<tr>
<td>Overview of Entrepreneurship and its need.</td>
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<tr>
<th>Unit</th>
<th>Entrepreneur - Qualities, Strengths &amp; Challenges - Govt. Regulations &amp; Taxes</th>
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<tr>
<td>Qualities and its strength, challenges as well as respective government originations.</td>
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<th>Unit</th>
<th>Road Map - Goal Setting &amp; Methodology, Case Studies</th>
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<td>Successful case studies and appropriate methodology.</td>
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<tr>
<th>Unit</th>
<th>Skill Sets required- Communication, Linguistic, Analytical &amp; Abstract Thinking Engineering etc.</th>
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<td>Soft skills and hard skills required to become a successful entrepreneur.</td>
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**References**
This course explores the area of cognitive computing and its implications for today’s world of big data analytics and evidence-based decision making. Topics covered include: cognitive computing design principles, natural language processing, knowledge representation. Students will have an opportunity to build cognitive applications, as well as explore how knowledge-based artificial intelligence and deep learning are impacting the field of data science. This course is open to students in Business Intelligence and Analytics, Information Systems, and Masters of Business Administration, or with the permission of the instructor.

**Course Objectives:**
1. To develop algorithms that use AI and machine learning along with human interaction and feedback to help humans make choices/decisions.
2. To get the detailed about appealing new model for application development.
3. To understand how to evaluate patterns and complex relationships in large unstructured data sets.
4. To understand how Cognitive computing supports human reasoning by evaluating data in context and presenting relevant findings along with the evidence that justifies the answers.

**Course Outcomes:**
By the end of the course, students should be able to
1. Understand and discuss what cognitive computing is, and how it differs from traditional approaches.
2. Plan and use the primary tools associated with cognitive computing.
3. Plan and execute a project that leverages cognitive computing.
4. Understand and discuss the business implications of cognitive computing.

**Unit I**
Introduction to Cognitive Systems and computation, Knowledge based AI

**Unit II**
Cognitive Functioning
Learning, Memorising, Adaptation, Self Origination, Control, Thinking, Reasoning, Decision Making & Judgement.

**Unit III**
Mental States

**Unit IV**
Perception and sensing
Hardware machines of vision and audition with reference to human and machine.

**References**
### Robotics
Robotics is a branch of AI, which is composed of Electrical Engineering, Mechanical Engineering, and Computer Science for designing, construction, and application of robots. The robots have mechanical construction, form, or shape designed to accomplish a particular task. They have electrical components which power and control the machinery. They contain some level of computer program that determines what, when and how a robot does something.

### Course Objectives:
1. To get the detailed robotics and rapid development.
2. To understand the robots functions.
3. To understand how mechanical devices converting into intelligent machines through a branch of computer science called artificial intelligence (AI).

### Course Outcomes:
By the end of the course, students should be able to
1. The goal of this course is to familiarize the students with the basic concepts of robotics, artificial intelligence and intelligent machines.
2. It will help students to understand and apply principles, methodology and techniques of intelligent systems to robotics.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
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<tbody>
<tr>
<td>I</td>
<td>Intelligent Robotics</td>
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<tr>
<td>II</td>
<td>Direct Kinematics</td>
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<tr>
<td>III</td>
<td>Inverse Kinematics</td>
</tr>
<tr>
<td>IV</td>
<td>Workspace Analysis and Trajectory Planning</td>
</tr>
</tbody>
</table>

### References:
1. Robotics and AI”, Andrew Staugaard, PHI.
7. Elaine Rich and Kevin Knight, “Artificial Intelligence”, TMH.