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

I N D E X

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.

B.E. (Information Technology) 2015 Course to be implemented from Academic Year 2018-19

SEMESTER-I

Subject Code	Subject	Teaching Scheme			Examination Scheme					Total Marks	Credits
		Lecture	Practical	Tutorial	In-Sem	TW	PR	OR	End-Sem		
414453	Information and Cyber Security	3	--	--	30	--	--	--	70	100	3
414454	Machine Learning and Applications	4	--	--	30	--	--	--	70	100	4
414455	Software Design and Modeling	3	--	--	30	--	--	--	70	100	3
414456	Elective-I	3	--	--	30	--	--	--	70	100	3
414457	Elective -II	3	--	--	30	--	--	--	70	100	3
414458	Computer Laboratory-VII	--	4	--	--	50	50	--	--	100	2
414459	Computer Laboratory-VIII	--	4	--	--	50	--	50	--	100	2
414460	Project Phase-I	--	--	2	--	--	--	50	--	50	2
414461	Audit Course-V	--	--	--	--	--	--	--	--	Grade	
Total		16	8	2	150	100	50	100	350	750	22
Total of Part-I		26			750						

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)

Elective I		Elective II	
414456 A	1. Wireless Communications	414457A	1. Software Defined Networks
414456B	2. Natural Language Processing	414457B	2. Soft Computing
414456C	3. Usability Engineering	414457C	3. Software Testing and Quality Assurance
414456D	4. Multicore and Concurrent Systems	414457D	4. Compiler Construction
414456E	5. Business Analytics and Intelligence	414457E	5. Gamification

Audit Course-V	
414461A	1. Emotional Intelligence
414461B	2. Green Computing
414461C	3. Critical Thinking
414461D	4. Statistical Learning model using R.

SEMESTER –II

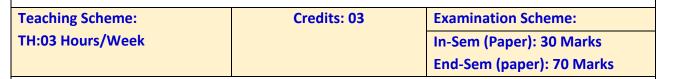| Subject Code	Subject	Teaching Scheme			Examination Scheme					Total Marks	Credits
		Lecture	Practical	Tutorial	In-Sem	TW	PR	OR	End-Sem		
414462	Distributed Computing System	3	--	--	30	--	--	--	70	100	3
414463	Ubiquitous Computing	3	--	--	30	--	--	--	70	100	3
414464	Elective-III	3	2	--	30	25	--	25	70	150	4
414465	Elective-IV	3	--	--	30	--	--	--	70	100	3
414466	Computer Laboratory-IX	--	4	--	--	50	50	--	--	100	2
414467	Computer Laboratory-X	--	2	--	--	25	--	25	--	50	1
414468	Project Work	--	--	6	--	50	--	100	--	150	6
414469	Audit Course-VI	--	--	--	--	--	--	--	--	Grade	
Total		**12**	**8**	**6**	**120**	**150**	**50**	**150**	**280**	**750**	**22**
Total of Part-II		**26**			**750**						

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		Elective IV	
414464A	1. Internet of Things (IoT)	414465A	1. Rural Technologies and Community Development
414464B	2. Information storage and retrieval	414465B	2. Parallel Computing
414464C	3. Multimedia Techniques	414465C	3. Computer Vision
414464D	4. Internet and Web Programming	414464D	4. Social Media Analytics
414464E	5. Computational Optimization	414465E	5. Open Elective

Audit Course-VI	
414469A	1. IoT – Application in Engineering field
414469B	2. Entrepreneurship
414469C	3. Cognitive Computing
414469D	4. AI and Robotics

SEMESTER-I

	Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 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

Information Security Concepts, Security Threats and Vulnerabilities, Security Architectures and Operational Models, Types of Security attacks, Goals of Security, Malicious code, Intrusion detection system (IDS): Need, Types, Limitations and Challenges, security and privacy.

Unit II	SYMMETRIC AND ASYMMETRIC KEY CRYPTOGRAPHY	7Hrs

Introduction, Classical Encryption Techniques, Block Ciphers and Data Encryption standards, Advanced Encryption standard, Public Key Cryptography and RSA, Chinese Remainder Theorem, Diffie-Hellman, Elgamal Curve Arithmetic, Elliptic Curve Arithmetic, Elliptic Curve Cryptography.

Unit III	DATA INTEGRITY ALGORITHMS AND SECURITY REQUIREMENTS	7 Hrs

Cryptographic Hash Functions, requirements and security, SHA-1, SHA-3, Digital Signatures, X.509 Certificate, Kerberos, IP Security: Architecture Protocols IPv4, IPv6, AH, EPS, ISAKMP, Web Security: SSL, HTTPS, Mail Security: PGP, S/MIME

Unit IV	LEGAL, ETHICAL, AND PROFESSIONAL ISSUES IN INFORMATION SECURITY, RISK MANAGEMENT	7 Hrs

Overview, Risk identification, Risk Assessment, Risk Control Strategies, Quantitative vs. Qualitative Risk Control Practices. Risk Management. Laws and Ethics in Information Security, Codes of Ethics, Protecting programs and data.

Unit V	INTRODUCTION TO CYBER LAWS	7 Hrs

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.

Unit VI	TOOLS AND METHODS USED IN CYBERCRIME	7 Hrs

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.

Text Books

1. William Stallings, Computer Security : Principles and Practices, Pearson 6th Ed, ISBN: 978-0-13-335469-0
2. Nina Godbole, Sunit Belapure , Cyber Security- Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiely India Pvt.Ltd, ISBN- 978-81-265-2179-1
3. Bernard Menezes, Network Security and Cryptography, Cengage Learning , ISBN-978-81-315-1349-1
4. Dr. V.K. Pachghare, Cryptography and Information security, PHI, Second edition, ISBN- 978-81-203-5082-3

Reference Books

1. Bruice Schneier , Applied Cryptography- Protocols, Algorithms and Source code in C, Algorithms, Wiely India Pvt Ltd, 2nd Edition, ISBN 978-81-265-1368-0.
2. Nina Godbole , Information Systems Security , Wiley India Pvt. Ltd, ISBN -978-81-265-1692-6
3. CK Shyamala et el., Cryptography and Security, Wiley India Pvt. Ltd, ISBN-978-81-265-2285-9.
4. Berouz Forouzan, Cryptography and Network Security, TMH, 2 edition, ISBN -978-00-707-0208-0.
5. Mark Merkow, Information Security-Principles and Practices, Pearson Ed., ISBN- 978-81-317-1288-7.

Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 414454: 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.
3. Understanding nature of problems solved with Machine Learning.

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.

Unit I	**INTRODUCTION TO MACHINE LEARNING**	8 Hrs

Introduction: What is Machine Learning, Examples of Machine Learning applications, Training versus Testing, Positive and Negative Class, Cross-validation.
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
Theory of Generalization: Bias and Variance Dilemma, Training and Testing Curves Case Study of Polynomial Curve Fitting.

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.

Unit V	PROBABILISTIC MODELS	8 Hrs

Conditional Probability, Joint Probability, Probability Density Function, Normal Distribution and its Geometric Interpretation, Naïve Bayes Classifier, Discriminative Learning with Maximum Likelihood. Probabilistic Models with Hidden variables: Expectation-Maximization methods, Gaussian Mixtures

Unit VI	TRENDS IN MACHINE LEARNING	8 Hrs

Ensemble Learning: Combining Multiple Models, Bagging, Randomization, Boosting, Stacking

Reinforcement Learning: Exploration, Exploitation, Rewards, Penalties

Deep Learning: The Neuron, Expressing Linear Perceptron as Neurons, Feed Forward Neural Networks, Linear Neurons and their Limitations, Sigmoid, Tanh and ReLU Neurons

Text Books

1. Ethem Alpaydin: Introduction to Machine Learning, PHI 2nd Edition-2013.
2. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.

Reference Books

1. C. M. Bishop: Pattern Recognition and Machine Learning, Springer 1st Edition-2013.
2. Ian H Witten, Eibe Frank, Mark A Hall: Data Mining, Practical Machine Learning Tools and Techniques, Elsevier, 3rd Edition.
3. Parag Kulkarni: Reinforcement Learning and Systemic Machine Learning for Decision Making, IEEE Press, Reprint 2015.
4. Nikhil Buduma: Fundamentals of Deep Learning, O'Reilly Media, June 2017.
5. Hastie, Tibshirani, Friedman: Introduction to Statistical Machine Learning with Applications in R, Springer, 2nd Edition 2012.
6. Kevin P Murphy: Machine Learning – A Probabilistic Perspective, MIT Press, August 2012.

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:

1. Problem Solving & Object-Oriented Programming.
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

1. Understand object oriented methodologies, basics of Unified Modeling Language (UML).
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

Views of Software Developments: Traditional System Development Methodology and Object Oriented Analysis and Design, Importance Object –Orientation
Some of the object Oriented Methodology:- Object Oriented Design –Booch, Object Modeling Techniques – Rumbaugh, Object – Oriented Analysis - Cood Yourdon, Object – Oriented Software Engineering – Ivar Jacobson
Unified Approach: Object Oriented Analysis, Object Oriented Design, Iterative Development & Continuous Testing, Modeling Based on UML, Layered Approach,
Unified Modeling Language: Introduction to Modeling & UML, MDA, UML Structure, UML Building Blocks, UML Common Mechanisms, Introduction to all UML Diagram Notational Techniques, 4+1 View.

Unit II	OBJECT ORIENTED ANALYSIS	7 Hrs

Object Oriented Analysis Process,
Use Case Modeling: Actor Identification, Actor Classification, Actor Generalization, Use Cases Identification, Communication, Uses/Include and Extend Associations, Writing a Formal Use Cases, Use Case realizations.
Domain / Class Modeling: Approaches For Identifying Classes (Noun-Phase Approach, Common Class Pattern Approach, Class Responsibilities Collaboration Approach, Naming Classes,
Class Associations and Identification of Associations, Generalization/Specialization Relationship, Aggregation and Composition Relationships, Attributes and Methods Identification.

Unit III	INTERACTION AND BEHAVIOR MODELING	7 Hrs

Activity Diagram : Activity and Actions, Initial and Final Activity, Activity Edge, Decision and Merge Points, Fork and Join, Input and Output Pins, Activity Group, Activity Partitions, Constraints on Action, Swim Lanes.
Sequence Diagram: Context, Objects and Roles, Links, Object Life Line, Message or stimulus, Activation/Focus of Control, Modeling Interactions.
Collaboration Diagram: Objects and Links, Messages and stimuli, Active Objects, Communication Diagram, Iteration Expression, Parallel Execution, Guard Expression, Timing Diagram.
State Diagram: State Machine, Triggers and Ports, Transitions, Initial and Final State, Composite States, Submachine States.

Unit IV	OBJECT ORIENTED DESIGN	7 Hrs

Object Oriented Design Process
Designing Business Layer : Object Oriented Constraints Language (OCL), Designing Business Classes : The Process, Designing Well Defined Class Visibility, Attribute Refinement, Method Design Using UML Activity Diagram, Packaging and Managing Classes.
Designing Access Layer: Object Relational Systems, Object Relation Mapping, Table Class Mapping, Table – Inherited Classes Mapping, Designing the Access Layer Classes: The Process,
Designing View Layer: View Layer Classes Design, Identifying View Classes by Analyzing Use Cases, Macro-Level Design Process, and Prototyping the User Interface.
Component and Deployment Design using Component and Deployment Diagram.

Unit V	DESIGN PRINCIPLES AND PATTERNS	7 Hrs

Introduction to Patterns
General Responsibility Assignment Software Patterns (GRASP) : Introduction, Creator , Information Expert, Low coupling, Controller, High Cohesion, Polymorphism , Pure fabrication, Indirection, Protected Variations.
Gang of Four (GoF): Introduction, Categories of Patterns (Creational, Structural and Behavioral Patterns), Singleton, Adapter, State, and Strategy.

Unit VI	ARCHITECTURAL DESIGN	7 Hrs

Overview of software Architecture, Designing Client / Server Software Architectures, Designing Service Oriented Software Architectures, Designing Component Based Software Architectures, Designing Concurrent and Real-Time Software Architectures, Designing Product Line Architectures, Related Case Studies.

Text Books

1. Ali Bahrami, Object Oriented System Development: Using Unified Modeling Language, McGraw-Hill, International Editions 1999,ISBN:0-07-116090-6.
2. Craig Larman, Applying UML and Patterns, Pearson Education, Second Edition,ISBN:978-0130925695.
3. Erich Gamma et al, Design Patterns: Elements of Reusable Object, Pearson, First Edition,ISBN:9789332555402, 9332555400.

Reference Books

1. Martin Fowler, UML Distilled, Pearson, Third Edition, ISBN:978-81-317-1565-9
2. Dan Pilone, Neil Pitman, UML in Nutshell, O'reilly Pub.,ISBN:8184040024, 9788184040029.
3. Roger S. Pressman, Software Engineering: A Practitioner's Approach, McGraw Hill, Seventh   Edition,ISBN: 9339212088, 9789339212087.
4. Hassan Gomaa, Software Modeling And Design UML, Use Cases, Pattern, & Software Architectures, Cambridge University Press, ISBN: 978-0-521-76414-8.
5. JIM Arlow, Ila Neustadt, UML 2 and the Unified Process, Pearson, Second Edition, ISBN: 9788131700549 Tom Pender, UML 2 Bible, Wiley India, ISBN: 9788126504527.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414456A: Elective-I
Wireless Communications

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

Prerequisites:
1. Foundations of Communication and Computer network.
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

Access Methods: TDMA (TDD and FDMA); Spread-Spectrum Frequency-Hopping; Direct-Sequence CDMA and CSMA. Comparison of Linearly Amplified BPSK, DQPS and DQPSK and Nonlinearly Amplified (NLA) GMSK, GFSK, 4-FM, and FQPSK Radio Equipment (Coherent and Noncoherent). Radio Link Design of Digital Wireless Cellular Systems. Spectrum Utilization in Digital Wireless Mobile Systems. Capacity and Throughput (Message Delay) Study and Comparison of GMSK, GFSK, and FQPSK Modulated Wireless Systems. Time Division Multiple Access Wireless Cellular Systems. Code Division Multiple Access Spread-Spectrum Digital Cellular IS-95 System.

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

Introduction to Wi-Fi, WiMAX, ZigBee Networks, Software Defined Radio, UWB Radio, Wireless Adhoc Network and Mobile Portability, Security issues and challenges in a Wireless network.

Text Books

1. Rappaport, T.S., "Wireless communications", Second Edition, Pearson Education, 2010.
2. Wireless Communications and Networking, Vijay Garg, Elsevier.
3. Wireless digital communication, KamiloFeher, PHI.
4. Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 20063.

Reference Books

1. David Tse and PramodViswanath, "Fundamentals of Wireless Communication", Cambridge University Press, 2005.
2. UpenaDalal, " Wireless Communication", Oxford University Press, 2009.
3. Van Nee, R. and Ramji Prasad, "OFDM for wireless multimedia communications", Artech House, 2000.
4. Mobile Communications Engineering, William C. Y. Lee, McGraw Hill Publications.
5. Mobile and personal Communication system and services by Rajpandya, IEEE press (PHI).
6. Wireless Communications-T.L.Singh-TMH.
7. Adhoc Mobile Wireless network, C.K.Toh Pearson.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414456B: Elective-I
Natural Language Processing

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

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

Applications of Natural Language Understanding, Evaluating Language Understanding Systems, The Elements of Simple Noun Phrases, Verb Phrases and Simple Sentences, Noun Phrases, Adjective Phrases, Adverbial Phrases.

Unit II	GRAMMARS	7 Hrs

Grammars and Sentence Structure, Top-Down Parser, Bottom-Up Chart Parser, Top-Down Chart Parsing, Finite State Models and Morphological Processing, Feature Systems and Augmented Grammars, Morphological Analysis and the Lexicon, Parsing with Features.

Unit III	EFFICIENT PARSING	7 Hrs

Auxiliary Verbs and Verb Phrases, Noun Phrases and Relative Clauses, Human Preferences in Parsing, Encoding Uncertainty: Shift-Reduce Parsers, A Deterministic Parser, Techniques for Efficient Encoding of Ambiguity, Partial Parsing.

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	7 Hrs

Semantic Interpretation and Compositionality, Prepositional Phrases and Verb Phrases, Lexicalized Semantic Interpretation and Semantic Roles, Handling Simple Questions, Semantic Interpretation Using Feature Unification, Semantic Filtering Using Selectional Restrictions, Semantic Networks, Statistical Word Sense Disambiguation

Unit VI	KNOWLEDGE REPRESENTATION	7 Hrs

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.

Text Books

1. Allen James, Natural Language Understanding, Pearson India, 2nd Edition, ISBN: 9788131708958, 8131708950.
2. James H. Martin, Daniel Jurafsky, Speech and Language Processing,Pearson,1st Edition,ISBN: 9789332518414, 8131716724.

Reference Books

1. M. Christopher, H. Schutze , Foundations of Statistical Natural Language Processing, MIT Press,1st Edition, ISBN:9780262133609.
2. C. Eugene,Statistical Language Learning, MIT Press,1st Edition, ISBN:9780262032162.
3. S. Bird, E. Klein &E. Loper,Natural Language Processing with Python, O' Reilly(Shroff Publishers), 1st Edition,ISBN:9788184047486.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414456C: Elective-I
Usability Engineering

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

Prerequisites:
1. Human Computer Interaction.

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

The Usability Engineering Lifecycle: Know the User, Competitive Analysis, Goal Setting, Parallel Design, Participatory Design, Coordinating the Total Interface, Guidelines and Heuristic Evaluation, Prototyping, Interface Evaluation, Iterative Design, Follow-Up Studies of Installed Systems, Meta-Methods, Prioritizing Usability Activities, Be Prepared.

Unit III	USABILITY HEURISTICS	7 Hrs

Usability Heuristics: Simple and Natural Dialogue, Speak the Users' Language, Minimize User Memory Load, Consistency, Feedback, Clearly Marked Exits, Shortcuts, Good Error Messages, Prevent Errors, Help and Documentation, Heuristic Evaluation.

Unit IV	USABILITY TESTING	7 Hrs

Usability Testing: Test Goals and Test Plans, Getting Test Users, Choosing Experimenters, Ethical Aspects of Tests with Human, Subjects, Test Tasks, Stages of a Test, Performance Measurement, Thinking Aloud, Usability Laboratories.

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

Interface Standards: National, International and Vendor Standards, Producing Usable In-House Standards. International User Interfaces: International Graphical Interfaces, International Usability Engineering Guidelines for Internationalization Resource Separation, Multi-locale Interfaces.

Unit VI	FUTURE DEVELOPMENTS	7 Hrs

Future Developments: Theoretical Solutions, Technological Solutions, CAUSE Tools: Computer-Aided Usability Engineering, Technology Transfer, Ubiquitous Computing, Intelligent User-interfaces, Simulation and Virtual Reality.

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

Text Books

1. Jakob Nielsen, "Usability Engineering", Morgan Kaufmann, An Imprint of Academic Press, Harcourt Science and Technology Company

Reference Books

1. Rosson, M. B., & Carroll, J. M. (2001), "Usability Engineering: Scenario-Based development of human-computer interaction", Elsevier.
2. Mayhew, D. (1999), "The Usability Engineering Lifecycle: A Practitioner's Handbook for user interface design", Morgan Kaufmann.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414456D: Elective-I
Multicore and Concurrent Systems

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

Prerequisites:
1. Computer Architecture and Organization.
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

Information Security Concepts, Security Threats and Vulnerabilities, Security Architectures and Operational Models, Types of Security attacks, Goals of Security, Malicious code, Intrusion detection system (IDS): Need, Types, Limitations and Challenges, security and privacy.

Unit II	MULTICORE AND CONCURRENT PROGRAM DESIGN	7 Hrs

The PCAM methodology, Decomposition patterns: Task parallelism, Divide-and-conquer decomposition.
Geometric decomposition, Recursive data decomposition, Pipeline decomposition, Event-based coordination decomposition, Program structure patterns: Single-program, multiple-data, Multiple-program, multiple-data, Master-worker, Map-reduce, Fork/join, Loop parallelism, Matching decomposition patterns with program structure patterns.

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

Introduction, OpenMP integration V.0: manual partitioning, OpenMP integration V.1: manual partitioning without a race condition, OpenMP integration V.2: implicit partitioning with locking, OpenMP integration V.3: implicit partitioning with reduction, Loop-level parallelism, Task parallelism, Synchronization constructs, Correctness and optimization issues.

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 proiling 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, Proiling CUDA programs, CUDA and MPI.

Text Books

1. Gerassimos Barlas, "Multicore and GPU Programming An Integrated Approach", Morgan Kaufmann, 2015.
2. Max Domeika, "Software Development for Embedded Multi-core Systems: A Practical Guide Using Embedded Intel® Architecture", Elsevier Inc., 2008.
3. Jean Bacon, Janet Van Der Linden, "Concurrent Systems: An Integrated Approach to Operating Systems, Distributed Systems and Database", Addison-Wesley, Edition 2000

Reference Books

1. John L. Hennessey and David A. Patterson, " Computer Architecture – A quantitative approach", Morgan Kaufmann / Elsevier, 4th. Edition.
2. David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture : A hardware/ software approach", Morgan Kaufmann / Elsevier. 3. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris", Pearson, 2011.
3. William Stallings, "Computer Organization and Architecture – Designing for Performance", Pearson Education, Seventh Edition.
4. Dezso Sima, Terence Fountain, Peter Kacsuk "Advanced Computer Architectures" A Design space approach, Pearson Education.
5. Advanced Computer Architecture Parallelism, Scalability – Kai Hwang, Programmability, Tata McGrawhill.
6. 4. Michael J Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw

Hill, 2003.
7. Shameem Akhter and Jason Roberts, "Multi-core Programming", Intel Press, 2006.
8. Roscoe A.W., "Understanding Concurrent Systems", Springer-Verlag, 2010.

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:
1. Fundamentals of Database Management System.
2. Fundamentals of Discrete mathematics.

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.
3. Propose the Framework for business intelligence.
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 III	Data Visualization and Dashboard Design	7 Hrs

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.

Unit IV	Business Performance Management Systems	7 Hrs

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.

Unit V	Role of Business Intelligence and Analytics in Business	7 Hrs

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

Unit VI	BI Maturity, Strategy and Modern Trends in BI	7 Hrs

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.

Text Books

1. Sabherwal, R. and Becerra-Fernandez, I.(2011). Business Intelligence: Practices, Technologies and Management. John Wiley.
2. Turban,E. and Volonino, L.(2011). Information Technology for Managment: Improving Strategic and Operational Performance. 8th edn.Wiley.

Reference Books

1. Avison, D. and Fitzgerald, G. (2006). Information Systems development: Methodologies, techniques and tools. 4th ed. McGraw-Hill.
2. Anderson-Lehman, R., Watson, H.J., Wixom, B.H., & Hoffer, J.A., 2004, Continental Airlines Flies High with Real-Time Business Intelligence, MIS Quarterly Executive, 3, 4, pp 163-176
3. Gangadharan, G.R., & Swami, N., 2004, Business Intelligence Systems: Design and Implementation Strategies, Proceedings of the 2nd International conference on Technology Interfaces, June 7-10, Cavtat, Croatia, pp 139-144

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414457A: 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.

Unit I	INTRODUCTION TO SDN: AN OVERVIEW	7 Hrs

Introduction: 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.

Unit II	OPEN FLOW PROTOCOLS	7 Hrs

Introduction: Definition, OpenFlow architecture, Flow & Group Tables, types,Hybrid Approaches, The OpenFlow forwarding and pipeline model. OpenFlow Advantages and Limitations, OpenFlow Protocol. Use Case:FloodLight, Mininet,

Unit III	NETWORK VIRTUALIZATION (NV)	7 Hrs

Definition, Concepts, Benefits of Network Virtualization, Components of a Virtual Network, Applications, Existing Network Virtualization Framework (VMWare and others), Network as a Service (NaaS).

Unit IV	CONTROL PLANE	7 Hrs

Control Plane: Overview, Existing SDN Controllers including Floodlight and Open Daylight projects. Customization of Control Plane: Switching and Firewall Implementation using SDN Concepts.

Unit V	DATA PLANE	7 Hrs

Data Plane: Software-based and Hardware-based; Programmable Network, Hardware.
Programming SDNs: Northbound Application Programming Interface,
Current Languages and Tools, Composition of SDNs.

Unit VI	NETWORK FUNCTIONS VIRTUALIZATION (NFV)	7 Hrs

Introduction: Concepts, Comparison of NFV and NV, Implementation and Applications.
Data Center Networks: Packet, Optical and Wireless Architectures, Network Topologies.

Text Books

1. Thomas D. Nadeau, Ken Gray, SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, O'Reilly Media, ISBN:10:1-4493-4230-2, 978-1-4493-4230-2.
2. Paul Goransson and Chuck Black, Software Defined Networks: A Comprehensive Approach, Morgan Kaufmann, ISBN: 9780124166752, 9780124166844.

Reference Books

1. Vivek Tiwari, SDN and OpenFlow for Beginners ,Digital Services,10: 1-940686-00-8 13: 978-1-940686-00-4
2. Fei Hu, Network Innovation through OpenFlow and SDN: Principles and Design,CRC Press,ISBN:10: 1466572094
3. Open Networking Foundation (ONF)Documents, https://www.opennetworking.org
4. OpenFlow standards, http://www.openflow.or
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

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

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	7 Hrs

Basic concepts of Soft Computing, Historical Developments and Definitions, Soft Computing Characteristics and Problem Solving– Strengths and Weaknesses, Constitutes of Soft Computing : Neural Computing, Fuzzy Logic and Computing, Evolutionary Computing and Genetic Algorithms, Probabilistic Reasoning.

Unit II	NEURAL NETWORKS OVERVIEW	7 Hrs

Fundamentals: Biological Neurons and Model of Artificial Neuron. Neural Network Architectures: Single Layer Network, Multi-Layer Feed Forward Neural Networks, and Feedback Networks. Perceptron Model and Learning in Perceptron, Limitation of Learning in Perceptron, Error Back Propagation learning in Multilayer FFNN. Performance Issues of EBP algorithm for MLFFNN.

Unit III	NEURAL NETWORK ARCHITECTURES	7 Hrs

Complex Architectures Learning: Competitive Learning-Self Organizing Maps, Hebbian Learning-Hopfield Networks, Boltzmann Machines, Adaptive Resonance Theory (ART) Networks, Bayesian Neural Networks, Deep Learning Architecture of Neural Networks, Applications of Neural Networks.

Unit IV	FUZZY LOGIC AND FUZZY SYSTEMS	7 Hrs

Fuzzy Logic, Fuzzy Sets and Operations, Fuzzy Relations, Fuzzy Arithmetic and Fuzzy Measures. Fuzzy to Crisp Conversions: Lambda Cuts for fuzzy sets, Fuzzy Relations, Defuzzification Methods. Fuzzy Rules and Reasoning, Fuzzy Inference Systems, Mamdani Fuzzy Models – Sugeno Fuzzy Models, Applications of Fuzzy Modeling for Decision Making.

Unit V	GENETIC ALGORITHMS	7 Hrs

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.

Unit VI	ADVANCES IN SOFT COMPUTING	7 Hrs

Soft Computing Paradigms and Hybrid Approaches. Neuro-Fuzzy modeling, Genetic Algorithm Based Backpropagation Network, Fuzzy logic based Backpropagation, Fuzzy Logic Controlled Genetic Algorithms, Simplified Fuzzy ARTMAP.

Text Books

1. S. N. Sivanandam, S. N. Deepa,Principles of Soft Computing,Wiley publications,2nd Edition, ISBN: 9788126527410.
2. J. S. R. Jang, C. T. Sun, E. Mizutani, Neuro-Fuzzy and Soft Computing- A computational approach to Learning and Machine Intelligence, PHI,1st Edition, ISBN:978-8131792469.

Reference Books

1. David E. Goldberg, Genetic Algorithms, Pearson Education, 2nd Edition, ISBN: 9788120322431, ISBN: 9780201157673.
2. Satish Kumar, Neural Networks - A Classroom Approach, Tata McGraw Hill,2nd Edition, ISBN:1259006166.
3. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Wiley India, 3rd Edition, ISBN: 9788126531264.
4. Samir Roy, Udit Chakroborthy,Introduction to soft computing - neuro-fuzzy and genetic algorithm ,Person Education, 1st Edition.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414457C: Elective-II
Software Testing and Quality Assurance

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

Prerequisites:
1. Software Engineering.

Course Objectives:
1. Learn to apply the testing strategies and methodologies in projects.
2. To understand test management strategies and tools for testing.
3. A keen awareness on the open problems in software testing and maintenance.
4. To explain quality assurance and various tools used in quality management.
5. To learn in detail about various quality assurance models.
6. To understand the audit and assessment procedures to achieve quality.

Course Outcomes:
By the end of the course, students should be able to
1. Test the software by applying testing techniques to deliver a product free from bugs.
2. Investigate the scenario and to select the proper testing technique.
3. Explore the test automation concepts and tools and estimation of cost, schedule based on standard metrics.
4. Understand how to detect, classify, prevent and remove defects.
5. Choose appropriate quality assurance models and develop quality.
6. Ability to conduct formal inspections, record and evaluate results of inspections.

Unit I	SOFTWARE TESTING BASICS	7 Hrs

Testing as an engineering activity, Role of process in software quality, Testing as a process, Basic definitions, Software testing principles, The tester's role in a software development organization, Origins of defects, Defect classes, The defect repository and test design, Defect examples, Developer / Tester support for developing a defect repository.

Unit II	TESTING TECHNIQUES AND LEVELS OF TESTING	7 Hrs

Using White Box Approach to Test design - Static Testing Vs. Structural Testing, Code Functional Testing, Coverage and Control Flow Graphs, Using Black Box Approaches to Test Case Design, Random Testing, Requirements based testing, Decision tables, State-based testing, Cause-effect graphing, Error guessing, Compatibility testing, Levels of Testing -Unit Testing, Integration Testing, Defect Bash Elimination. System Testing - Usability and Accessibility Testing, Configuration Testing, Compatibility Testing.

Random Testing, Requirements based testing, Decision tables, State-based testing, Cause-effect graphing, Error guessing, Compatibility testing, Levels of Testing -Unit Testing, Integration Testing, Defect Bash Elimination. System Testing - Usability and Accessibility Testing, Configuration Testing, Compatibility Testing.

Unit III	SOFTWARE TEST AUTOMATION AND QUALITY METRICS	

Software Test Automation, Skills needed for Automation, Scope of Automation, Design and Architecture for Automation, Requirements for a Test Tool, Challenges in Automation Tracking the Bug, Debugging. Testing Software System Security - Six-Sigma, TQM - Complexity Metrics and Models, Quality Management Metrics, Availability Metrics, Defect Removal Effectiveness, FMEA, Quality Function Deployment, Taguchi Quality Loss Function, Cost of Quality.

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

Software Process- PSP and TSP, OO Methodology, Clean-room software engineering, Defect Injection and prevention, Internal Auditing and Assessments, Inspections & Walkthroughs, Case Tools and their Affect on Software Quality.

Text Books

1. Srinivasan Desikan, Gopalaswamy Ramesh,Software Testing: Principles and Practices Pearson.
2. Daniel Galin, Software Quality Assurance: From Theory to Implementation, Pearson Addison Wesley.

Reference Books

1. Aditya P. Mathur, Foundations of Software Testing, Pearson.
2. Paul Ammann, Jeff Offutt, Introduction to Software Testing, Cambridge University Press.
3. Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Auerbach Publications.
4. William Perry, Effective Methods of Software Testing, Wiley Publishing, Third Edition.
5. Renu Rajani, Pradeep Oak, Software Testing – Effective Methods, Tools and Techniques, Tata McGraw Hill.
6. Stephen Kan, Metrics and Models in Software Quality, Addison – Wesley, Second Edition.
7. S.A.Kelkar, Software quality and Testing, PHI Learing, 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

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

Prerequisites:
1. Fundamentals of System Programming.
2. Computer Organization and architecture.
3. Processor Architecture and Interfacing.
4. Fundamentals of Data Structures, Data Structures and Files.
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;

Garbage collection: Mark-and-sweep collection, copying, generational collection, incremental collection, Baker's algorithm, Interface to the compiler.

Unit III	OBJECT ORIENTED AND FUNCTIONAL PROGRAMMING LANGUAGE	7 Hrs

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.

Unit IV	POLYMORPHIC TYPES AND DATA FLOW ANALYSIS	7 Hrs

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.

Unit V	STATIC SINGLE ASSIGNMENT FORM	7 Hrs

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.

Unit VI	PIPELINING AND SCHEDULING	7 Hrs

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.

Text Books

1. Andrew W Appel, Modern compiler implementation in C, Cambridge University, Press,4TH, ISBN:0 521 58390 X.

Reference Books

2. J. Singer,Static Single Assignment Book, Springer,1st Edition.
3. Russell Jesse , Static Single Assignment Form, Springer, ISBN: 10: 5508387455.
4. B. Alpern, M. N. Wegman, and F. K. Zadeck, Detecting Equality of Variables in Programs. Proceedings of the Fifteenth Annual ACM Symposium on Principles of Programming Languages, ACM.
5. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Compilers Principles, Techniques and Tools, Addison Wesley, Low Price Edition, ISBN: 981–235–885 – 4.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414457E: 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.

Unit I	Gaming Foundations	7 Hrs

Introduction: Definition of Gamification, Why Gamify, Examples and Categories, Gamification in Context, Resetting Behavior, Replaying History, Gaming foundations: Fun Quotient, Evolution by loyalty, status at the wheel, the House always wins.

Unit II	Developing Thinking	7 Hrs

Re-framing Context: Communicology, Apparatus, and Post-history, Concepts Applied to Video games and Gamification, Rethinking 'playing the game' with Jacques Henriot, To Play Against: Describing Competition in Gamification, Player Motivation: Powerful Human Motivators, Why People Play, Player types, Social Games, Intrinsic verses Extrinsic Motivation, Progression to Mastery. Case studies for Thinking: Tower of Hanoi.

Unit III	Opponent Moves in Gamification	7 Hrs

Reclaiming Opposition: Counter gamification, Gamed Agencies: Affectively Modulating Our Screen-and App-Based Digital Futures, Remodeling design, Game Mechanics, Designing for Engagement, Case study of Maze Problem.

Unit IV	Game Design	7 Hrs

Game Mechanics and Dynamics: Feedback and Re-enforcement, Designing for engagement Game Mechanics in depth, Putting it together, Case study of 8 queen's problem.

Unit V	Advanced tools, techniques	7 Hrs

Gamification case Studies, Coding basic game Mechanics

Unit VI	Applications	7 Hrs

Instant Gamification Platforms, Mambo.io (Ref:http://mambi.io), Installation and use of BigDoor (OpenSourcehttp://bigdoor.com),ngageoint/gamification-server(ref:https://github.com/ ngageoint/ gamification-server).

Text Books

1. Mathias Fuchs, Sonia Fizek, Paolo Ruffino, Niklas Schrape, Rethinking Gamification.
2. http://meson.press/books/rethinking-gamification, Meson Press, First Edition,ISBN:978-3-95796-001-6.
3. Gabe Zechermann, Christopher Cunningham Gamification by Design, Oreilly media, First, ISBN: 978-1-449-39767-8.

Reference Books

1. Susan Jacobs, Getting Gamification Right, The eLearning Guild, First.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414458: Computer Laboratory VII

Teaching Scheme:	Credits:02	Examination Scheme:
Practical:04 Hours/Week		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).
3. Dr. Mark Gardener, Beginning R The Statistical Programming Language, ISBN: 978-81-2654120-1, Wiley India Pvt. Ltd.
4. Jason Bell, "Machine Learning for Big Data Hands-On for Developers and Technical Professionals", ISBN: 978-81-265-5337-2-1, Wiley India Pvt. Ltd.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414459: Computer Laboratory VIII

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

Prerequisites:
1. Problem Solving & Object-Oriented Programming.
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.

Draw Analysis class Model using UML2.0 Notations.

Implement Analysis class Model-class diagram with a suitable object oriented language

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
2. Applying UML and Patterns Second Edition by Craig Larman, Pearson Education
3. UML 2 and the Unified Process, Second Edition, JIM Arlow, Ila Neustadt, Pearson
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
2. Applying UML and Patterns Second Edition by Craig Larman, Pearson Education
3. UML 2 and the Unified Process, Second Edition, JIM Arlow, Ila Neustadt, Pearson
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)
414461: Audit Course-V

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

Course Code	Audit Course Title
414461A	1. Emotional Intelligence
414461B	2. Green Computing
414461C	3. Critical Thinking
414461D	4. Statistical Learning model using R.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414461A: Audit Course-V
Emotional Intelligence

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 4

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

1) Daniel Goleman," Emotional Intelligence – Why It Matters More Than IQ," Bantam Books.

2) ISBN-10: 055338371X13: 978-0553383713 2. Steven Stein, "The EQ Edge", Jossey-Bass, ISBN: 978-0-470-68161-9.

3) Drew Bird, "The Leader's Guide to Emotional Intelligence", ISBN: 9781535176002.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414461B: Audit Course-V
Green Computing

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

Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot Print - Measuring, Details, reasons to bother, Plan for the Future, Cost Savings: Hardware, Power.

Unit II	Green Assets and Power Problems

Green Assets: Buildings, Data Centers, Networks, and Devices, Green Information Systems : Design and Development Models, Monitoring Power Usage, Servers, Low-Cost Options, Reducing Power Use, Data De-Duplication, Low-Power Computers and peripheral devices.

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

1. Woody Leonhard, Katherrine Murray, "Green Home computing for dummies", August2009, ISBN: 978-0-470-46745-9
2. Alvin Galea, Michael Schaefer, Mike Ebbers, "Green Data Center: steps for the Journey",

Shoff/IBM rebook, 2011. ISBN: 10: 1-933742-05-4; 13: 978-1-933742-05-2

3. John Lamb, "The Greening of IT", Pearson Education, 2009, ISBN 10: 0137150830
4. Jason Harris, "Green Computing and Green IT- Best Practices on regulations & industry",Lulu.com, 2008, ISBN: 1558604898.
5. Bud E. Smith, "Green Computing Tools and Techniques for Saving Energy, Money and Resources", CRC Press, 2014, 9781466503403

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414461C: Audit Course-V
Critical Thinking

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

1) "Thinking Fast and Slow"- Daniel Kahneman – Penguin Books.
2) "Critical Thinking – Students Introduction" - Bassham, Irwin, Nardone, Wallace – McGraw Hill.

Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 414461D: Audit Course-V Statistical Learning Model using R

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

Unit I	Introduction to Statistical Learning

What is Statistical Learning, Various issues to consider while "modeling"

Unit II	Getting started with R programming

Introduction to the R-Studio, user-interface, Basic commands, Data Structures in R, Graphics, Reading data into R.

Unit III	Linear Regression models including Lab

Instructor should select a problem statement and design the assignment for Linear Regression.

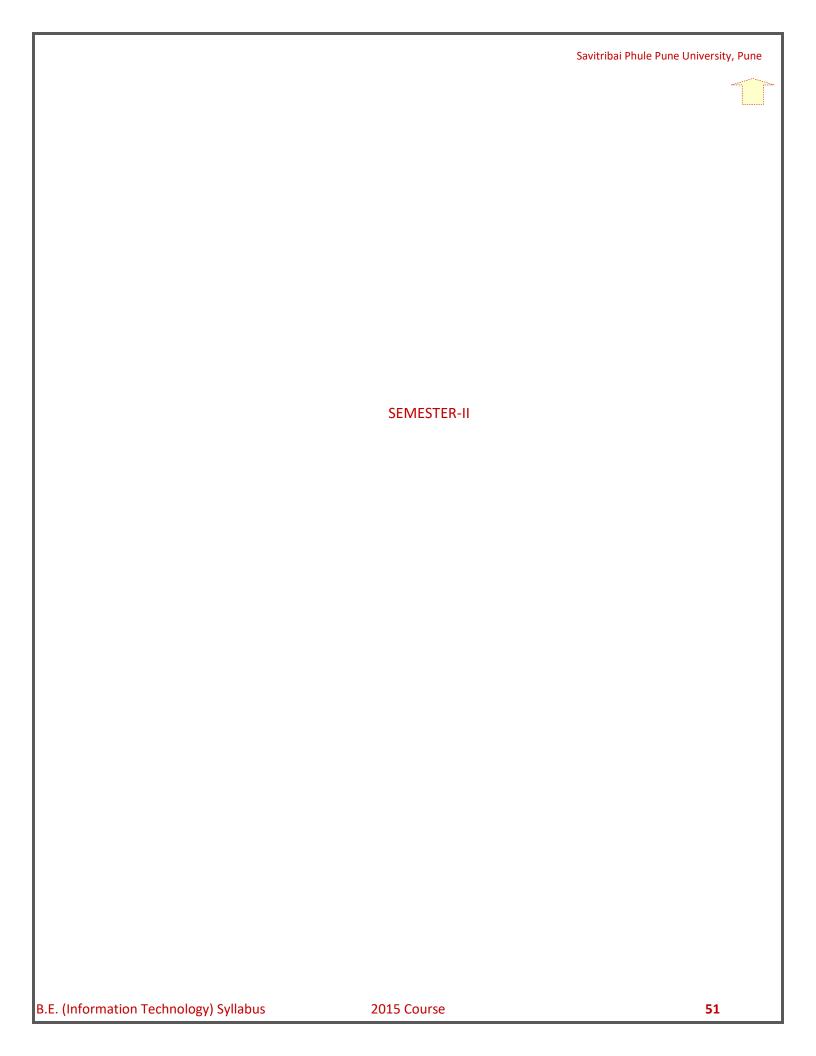| Unit IV	Classification models (Logistic Regression and LDA) with Lab

Instructor should select a problem statement and design the assignment for Logistic Regression and LDA.

Unit VI	Tree based methods (regression trees, classification tree) with Lab

Instructor should select a problem statement and design the assignment for Tree based methods (regression trees, classification tree) with lab.

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

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

Replication: Reasons for replication, Replica management, Failure masking and replication, Consistency protocols, Catching and replication in web,Fault Tolerance: Introduction, Failure models, Fault systems with arbitrary failures, Reliable client server communication, Reliable group communication, Distributed commit, Recovery, Checkpoints.

Case Study: Catching and Replication in Web

UNIT IV	DISTRIBUTED FILES AND MULTIMEDIA SYSTEMS	7 Hrs

Distributed File Systems: Introduction, File System Architecture, Sun Network File System, and HDFS. Name Services: Introduction, Name Services and the Domain Name System, Directory Services.

Case Study- 1: The Global Name Service, 2. The X.500 Directory Service.

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

Architecture of Traditional Web-Based Systems, Apache Web Server, Web Server Clusters, Communication by Hypertext Transfer Protocol, Synchronization, Web Proxy Caching, Replication for Web Hosting Systems, Replication of Web Applications, Fault Tolerance in distributed web based systems, Security Concerns.

Case Study: HyperText Transfer Protocol (HTTP)

UNIT VI	SECURITY IN DISTRIBUTED SYSTEMS	7 Hrs

Introduction to Security: Security Threats, Policies, and Mechanisms, Design Issues, Cryptography.

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

Access Control: General Issues in Access Control, Firewalls, Secure Mobile Code, Denial of Service (DOS).

Security Management: Key Management, Secure Group Management, Authorization Management.

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

Case Study: Kerberos.

Text Books

1. Maarten van Steen, Andrew S. Tanenbaum, Distributed Systems , PHI, 3rd Edition Version 3.01, ISBN: 978-15-430573-8-6(Printed).
2. Andrew S. Tanenbaum, Maarten van Steen, Distributed Systems – Principles and Paradigms, PHI, 2nd Edition, ISBN: 978-0130888938.

Reference Books

1. George Coulouris, Distributed Systems: Concepts and Design,Pearson, 5th edition, Jean Dollimore, Tim Kindberg, Gordon Blair, ISBN:13: 978-0132143011, ISBN:10: 0132143011.
2. Abhijit Belapurkar, Anirban Chakrabarti, Harigopal Ponnapalli, Niranjan Varadarajan, Srinivas Padmanabhuni, Srikanth Sunderrajan, Distributed System Security: Issues, Processes and solutions, Willey online Library, ISBN: 978-0-470-51988-2.
3. Sunita Mahajan, Seema Shah, Distributed Computing, Oxford University Press, 2nd Edition, ISBN-13: 978-0198093480.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414463: Ubiquitous Computing

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

Prerequisites:
1. Human Computer Interaction.
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

Concept of Ubiquitous Computing and Advantages, Ubiquitous Computing Applications and Scope, Properties of Ubiquitous Computing, Modelling the Key Ubiquitous Computing Properties. Ubiquitous System Environment Interaction. Architectural Design for UbiCom Systems: Smart DEI Model.

UNIT II	UBIQUITOUS COMPUTING SMART DEVICES AND SERVICES	7 Hrs

Smart Devices and Service properties, Smart mobile devices and Users, Mobile code, Smart Card Devices and Networks, Service Architecture Models. Service Provision Life-Cycle. Virtual Machines and Operating Systems, OS for Mobile Computers and Communicator Devices.

UNIT III	ACTUATION AND CONTROL	7 Hrs

Tagging the Physical World, Sensors and Networks, Micro- Electro-Mechanical Systems (MEMS), Embedded Systems and Real-Time Systems. Programmable and PID type control system, Robots.

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

1. Stefan Poslad, Ubiquitous Computing, Wiley, Student Edition, ISBN:9788126527335 John Krumm, Ubiquitous Computing Fundamentals.

Reference Books

1. Yin-Leng Theng and Henry B. L. Duh, Ubiquitous Computing, IGI, 2nd Edition, ISBN: 9781599046938.
2. Adam Greenfield, Everyware the Drawing age of Ubiquitous Computing, AIGA, 1st Edition, ISBN: 9780321384010.
3. Laurence T. Yeng, Evi Syukur and Seng W. Loke, Handbook on Mobile and Ubiquitous Computing, CRC, 2nd Edition, ISBN: 9781439848111.

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

Teaching Scheme:	Credits:04	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks
		End-Sem (paper): 70 Marks

Prerequisites:
1. Fundamentals of Communication and Computer Network.
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.

See next page for colour coding

UNIT I	INTRODUCTION TO INTERNET OF THINGS	8 Hrs

What is the Internet of Things? Internet of Things Definitions and Frameworks : IoT Definitions, IoT Architecture, General Observations, ITU-T Views, Working Definition, IoT Frameworks, Basic Nodal Capabilities, Physical Design of IoT: IoT Protocols, Logical Design of IoT: Functional block, communication Model, Communication API's, IoT Enabling Technologies: WSN, cloud computing, Big data Analytics, communication Protocols, Embedded systems, IoT levels and Deployment templates: Level 1 to Level 5.

UNIT II	IoT NETWORK ARCHITECTURE AND DESIGN	8 Hrs

The one M2M IoT Standardized Architecture, The IoT World Forum (IoTWF) Standardized Architecture, A Simplified IoT Architecture, IoT protocol stack, The Core IoT Functional Stack, IoT Data Management and Compute Stack: Fog Computing, Edge Computing, The Hierarchy of Edge, Fog, and Cloud IoT and M2M: Introduction to M2M, Difference between IoT and M2M, SDN and NFV for IoT.

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

Address Capabilities, IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6, Header Compression Schemes, Quality of Service in IPv6, Migration Strategies to IPv6, Mobile IPV6 technologies for the IoT: Protocol Details, IPv6 over low-power WPAN (6LoWPAN).

UNIT V	IoT PLATFORMS	8 Hrs

What is an IoT Device, Exemplary Devices: Raspberry Pi, Raspberry Pi Interfaces, Other IoT Devices: pcDuino, Beagle Bone Black, CubieBoard, ARDUINO.

UNIT VI	IoT PHYSICAL SERVERS AND CLOUD OFFEREINGS	8 Hrs

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.

Text Books

1. Internet of Things: A Hands-On Approach Arshdeep Bahga, Vijay Madisetti VPT – Paperback 2015 978- 0996025515 628/- 2.
2. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things David Hanes, Gonzalo Salgueiro, Patrick Grossetete Cisco Press – Paperback – 16 Aug 2017 978-1- 58714-456- 1 599.
3. Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications Daniel Minoli Willy Publication s - 2013 978-1-118- 47347-4, 466.

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:
1. Computer Network Technology.
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

Open source prototype platform- Raspberry-Pi/Beagle board/Arduino -Simple program digital read/write using LED and Switch -Analog read/write using sensor and actuators.
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'REILL Y IOT.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464B: Elective III
Information Storage and Retrieval

Teaching Scheme: TH:03 Hours/Week	Credits:04	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (paper): 70 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 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	CLASSIFICATOIN AND RETRIEVAL SEARCH STRATEGIES	8 Hrs

Retrieval strategies: Vector Space model, Probabilistic retrieval strategies, Language models, Inference networks, Extended Boolean retrieval, Latent semantic indexing, neural networks, Fuzzy set retrieval.
Retrieval utilities: Relevance feedback, Cluster Hypothesis, Clustering Algorithms: Single Pass Algorithm, Single Link Algorithm.

UNIT III	RETRIEVAL PERFORMANCE EVALUATION AND VISUALISATION	8 Hrs

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, Mata-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

Semantic Search systems: G Semantic Web Google knowledge graphs, Ontology, Searching across ontologies, semantic web search.

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

1. Yates & Neto, Modern Information Retrieval, Pearson Education, ISBN:81-297-0274-6
2. C.J. Rijsbergen, Information Retrieval, (www.dcs.gla.ac.uk)., 2ndISBN:978- 408709293.
3. David Grossman, Ophir Frieder, Information Retrieval - Algorithms and Heuristics, Springer International Edition, ISBN: 978-1-4020-3004-8.
4. Grigoris Antoniou and Frank van Harmelen, A semantic Web Primer, Massachusetts Institute of Technology, ISBN: 978-0-262-01242-3.
5. Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, Foundations of Semantic Web Technologies, Chapman & Hall/CRC, ISBN: 9781420090505.
6. Hang Li, Learning to Rank forInformation Retrievaland Natural Language.
7. Processing, Morgan & Claypool, ISBN: 9781608457076.

Reference Books

1. Christopher D. Manning, Prabhakar Raghavan and HinrichSchutzen, Introduction to Information Retrieval, Cambridge University Press, Online book, ISBN:978-0-521-86571-5
2. Robert Korfhage, Information Storage and Retrieval, John Wiley & Sons,1 Edition, ISBN:9788126507702.
3. Kowalski, Gerald, Maybury, Mark, Information Storage and Retrieval Systems :Theory and Implementation, Springer US, 2nd Edition,ISBN:978-0-7923-7924-9.
4. Zhang, Jin, Visualization for Information Retrieval, Springer-Verlag Berlin Heidelberg,1st Edition,ISBN:978-3-642-09442-2Mark leven, Introduction to search engines and web navigation, John Wiley and sons Inc, 2nd Edition,ISBN 9780-170-52684-2.
5. V. S. Subrahamanian, Satish K. Tripathi , Multimedia information System,Kulwer Academic Publisher.
6. ChabaneDjeraba, Multimedia mining A highway to intelligent multimedia documents, Kulwer Academic Publisher, ISBN:1-4020-7247-3.

7. Ricci, F, Rokach, L. Shapira, B.Kantor, Recommender Systems Handbook.
8. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, Information Retrieval Implementing and Evaluating Search Engines, The MIT Press, Cambridge.

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

1. Yates & Neto, "Modern Information Retrieval", Pearson Education.
2. C.J. Rijsbergen, "Information Retrieval", (www.dcs.gla.ac.uk).
3. R. C. Gonzalez, R. E. Woods, "Digital Image Processing", Pearson Education.

4. Zhang, Jin, "Visualization for Information Retrieval", Springer-Verlag Berlin Heidelberg.

5. V. S. Subrahamanian, Satish K. Tripathi, "Multimedia information System", Kulwer Academic Publisher.

6. Ricci, F, Rokach, L. Shapira, B.Kantor, "Recommender Systems Handbook".

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

Teaching Scheme: TH:03 Hours/Week	Credits:04	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks

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, Nerodigtal,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

1. Ralf Steinmetz and Klara Nahrstedt "Multimedia Computing, Communication and Applications", Pearson Education.
2. K.R. Rao, "Multimedia Communication Systems: Techniques, Standards, and Networks", TMH.
3. Ranjan Parekh, "Principles of Multimedia", 2/E, Tata McGraw-Hill, ISBN: 1259006506
4. David F. Rogers, "Procedural Elements for Computer Graphics", 2nd Ed - Tata McGraw Hill Edition.
5. "OpenGL Programming Guide: The Official Guide to Learning OpenGL", Mason Woo, Jackie, Tom Davis, Version 2.1, 6th Edition, Pearson Education, ISBN 978-81-317-2184-1.

Reference Books

1. Ashok Banerji, AnandaGhosh, "Multimedia Technologies", ISBN: 9780070669239.
2. Gonzalez, Woods, "Digital Image Processing" Addison Wesley.
3. Ze-Nian Li, Marks S. Drew, "Fundamentals of Multimedia", Pearson Education.
4. Edward Angel, "OpenGL: A Primer", Addison-Wesley.
5. Parag Havaldar, Gerard Medioni, "Multimedia Systems", Cengage Learning.
6. Hill, Kelly, "Computer Graphics using OpenGL", 3rd Ed, Eastern Economy Edition.
7. Alan H. Watt and Mark Watt,"Advanced Animation and Rendering Techniques: Theory and Practice", Addison-Wesley, ACM Press, ISBN: 0201544121.
8. Foley, Dam, Feiner, Hughes,"Computer Graphics Principles & Practice", 2nd Ed, Pearson Education.
9. Introduction to Game Development Using Processing, by J. R. Parker , Mercury Learning & Information; Pap/Com edition.

Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 414464C: Multimedia Techniques Laboratory		
Teaching Scheme: **Practical:02 Hours/Week**	**Credits:04**	**Examination Scheme:** **TW:25 Marks** **OR: 25 Marks**

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

1. Ralf Steinmetz and Klara Nahrstedt "Multimedia Computing, Communication and Applications", Pearson Education.
2. K.R. Rao, "Multimedia Communication Systems: Techniques, Standards, and Networks", TMH.
3. Ranjan Parekh, "Principles of Multimedia", 2/E, Tata McGraw-Hill, ISBN: 1259006506.
4. David F. Rogers, "Procedural Elements for Computer Graphics", 2nd Ed - Tata McGraw Hill Edition.
5. "OpenGL Programming Guide: The Official Guide to Learning OpenGL", Mason Woo, Jackie, Tom Davis, Version 2.1, 6th Edition, Pearson Education, ISBN 978-81-317.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464D: Elective III
Internet and Web Programming

Teaching Scheme:	Credits:04	Examination Scheme:
TH:03 Hours/Week		In-Sem (Paper): 30 Marks
		End-Sem (paper): 70 Marks

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

The Internet, Introduction Basic Internet Protocol, The World Wide Web, Introduction to Web Programming, Web Clients, Web Servers, Browser and Search Engines.
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

Introduction to Web Services, Web Services Architecture, XML Messaging, SOAP, WSDL, UDDI, REST, Java Web Services, Amazon Web Services, DevOps, Introduction to Content Management System (CMS), Wordpress / Joomla, Advanced Technology: Bootstrap, JSF, Spring.

UNIT V	MOBILE WEB DEVELOPMENT	8 Hrs

What is Mobile Web? Understanding Mobile Devices, Mobile Data Usage, Mobiles and Desktops, Building an HTML page, Getting jQuery Mobile, Implementing jQuery Mobile, Working with data attributes, Working with jQuery Mobile Pages, Enhancing Pages with Headers, Footers, and Toolbars; Working with Lists, Building a Simple Mobile Website, Working with Forms and jQuery Mobile, Creating Modal Dialogs and Widgets, Creating Grids, Panels, and Other Widgets; jQuery Mobile Configuration, Utilities, and JavaScript Methods; Working with Events.

UNIT VI	WEB SECURITY AND CYBER ETHICS	8 Hrs

Overview of Web Security: Need of Web Security, Breach of Web Security, What need to be Secure on Web? Can Web be secure? Aspects of Web Security, Purpose of Web Security, A Security Equation, Defining Security Equation, Common Threats on Web, User level Security, Server Level Security, Cyber ethics, Issues in Cyber ethics.

Text Books

1. Kogent Learning Solutions Inc,Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Blackbook, Dreamtech Press, Second Edition ,ISBN:9788177228496.
2. Raymond Camden, Andy Matthews, jQuery Mobile Web Development Essentials, Packt Publishing, Second Edition, 9781782167891.
3. Ethan Cerami, Web Services Essentials, O'Reilly Media, First Edition, 0-596-00224-6.
4. Shweta Bhasin, Web Security Basics, Premier Press, First Edition, ISBN: l978-1592000067.

Reference Books

1. Dr.Hiren Joshi, Web Technology and Application Development, DreamTech, First,ISBN:978-93- 5004-088-1.
2. Santosh Kumar K., DT Editorial Services,Black Book, JDBC 4.2, Servlet 3.1 & JSP 2.3,Dreamtech Press, Second Edition, ISBN:978-8177228700.
3. Steven M. Schafer, "HTML, XHTML and CSS", Wiley India Edition, Fourth Edition, 978-81-265-1635-3.
4. B. V. Kumar, S. Sangeetha, S.V. Subrahmanya, J2EE Architecture, an illustrative gateway to enterprise solutions, Tata McGraw Hill Publishing Company, Second Edition, ISBN:978-0-070-621-633.
5. Ivan Bayross,"Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP,BPB Publications,4th Edition,ISBN:978-8183330084.
6. Brain Fling, Mobile Design and Development, O'REILLY, First Edition, ISBN: 13:978-81-8404-817-9.

7. Jason Hunter, Java Servlet Programming, O'reilly Publications, 2nd Edition, ISBN: 978-0-596-00040-0.

8. Adam Bretz & Colin J Ihrig, Full Stack Javascript Development with MEAN, SPD, First Edition, ISBN:978-0992461256.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464D: Internet and Web Programming Laboratory

Teaching Scheme:	Credits:04	Examination Scheme:
Practical:02 Hours/Week		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 Tolls 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.
2. Apply scripting skills for Server side and Client-side Programming.
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.

Reference Books

1. Aleksa Vukotic and James Goodwill, "Apache Tomcat 7", Apress, 2011, ISBN: 10: 1430237236.
2. Bryan Basham, Kathy Sierra, Bert Bates, "JSP: Passing the Sun Certified Web Component Developer Exam", O'Reilly Media ISBN: 978-0-596-51668-0.
3. Chirag Rathod, Jonathan Wetherbee, Peter Zadrozny, and Raghu R. Kodali, "Beginning EJB 3: Java EE 7 Edition", Apress, 2013, ISBN: 9781430246923.
4. Richard Monson-Haefel, "J2EE Web Services", Addison-Wesley Professional, First Edition, 2004, ISBN: 10: 0321146182.
5. Chuck Cavaness, "Programming Jakarta Struts", O'relly Media, second edition 2004, ISBN: 978- 0-596-00651-8.
6. Michael Morrison, Lynn Beighley, "Head First PHP & MySQL: A Brain-Friendly Guide", O'relly Media, second edition 2008, ISBN: 13: 9788184046588.
7. Dan Rahmel, "Advanced Joomla!" Apress, First Edition, 2013, ISBN: 13: 9781430216285.
8. Iwein Fuld, Marius Bogoevici, Mark Fisher, Jonas Partner", Spring Integration in Action", Manning, 2012, ISBN: 13: 9781935182436.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464E: Elective III
Computational Optimization

Teaching Scheme: TH:03 Hours/Week	Credits :04	Examination Scheme:
		In-Sem (Paper): 30 Marks
		End-Sem (paper): 70 Marks

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

Overview, Operation Research Modeling Approach and Various Real Life Situations, Linear Programming Problems (LPP): Basic LPP and Applications; Various Components of LP Problem Formulation, Solving Linear Programming Problems: Using Simultaneous Equations and Graphical Method; Simplex Method; Duality Theory; Charnes' Big – M Method. Transportation Problems and Assignment Problems, 0/1 knapsack problem using brute force and dynamic approach.

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

1. H.A. Taha, "Operations Research", Fifth Edn. Macmillan Publishing Company, 1992.
2. K. Deb, "Optimization for Engineering Design- Algorithms and Examples", Prentice-Hall Of India Pvt. Ltd., New Delhi, 1995.
3. Hadley G., "Linear Programming" Narosa Publishers, 1987.
4. Mital : Optimization Methods, New Age International.
5. Kalyanmoy Deb, Mulitobjective Optimization –An evolutionary Algorithmic Approcach, John Wiley & Sons, New York.

Reference Books

1. V.K.Kapoor – "Operations Research".
2. Kanti Swaroop – "Operations Research".
3. Hillier F.& Liebermann G.J., "Operations Research", Holder Day Inc, 1974.
4. Mustafi : Operations Research, New Age International.
5. Shenoy : Operations Research for Management , New Age International.
6. Mahapatra : Introduction to System Dynamics Modelling, Universities Press.
7. Rao : Engineering Optimization , New Age International.
8. Schaum Outline Series – "Operations Research", TMH.
9. Introduction to Optimization – Edwin K P Chong, Stainslaw H Zak.
10. Nonlinear programming – Dimitry Bertsekas.
11. J.C.Pant, Introduction to Optimization, Jain Brothers, New Delhi, 1983.
12. kershenbaum A., " Telecommunication network design algorithms", TMH

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464E: Computational Optimization Laboratory

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

Prerequisites:
1. Optimization Algorithms.
2. Basics of Problem Solving.
3. Fundamentals of Design and Analysis of Algorithms.

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.
Study Assignments
Assignment 1
EOQ Models
Assignment 2
Safety stock and buffer stock
Assignment 3
M/M/1:∞/FIFO
Assignment 4
M/M/1:N/FIFO

Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 414465A: Elective IV Rural Technologies and Community Development		
Teaching Scheme: **TH:03 Hours/Week**	**Credits:03**	**Examination Scheme:** **In-Sem (Paper): 30 Marks** **End-Sem (paper): 70 Marks**

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.

PARADIGMS OF RURAL DEVELOPMENT - Introduction, The modernization theory, The dependency theory of Marxist School, Rosenstein- Rodan's theory of 'Big Push', Lewis' model of economic development, The human capital model of development, The Gandhian Concept of Rural Development theories from other social sciences.

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

Building Infrastructures and Creating Energy - Basic energy uses , Energy Sources - Firewood, Solar Energy, Hydroelectricity, Hydromechanical, Wind Energy, Energy Storage,Connecting to the Electrical Network, Environmental Considerations

Use of ICT in Rural and agricultural development - Education, Healthcare, Agriculture, Business, Resource Mapping, Digital and Social Media Marketing Decision Support Systems for soil conservation and farm management Waste Management and Sanitation.

UNIT IV	COMMUNITY DEVELOPMENT	7 Hrs

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.

UNIT V	COMMUNITY DEVELOPMENT - RURAL ENTREPRENEURSHIP	7 Hrs

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.

UNIT VI	CASE STUDIES AND FIELD VISIT	7 Hrs

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 - Ahemadnagar, Hiware Bazar Dist - Ahemadnagar, Tikekarwadi - Dist. - Pune, Buchekarwadi Dist- Pune etc.

Text Books

1. "Rural Development: Principles, Policies and Management" - Katar Singh , Sage Publications.
2. "Introduction to Community Development - Theory, Practice and Service Learning", Edited by J W Robinson, Sage Publications.
3. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modeling and Applications, Narosa, 2002.
4. "Fundamentals of Entrepreneurship", H. Nandan, Third Edition, PHL Learning Pvt. Ltd.,
5. "Monetary Economics-Institutions, Theory and Policy" , First Edition, S B Gupta, S Chand Publications, ISBN – 9788121904346.

Reference Books

1. "KURUKSHETRA" - A Journal on Rural Development.
2. "Energy conversion", R. Y. Goswami, Frank Kreith, CRC Press, 2007.
3. "Solar Energy: Fundamental and Application" , H. P. Garg and S. Prakash,Tata McGraw Hill, 1997.
4. "Technologies for Sustainable Rural Development: Having Potential of Socio Economic. Upliftment" , TSRD 2014 , edited by Jai Prakash Shukla, Allied Publishers Pvt. Ltd.

Savitribai Phule Pune University Fourth Year of Information Technology (2015 Course) 414465B: Elective IV Parallel Computing		
Teaching Scheme: **TH:03 Hours/Week**	**Credits:03**	**Examination Scheme:**
		In-Sem (Paper): 30 Marks
		End-Sem (paper): 70 Marks

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

Need for Parallel Computing, Different Parallel Computer Models, ILP, TLP and Data Parallelism, Parallel Programming Overview, Shared Memory Programming, Message Passing Paradigm, Interaction and Communication, Interconnection Networks.

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 HETEROGENEOUS 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

1. John L. Hennessey and David A. Patterson, "Computer Architecture, A quantitative approach", Morgan Kaufmann / Elsevier Publishers, 5th. Edition, 2012.
2. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan Kaufmann, 2011.
3. Michael J Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, 2003.
4. David B. Kirk and Wen,mei W. Hwu, "Programming Massively Parallel Processors", Morgan Kaufmann, 2010.
5. David Culler: Parallel Computer Architecture: A Hardware/Software Approach, Morgan Kaufmann.
6. Jack Dongarra et al., Sourcebook of Parallel Computing, Morgan Kaufman Publishers, San Francisco, CA, 2003.

Reference Books

1. Ananth Grama, George Karypis, Vipin Kumar and Anshul Gupta, "Introduction to Parallel Computing", Second Edition, Pearson Education Limited, 2003.
2. Shameem Akhter and Jason Roberts, "Multi,core Programming", Intel Press, 2006.
3. Ian Foster, "Designing and Building Parallel Programs: Concepts and Tools for Parallel Software Engineering", Addison Wesley Longman Publishing Co., USA, 1995.
4. David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture: A hardware Software approach", Morgan Kaufmann / Elsevier Publishers, 1999.

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

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

UNIT III	HOUGH TRANSFORM	7 Hrs

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

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 –

point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline based motion – optical flow – layered motion.

UNIT V	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

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

Text Books

1. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.

Reference Books

1. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012.
2. R. Szeliski, "Computer Vision: Algorithms and Applications", Springer 2011.
3. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012.
4. D. L. Baggio et al., "Mastering OpenCV with Practical Computer Vision Projects", Packt Publishing, 2012.
5. Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.
6. Sudha Challa, "Fundamentals of Object Tracking", Cambridge University Press, 2011.

ONLINE REFERENCES

1. http://kercd.free.fr/linksKCD.html

2. http://www.cs.ubc.ca/spider/lowe/vision.html

3. http://www.teiath.gr/seyp/optics/Vision.htm

4. http://www.visionscience.com/

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414464D: Elective IV
Social Media Analytics

Teaching Scheme:	Credits:03	Examination Scheme:
TH:03 Hours/Week		**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 Face book 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

Introduction, A Taxonomy of Visualization, The convergence of Visualization, Interaction and Analytics. Data mining in Social Media: Introduction, Motivations for Data mining in Social Media, Data mining methods for Social Media, Related Efforts.

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

UNIT VI	CASE STUDY	7 Hrs

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

1. Reza Zafarani Mohammad Ali Abbasi Huan Liu, Social Media Mining, Cambridge University Press, ISBN: 10: 1107018854.
2. Charu C. Aggarwal, Social Network Data Analytics, Springer, ISBN: 978-1-4419-8461-6.

Reference Books

1. Marshall Sponder, Social Media Analytics: Effective Tools for Building, Interpreting, and Using Metrics, McGraw Hill Education, 978-0-07-176829-0.
2. Matthew A. Russell, Mining the Social Web, O'Reilly, 2nd Edition, ISBN:10: 1449367615.
3. Jiawei Han University of Illinois at Urbana-Champaign Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann, 2nd Edition, ISBN: 13: 978-1-55860-901-3 ISBN: 10: 1-55860-901-6.
4. Bing Liu, Web Data Mining : Exploring Hyperlinks, Contents and Usage Data, Springer, 2nd Edition, ISBN: 978-3-642-19459-7.

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

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

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.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414466: COMPUTER LABORATORY-IX

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

Prerequisites:
1. Operating Systems.
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:

1. George Coulouris, Jean Dollimore, Tim Kindberg & Gordon Blair,Distributed Systems – Concept and Design,Pearson,5th Edition ,ISBN:978-13-214301-1.
2. Nancy Ann Lynch, Distributed Algorithms, Morgan Kaufmann Publishers, illustrated, reprint, ISBN: 9781558603486.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414467: COMPUTER LABORATORY-X

Teaching Scheme: Practical:02 Hours/Week	Credits:01	Examination Scheme:
		TW:25Marks OR: 25Marks

Prerequisites:
1. Computer Network Technology.
2. Human Computer Interface.

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, Ardunio 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

Android Security: Authentication of two mobile devices.

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

Teaching Scheme: TUT:06 Hours/Week	Credits:06	Examination Scheme: TW:50 Marks OR:100 Marks

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)
4. System implementation – code documentation – dataflow diagrams/ algorithm, protocols used.
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.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414461: Audit Course-VI

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

Course Code	Audit Course Title
414469A	1. IoT – Application in Engineering Field
414469B	2. Entrepreneurship
414469C	3. Cognitive Computing
414469D	4. AI and Robotics

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414469A: Audit Course-VI
IoT Applications in Engineering Field.

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.

Unit I	**Basics of IOT – Difference between IOT and IIoT**

Overview of System Components of IOT.

Unit II	**Architecture**

Importance, Advantages & Disadvantages.

Unit III	**Sensors, Transducers, Special requirements for IIOT sensors, Actuators, Types of Sensors, Actuators**

Sensors, Transducers, Special requirements for IIOT sensors, Actuators, Types of Sensors, Actuators.

Unit IV	**Protocols - HART, MODBUS-Serial & Parallel, Ethernet, BACNet**

Protocols - HART, MODBUS-Serial & Parallel, Ethernet, BACNet.

Unit V	**Introduction to IIOT Cloud Platform and Security Aspects Importance and likely Risk Elements**

Introduction to IIOT Cloud Platform and Security Aspects Importance and likely Risk Elements.

Unit VI	**Quiz, Case Studies and Student Presentations**

Illustrative IIOT applications in Engineering Disciplines – Civil, Chemical, Electrical, E & TC, Mechanical and Metallurgical.

References

1. Internet of Things (A Hands-on-Approach) ISBN: 978-0996025515 - by ArshdeepBahga and Vijay Madisetti.
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.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414469B: Audit Course-VI
Entrepreneurship

Today Entrepreneurship & Start -Ups are Key Words. Developing Entrepreneurs & Jobs is National Requirement. Separate PPT - presentation from our EEC Group can be Guideline as Reference Though reference books are available, it is best to see - Google Search videos and films that elaborate most of these concepts. You tube is a rich source of such content on each of these topics. This module also helps students get better prepared for interviews and group discussions.

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.

Unit I	**Introduction To Entrepreneurship & Favorable Environment for Startups**

Overview of Entrepreneurship and its need.

Unit II	**Entrepreneur - Qualities, Strengths & Challenges - Govt. Regulations & Taxes**

Qualities and its strength, challenges as well as respective government originations.

Unit III	**Road Map - Goal Setting & Methodology, Case Studies**

Successful case studies and appropriate methodology.

Unit IV	**Skill Sets required- Communication, Linguistic, Analytical & Abstract Thinking Engineering etc.**

Soft skills and hard skills required to become a successful entrepreneur.

References

1. Burns, Paul, 1949- author. Title: Entrepreneurship and small business.
2. Hisrich R D and Peters M P; "Entrepreneurship"; 5th Edition Tata McGraw-Hill.

Savitribai Phule Pune University
Fourth Year of Information Technology(2015 Course)
414469C: Audit Course-VI
Cognitive computing

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**

Cognitive systems, Different modes of Computing: Turning machine Lambda, Calculus, Hyper Computing, Super Computing, Pan Computing and Interactive Computing.

Unit II	**Cognitive Functioning**

Learning, Memorising, Adaptation, Self Origination, Control, Thinking, Reasoning, Decision Making & Judgement.

Unit III	**Mental States**

Belief Desire Intention (BDI) emotion and feeting. Computation of Cognitive Functioning in machines: Robotics, Human Robotics Interaction, Hepatic.

Unit IV	**Perception and sensing**

Hardware machines of vision and audition with reference to human and machine.

References

1. Hurwitz, Kaufman, and Bowles, Cognitive Computing and Big Data Analytics, Wiley, Indianapolis, IN, 2005, ISBN: 978-1-118-89662-4.

Savitribai Phule Pune University
Fourth Year of Information Technology (2015 Course)
414469D: Audit Course-VI
AI and 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.

Unit I	Intelligent Robotics

Automation and Robots, Robot Classification, Robot Specifications, Sensory perception, Robot control and Intelligence.

Unit II	Direct Kinematics

Coordinate Frames, Rotations, Homogeneous Coordinates, The arm Equation, (DK analysis of - 2 Axis and 3 Axis Planar robot, Four axis SCARA Robot, Five axis Articulated robot).

Unit III	Inverse Kinematics

General Properties of Solutions, Tool Configuration, (IK analysis of - 2 Axis and 3 Axis Planar robot, Four axis SCARA Robot, Five axis Articulated robot).

Unit IV	Workspace Analysis and Trajectory Planning

Workspace analysis, Work envelope of 4-axis SCARA Robot, Work envelope of 5-axis articulated Robot, Workspace Fixtures, The pick-and-place operation, Continuous-Path Motion, Interpolated Motion, Straight Line Motion.

References:

1. Robotics and AI", Andrew Staugaard, PHI.
2. Fundamentals of Robotics- Analysis and Control", Robert Schilling, Pearson Education.
3. Introduction to Robotics", J. J. Craig, Pearson Education.
4. "Robotics", Fu, Gonzales and Lee, McGraw Hill.
5. "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", George F. Luger, Pearson Education.
6. "Industrial Robotics- Technology, programming, and applications", Groover, Weiss, Nagel and Odrey, McGraw Hill
7. Elaine Rich and Kevin Knight, "Artificial Intelligence", TMH.