

**Faculty of Engineering
Savitribai Phule Pune University, Pune
Maharashtra, India**



**Syllabus
for
Fourth Year of Computer Engineering
(2015 Course)
(with effect from 2018-19)**

Prologue

It is with great pleasure and honor that I share the syllabi for Fourth Year of Computer Engineering (2015 Course) on behalf of Board of Studies, Computer Engineering. We, members of BOS are giving our best to streamline the processes and curricula design.

I am sincerely indebted to all the minds and hands who work adroitly to materialize these tasks. I really appreciate your contribution and suggestions in finalizing the contents.

Thanks

Dr. Varsha H. Patil
Coordinator, Board of Studies (Computer Engineering), SPPU, Pune

[This document contains Program Educational Objectives - Program Outcomes - Program Specific Outcomes(page 3), Courses (teaching scheme, examination, marks and credit)(page 4-5), Courses syllabi(page 6-83) and FE to BE at a glance(Page 84)]

Savitribai Phule Pune University, Pune

Computer Engineering

Program Educational Objectives

1. To prepare globally competent graduates having strong fundamentals, domain knowledge, updated with modern technology to provide the effective solutions for engineering problems.
2. To prepare the graduates to work as a committed professional with strong professional ethics and values, sense of responsibilities, understanding of legal, safety, health, societal, cultural and environmental issues.
3. To prepare committed and motivated graduates with research attitude, lifelong learning, investigative approach, and multidisciplinary thinking.
4. To prepare the graduates with strong managerial and communication skills to work effectively as individual as well as in teams.

Program Outcomes

Students are expected to know and be able –

1. To apply knowledge of mathematics, science, engineering fundamentals, problem solving skills, algorithmic analysis and mathematical modeling to the solution of complex engineering problems.
2. To analyze the problem by finding its domain and applying domain specific skills
3. To understand the design issues of the product/software and develop effective solutions with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
4. To find solutions of complex problems by conducting investigations applying suitable techniques.
5. To adapt the usage of modern tools and recent software.
6. To contribute towards the society by understanding the impact of Engineering on global aspect.
7. To understand environment issues and design a sustainable system.
8. To understand and follow professional ethics.
9. To function effectively as an individual and as member or leader in diverse teams and interdisciplinary settings.
10. To demonstrate effective communication at various levels.
11. To apply the knowledge of Computer Engineering for development of projects, and its finance and management.
12. To keep in touch with current technologies and inculcate the practice of lifelong learning.

Program Specific Outcomes (PSO)

A graduate of the Computer Engineering Program will demonstrate-

PSO1: Professional Skills-The ability to understand, analyze and develop computer programs in the areas related to algorithms, system software, multimedia, web design, big data analytics, and networking for efficient design of computer-based systems of varying.

PSO2: Problem-Solving Skills- The ability to apply standard practices and strategies in software project development using open-ended programming environments to deliver a quality product for business success.

PSO3: Successful Career and Entrepreneurship- The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.

Savitribai Phule University of Pune
Fourth Year Computer Engineering (2015 Course)
(with effect from 2018-19)

Semester I

Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks						Credit	
		Theory	Practical	In-Sem	End-Sem	TW	PR	OR/ *PRE	Total	TH/ TUT	PR
410241	High Performance Computing	04	--	30	70	--	--	--	100	04	--
410242	Artificial Intelligence and Robotics	03	--	30	70	--	--	--	100	03	--
410243	Data Analytics	03	--	30	70	--	--	--	100	03	--
410244	Elective I	03	--	30	70	--	--	--	100	03	--
410245	Elective II	03	--	30	70	--	--	--	100	03	--
410246	Laboratory Practice I	--	04	--	--	50	25	25	100	--	02
410247	Laboratory Practice II	--	04	--	--	50	25	25	100	--	02
410248	Project Work Stage I	--	02	--	--	--	--	*50	50	--	02
Total Credit										16	06
Total		16	10	150	350	100	50	100	750	22	
410249	Audit Course 5										Grade
Elective I				Elective II							
410244 (A) Digital Signal Processing				410245 (A) Distributed Systems							
410244 (B) Software Architecture and Design Patterns				410245 (B) Software Testing and Quality Assurance							
410244 (C) Pervasive and Ubiquitous Computing				410245 (C) Operations Research							
410244 (D) Data Mining and Warehousing				410245 (D) Mobile Communication							

410249-Audit Course 5 (AC5) Options:

AC5-I Entrepreneurship Development

AC5-IV: Industrial Safety and Environment Consciousness

AC5-II: Botnet of Things

AC5-V: Emotional Intelligence

AC5-III: 3D Printing

AC5-VI MOOC- Learn New Skills

Abbreviations:

TW: Term Work **TH:** Theory **OR:** Oral **PR:** Practical **Sem:** Semester **PRE:** Presentation

Savitribai Phule University of Pune												
Fourth Year Computer Engineering (2015 Course)												
(with effect from 2018-19)												
Semester II												
Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks						Credit		
		Theory	Practical	In-Sem	End-Sem	TW	PR	OR/ *PRE	Total	TH/ TUT	PR	
410250	Machine Learning	03	--	30	70	--	--	--	100	03		
410251	Information and Cyber Security	03	--	30	70	--	--	--	100	03		
410252	Elective III	03	--	30	70	--	--	--	100	03		
410253	Elective IV	03	--	30	70	--	--	--	100	03	--	
410254	Laboratory Practice III	--	04	--	--	50	25	25	100	--	02	
410255	Laboratory Practice IV	--	04	--	--	50	25	25	100	--	02	
410256	Project Work Stage II	--	06	--	--	100	--	*50	150	--	06	
Total Credit										12	10	
Total		12	14	120	280	200	50	100	750	22		
410257	Audit Course 6										Grade	
Elective III					Elective IV							
410252 (A) Advanced Digital Signal Processing					410253 (A) Software Defined Networks							
410252 (B) Compiler Construction					410253 (B) Human Computer Interface							
410252 (C) Embedded and Real Time Operating System					410253 (C) Cloud Computing							
410252 (D) Soft Computing and Optimization Algorithms					410253 (D) Open Elective							

410259-Audit Course 6 (AC6) Options:

AC6-I: Business Intelligence

AC6-II: Gamification

AC6-III: Quantum Computing

AC6-IV: Usability Engineering

AC6-V: Conversational Interfaces

AC6-VI: MOOC- Learn New Skills

Abbreviations:

TW: Term Work **TH:** Theory **OR:** Oral **PR:** Practical **Sem:** Semester **PRE:** Presentation

SEMESTER I

Savitribai Phule Pune University Final Year of Computer Engineering (2015 Course) 410241: High Performance Computing		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 210253-Microprocessor, 210244- Computer Organization and Architecture, 210254-Principles of Programming Languages, 310251- Systems Programming and Operating System		
Companion Course: 410247-Laboratory Practice II		
Course Objectives: <ul style="list-style-type: none"> To study parallel computing hardware and programming models To be conversant with performance analyze and modeling of parallel programs 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> To describe different parallel architectures, inter-connect networks, programming models To develop an efficient parallel algorithm to solve given problem To analyze and measure performance of modern parallel computing systems 		
Course Contents		
Unit I	Parallel Processing Concepts	08 Hours
Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Scalable design principles, Architectures: N-wide superscalar architectures, Multi-core architectures.		
Unit II	Parallel Programming	08 Hours
Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.		
Unit III	Basic Communication	08 Hours
Operations- One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.		
Unit IV	Analytical Modelling of Parallel Programs	08 Hours
Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum execution time and minimum cost optimal execution time. Dense Matrix Algorithms: Matrix-Vector Multiplication, Matrix-matrix multiplication.		
Unit V	Searching, Sorting and Graph Algorithms	08 Hours

Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Parallelizing Quicksort, All-Pairs Shortest Paths, Algorithm for sparse graph, Parallel Depth-First Search, Parallel Best-First Search.

Unit VI	CUDA Architecture	08 Hours
What Is the CUDA Architecture, Using the CUDA Architecture, Applications of CUDA Introduction to CUDA C- Write and launch CUDA C kernels, Manage GPU memory, Manage communication and synchronization, parallel programming in CUDA- C.		
Books:		
Text:		
<ol style="list-style-type: none"> 1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Welsey, 2003, ISBN: 0-201-64865-2 2. Jason sanders, Edward Kandrot, “CUDA by Example”, Addison-Welsey, ISBN-13: 978-0-13-138768-3 		
References:		
<ol style="list-style-type: none"> 1. Kai Hwang,, ”Scalable Parallel Computing”, McGraw Hill 1998, ISBN:0070317984 2. Shane Cook, “CUDA Programming: A Developer's Guide to Parallel Computing with GPUs”, Morgan Kaufmann Publishers Inc. San Francisco, CA, USA ©2013 ISBN: 9780124159884 3. David Culler Jaswinder Pal Singh, ”Parallel Computer Architecture: A hardware/Software Approach”, Morgan Kaufmann,1999, ISBN 978-1-55860-343-1 		

Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) 410242: Artificial Intelligence and Robotics		
Teaching Scheme:	Credit	Teaching Scheme:
TH: 03 Hours/Week	03	TH: 03 Hours/Week
Prerequisite Courses: 210254-Principles of Programming Languages		
Companion Course: 410247-Laboratory Practice II		
Course Objectives: <ul style="list-style-type: none"> To understand the concept of Artificial Intelligence To learn various peculiar search strategies for AI To acquaint with the fundamentals of mobile robotics To develop a mind to solve real world problems unconventionally with optimality 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> Identify and apply suitable Intelligent agents for various AI applications Design smart system using different informed search / uninformed search or heuristic approaches. Identify knowledge associated and represent it by ontological engineering to plan a strategy to solve given problem. Apply the suitable algorithms to solve AI problems 		
Course Contents		
Unit I	Introduction	07 Hours
Artificial Intelligence : Definition, Introduction, Typical Applications. State Space Search : Depth Bounded DFS, Depth First Iterative Deepening. Heuristic Search : Heuristic Functions, Best First Search, Hill Climbing, Variable Neighborhood Descent, Beam Search, Tabu Search. Optimal Search : A* algorithm, Iterative Deepening A*, Recursive Best First Search, Pruning the CLOSED and OPEN Lists.		
Unit II	Problem Decomposition and Planning	07 Hours
Problem Decomposition : Goal Trees, Rule Based Systems, Rule Based Expert Systems Planning : STRIPS, Forward and Backward State Space Planning, Goal Stack Planning, Plan Space Planning, A Unified Framework For Planning Constraint Satisfaction : N-Queens, Constraint Propagation, Scene Labeling, Higher order and Directional Consistencies, Backtracking and Lookahead Strategies		
Unit III	Logic and Reasoning	07 Hours
Knowledge Based Reasoning : Agents, Facets of Knowledge. Logic and Inferences : Formal Logic, Propositional and First Order Logic, Resolution in Propositional and First Order Logic, Deductive Retrieval, Backward Chaining, Second order Logic Knowledge Representation : Conceptual Dependency, Frames, Semantic nets.		
Unit IV	Natural Language Processing and ANN	07 Hours

Natural Language Processing : Introduction, Stages in natural language Processing, Application of NLP in Machine Translation, Information Retrieval and Big Data Information Retrieval
 Learning : Supervised, Unsupervised and Reinforcement learning.
 Artificial Neural Networks(ANNs): Concept, Feed forward and Feedback ANNs, Error Back Propagation, Boltzman Machine.

Unit V	Robotics	07 Hours
Robotics : Fundamentals, path Planning for Point Robot, Sensing and mapping for Point Robot, Mobile Robot Hardware, Non Visual Sensors like : Contact Sensors, Inertial Sensors, Infrared Sensors, Sonar, Radar, laser Rangefinders, Biological Sensing Robot System Control : Horizontal and Vertical Decomposition, Hybrid Control Architectures, Middleware, High-Level Control, Human-Robot Interface		
Unit VI	Robots in Practice	07 Hours
Robot Pose Maintenance and Localization : Simple Landmark Measurement, Servo Control, Recursive Filtering, Global Localization Mapping : Sensorial Maps, Topological Maps, Geometric Maps, Exploration Robots in Practice : Delivery Robots, Intelligent Vehicles, Mining Automation, Space Robotics, Autonomous Aircrafts, Agriculture/Forestry, Domestic Robots		
Books:		
Text:		
<ol style="list-style-type: none"> 1. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1 2. Elaine Rich, Kevin Knight and Nair, “Artificial Intelligence”, TMH,ISBN-978-0-07-008770-5 3. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Third edition, Pearson, 2003, ISBN :10: 0136042597 4. Michael Jenkin, Gregory, “ Computational Principals of Mobile Robotics”, Cambridge University Press, 2010, ISBN : 978-0-52-187157-0 		
References:		
<ol style="list-style-type: none"> 1. Nilsson Nils J , “Artificial Intelligence: A new Synthesis, Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4 2. Patrick Henry Winston, “Artificial Intelligence”, Addison-Wesley Publishing Company, ISBN: 0-201-53377-4 		

Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) 410243: Data Analytics		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 310242-Database Management Systems		
Companion Course: 410247-Laboratory Practice II		
Course Objectives: <ul style="list-style-type: none"> To develop problem solving abilities using Mathematics To apply algorithmic strategies while solving problems To develop time and space efficient algorithms To study algorithmic examples in distributed, concurrent and parallel environments 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> To write case studies in Business Analytic and Intelligence using mathematical models. To present a survey on applications for Business Analytic and Intelligence. To write problem solutions for multi-core or distributed, concurrent/Parallel environments 		
Course Contents		
Unit I	Introduction and Life Cycle	08 Hrs
Introduction: Big data overview, state of the practice in Analytics- BI Vs Data Science, Current Analytical Architecture, drivers of Big Data, Emerging Big Data Ecosystem and new approach. Data Analytic Life Cycle: Overview, phase 1- Discovery, Phase 2- Data preparation, Phase 3- Model Planning, Phase 4- Model Building, Phase 5- Communicate Results, Phase 6- Operationalize. Case Study: GINA		
Unit II	Basic Data Analytic Methods	06 Hrs
Statistical Methods for Evaluation- Hypothesis testing, difference of means, wilcoxon rank–sum test, type 1 type 2 errors, power and sample size, ANNOVA. Advanced Analytical Theory and Methods: Clustering- Overview, K means- Use cases, Overview of methods, determining number of clusters, diagnostics, reasons to choose and cautions.		
Unit III	Association Rules and Regression	06 Hrs
Advanced Analytical Theory and Methods: Association Rules- Overview, a-priori algorithm, evaluation of candidate rules, case study-transactions in grocery store, validation and testing, diagnostics. Regression- linear, logistics, reasons to choose and cautions, additional regression models.		
Unit IV	Classification	07 Hrs
Decision trees- Overview, general algorithm, decision tree algorithm, evaluating a decision tree. Naïve Bayes – Bayes’ Algorithm, Naïve Bayes Classifier, smoothing, diagnostics. Diagnostics of classifiers, additional classification methods.		
Unit V	Big Data Visualization	06 Hrs

Introduction to Data visualization, Challenges to Big data visualization, Conventional data visualization tools, Techniques for visual data representations, Types of data visualization, Visualizing Big Data, Tools used in data visualization, Analytical techniques used in Big data visualization

Unit VI	Advanced Analytics-Technology and Tools	06 Hrs
Analytics for unstructured data- Use cases, Map Reduce, Apache Hadoop. The Hadoop Ecosystem- Pig, HIVE, HBase, Mahout, NoSQL. An Analytics Project-Communicating, operationalizing, creating final deliverables.		
Books:		
Text: <ol style="list-style-type: none"> 1. David Dietrich, Barry Hiller, “Data Science & Big Data Analytics”, EMC education services, Wiley publications, 2012, ISBN 0-07-120413-X 2. Carlo Vercellis, “Business Intelligence - Data Mining and Optimization for Decision Making”, Wiley Publications, ISBN: 9780470753866. 3. Ashutosh Nandeshwar , “Tableau Data Visualization Codebook”, Packt Publishing, ISBN 978-1-84968-978-6 		
References: <ol style="list-style-type: none"> 1. Mark Gardner, “Beginning R: The Statistical Programming Language”, Wrox Publication, ISBN: 978-1-118-16430-3 2. Luís Torgo, “Data Mining with R, Learning with Case Studies”, CRC Press, Talay and Francis Group, ISBN 9781482234893 		

Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) Elective I 410244(A): Digital Signal Processing		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 207003- Engineering Mathematics III		
Companion Course: 410247-Laboratory Practice II		
Course Objectives: <ul style="list-style-type: none"> To learn methodology to analyze signals and systems Study transformed domain representation of signals and systems Design of filters as DT systems To get acquainted with the DSP Processors and DSP applications 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> 		
Course Contents		
Unit I	Signals and Systems	9 Hours
Continuous time (CT), Discrete-time (DT) and Digital signals, Basic DT signals and Operations. Discrete-time Systems, Properties of DT Systems and Classification, Linear Time Invariant (LTI) Systems, Impulse response, Linear convolution, Linear constant coefficient difference equations, FIR and IIR systems, Periodic Sampling, Relationship between Analog and DT frequencies, Aliasing, Sampling Theorem, A to D conversion Process: Sampling, quantization and encoding		
Unit II	Frequency Domain Representation of Signal	8 Hours
Introduction to Fourier Series, Representation of DT signal by Fourier Transform (FT), Properties of FT: Linearity, periodicity, time shifting, frequency shifting, time reversal, differentiation, convolution theorem, windowing theorem .Discrete Fourier Transform (DFT), DFT and FT, IDFT, Twiddle factor, DFT as linear transformation matrix, Properties of DFT, circular shifting, Circular Convolution, DFT as Linear filtering, overlap save and add, DFT spectral leakage		
Unit III	Fast Fourier Transform (FFT) and Z-Transform (ZT)	9 Hours
Effective computation of DFT, Radix-2 FFT algorithms: DIT FFT, DIF FFT, Inverse DFT using FFT, Z-transform (ZT) , ZT & FT, ZT & DFT , ROC and its properties, ZT Properties , Rational ZT, Pole Zero Plot, Behaviour of causal DT signals, Inverse Z Transform (IZT): power series method, partial fraction expansion (PFE) , Residue method		
Unit IV	Analysis of DT - LTI Systems	8 Hours
System function $H(z)$, $H(z)$ in terms of Nth order general difference equation, all pole and all zero systems, Analysis of LTI system using $H(Z)$, Unilateral Z-transform: solution of difference equation, Impulse and Step response from difference equation, Pole zero plot of $H(Z)$ and difference equation, Frequency response of system, Frequency response from pole-zero plot using simple geometric construction, Ideal frequency selective filters, magnitude and phase response		
Unit V	Digital Filter Design	9 Hours

Concept of filtering, Ideal filters and approximations, specifications, FIR and IIR filters, linear phase response, FIR filter Design: Fourier Series method, Windowing method, Gibbs Phenomenon, desirable features of windows, Different window sequences and its analysis, Design examples: IIR filter design: Introduction, Mapping of S-plane to Z-plane, Impulse Invariance method, Bilinear Z transformation (BLT) method, frequency warping, Prewarping, Design examples, Practical filters e.g. Butterworth filters, Comparison of IIR and FIR Filters, Finite word length effect

Unit VI	Digital Filter Design	8 Hours
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Concept of filtering, Ideal filters and approximations, specifications, FIR and IIR filters, linear phase response, FIR filter Design: Fourier Series method, Windowing method, Gibbs Phenomenon, desirable features of windows, Different window sequences and its analysis, Design examples: IIR filter design: Introduction, Mapping of S-plane to Z-plane, Impulse Invariance method, Bilinear Z transformation (BLT) method, frequency warping, Prewarping, Design examples, Practical filters like- Butterworth filters, Comparison of IIR and FIR Filters, Finite word length effect

Books:

Text:

1. Proakis J., Manolakis D., "Digital signal processing", 4th Edition, Pearson Education, ISBN 9788131710005
2. Oppenheim A., Schaffer R., Buck J., "Discrete time signal processing", 2nd Edition, Pearson Education, ISBN 9788131704929

Reference:

1. Babu R., "Digital Signal Processing", Scitech Publications, 4th Edition, ISBN 978-81-8371-081-7
2. Mitra S., "Digital Signal Processing: A Computer Based Approach", Tata McGraw-Hill, 1998, ISBN 0-07-044705-5
3. Vallavraj A., "Digital Signal Processing", ISBN 0-07-463996-X
4. Ifleachor E. C., Jervis B. W., "Digital Signal Processing: A Practical Approach", Pearson-Education, 2002
5. S. Poornachandra, B.Sasikala, "Digital Signal Processing", McGrawHill, 3rd Edition, ISBN-13:978-07-067279-6

Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) Elective IV 410244(B): Software Architecture and Design Patterns		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 310243- Software Engineering and Project Management		
Companion Course: 410247-Laboratory Practice II		
Course Objectives: <ul style="list-style-type: none"> . 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> . 		
Course Contents		
Unit I	Introduction	06 Hours
Introduction to Software Architecture, Architecture Business Cycle - Where do architecture come from, Software processes and the Architecture Business cycle, What makes Good Architecture. What is software architecture - What Software Architecture is and what it is not, Other points of View, Architectural Patterns, Reference Models, Reference Architectures, Why is Software Architecture important, Architectural structure and Views. Case Study-A-7E Avionics System		
Unit II	Quality Attributes	06 Hours
Introduction to Quality Attributes, Understanding quality attributes- Functionality and Architecture, architecture and quality attributes, System Quality Attributes, Quality Attribute Scenario in Practice, Other System Quality Attributes, Business Qualities, and Architecture Qualities. Achieving quality attributes- Introducing Tactics, Availability tactics, Modifiability tactics, Performance tactics, Security tactics, Testability tactics, Usability tactics, Relationship of tactics to Architectural patterns, Architectural Patterns and Styles. Case study- Air Traffic Control		
Unit III	Designing the Architectures and Introduction to Design Patterns	06 Hours
Architecture in Life Cycle, Designing the Architecture, Forming the team structure, Creating a skeletal system, Case Study- Flight Simulation. Design Patterns: What is Design Pattern?, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design patterns solves design problems, How to select Design Patterns, How to use Design Patterns.		
Unit IV	Design Pattern Catalog	08 Hours
Creational Patterns - Abstract Factory, Singleton. Structural Patterns - Adaptor, Facade, Proxy. Behavioral Patterns - Chain of Responsibility, Iterator, Mediator, Observer. What to expect from Design Patterns.		
Unit V	Client Side Technologies	07 Hours
Introduction to three tier and n -Tier Web Architectures, Need of Client side technology in multi-tier architectures, XML, Client side technologies- HTML, DHTML, Java Applets, Active X controls, DOM, AJAX. Case study-Mobile or portable client side technologies.		
Unit VI	Middleware and Server Side Technologies	07 Hours

Introduction to Middleware, Types of Middleware, Application servers, Introduction to Java EE, Introduction to Java EE technologies like JMS, JDBC, RPC, RMI, SOCKET. EJB 3.0 Architecture, Entity, Session, Message beans, XML, XSLT. Specifications and characteristics of Middleware technologies.

Server Side Technologies- Need of server side technology in multi-tier architectures, Java Web Services, Server side technologies: JSP, JSF, SOA, MVC. Java Servlets, struts.

Books:

Text:

1. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Second Edition, Pearson ,ISBN 978-81-775-8996-2
2. Erich Gamma, "Design Patterns", Pearson, ISBN 0-201-63361-2.
3. Kogent, "Java Server Programming Black Book", Dream Tech Press, PHI Publications, ISBN: 978-81-7722-835-9.

References:

1. James L. Weaver, Kevin Mukhar, "Beginning J2EE 1 .4: From Novice to Professional
2. Richard N.Taylor , Nenad M., "Software Architecture Foundation Theory and practice", Wiley ISBN: 978-81-265-2802-8.
3. Java6 Programming, Black Book dreamTech Press ISBN:978-81-7722-736-9

Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) Elective I 410244(C): Pervasive and Ubiquitous Computing		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 310245- Computer Networks		
Companion Course: 410247-Laboratory Practice II		
Course Objectives: <ul style="list-style-type: none"> To understand the characteristics and principles of Pervasive computing To introduce to the enabling technologies of pervasive computing To understand the basic issues and performance requirements of pervasive computing applications To learn the trends of pervasive computing 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> Design and implement primitive pervasive applications Analyze and estimate the impact of pervasive computing on future computing applications and society Develop skill sets to propose solutions for problems related to pervasive computing system Design a preliminary system to meet desired needs within the constraints of a particular problem space 		
Course Contents		
Unit I	Pervasive Computing	08 Hours
Pervasive Computing, Applications, Pervasive Computing devices and Interfaces, Device technology trends, Connecting issues and protocols. Pervasive Computing- Principles, Characteristics, interaction transparency, context aware, automated experience capture. Architecture for pervasive computing.		
Unit II	Open Protocols	07 Hours
Open protocols, Service discovery technologies- SDP, Jini, SLP, UpnP protocols, data Synchronization, SyncML framework, Context aware mobile services, Context aware sensor networks, addressing and communications- Context aware security. Pervasive Computing and web based Applications - XML and its role in Pervasive Computing, Wireless Application Protocol (WAP) Architecture and Security, Wireless Mark-Up language (WML) – Introduction. Moving on from Weiser's Vision of Calm Computing: Engaging UbiComp Experiences.		
Unit III	Voice Enabled Pervasive Computing	08 Hours
Voice Enabled Pervasive Computing, Voice Standards, Speech Applications in Pervasive Computing and security. Device Connectivity, Web application Concepts, WAP and Beyond. Voice Technology – Basis of speech Recognition, Voice Standards, Speech Applications, Speech and Pervasive Computing, Security, The Hitchhiker's Guide to UbiComp: Using techniques from Literary and Critical Theory to Reframe Scientific Agendas.		
Unit IV	Personal Digital Assistant	08 Hours

Personal Digital Assistant – History, Device Categories, Device Characteristics, Software Components, Standards. Server side programming in Java, Pervasive Web application Architecture, Example Application, Access via PCs, Access via WAP, Access via PDA, and Access via Voice, PinchWatch: A Wearable Device for One-Handed Micro interactions., Interfaces - Enabling mobile micro-interactions with physiological computing.

Unit V**User Interface****07 Hours**

User Interface Issues in Pervasive Computing, Architecture, and Smart Card based Authentication Mechanisms, Wearable computing Architecture. Touche: Enhancing Touch Interaction on Humans, Screens, Liquids, and Everyday Objects

Unit VI**Context Awareness & Application Development****07 Hours**

Location as context, Location Tracking, Co-ordinate models, Location Data Sources, sorting & search in location data. Sensing Activity based on various wearable sensors, smart phone sensors. Wearable Computing applications in Healthcare and Assistive Technologies. Developing, Deploying and Evaluating Pervasive computing applications. Application in Augmented Reality.

Books:**Text:**

1. Jochen Burkhardt, Horst Henn, Stefan Hepper, Thomas Schaec & Klaus Rindtorff, "Pervasive Computing Technology and Architecture of Mobile Internet Applications", Addison Wesley, 2002. ISBN:13: 978-0-201-72215-4
2. Uwe Hansman, Lothar Merk, Martin S Nicklous & Thomas Stober: "Principles of Mobile Computing", Second Edition, Springer- Verlag, New Delhi, 2003, ISBN: 9783662043189

References:

1. Mohammads, Obaidait, Denko, Woungang, "Pervasive Computing and Networking", Wiley, ISBN:978-0-470-74772-8
2. Seng Loke, "Context-Aware Computing Pervasive Systems", Auerbach Pub., New York, 2007, ISBN: 978-1-4471-5006-0
3. Uwe Hansmann etl, "Pervasive Computing", Springer, New York, 2001., ISBN: 10: 3540002189
4. John Krumm, "Ubiquitous Computing Fundamentals", Shroff Publishers, ISBN: 9781420093605

<p align="center">Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) Elective II 410245(A): Distributed Systems</p>		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 310254- Web Technology, 210254-Principles of Programming Languages		
Companion Course: 410247-Laboratory Practice II		
Course Objectives: <ul style="list-style-type: none"> . 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> . 		
Course Contents		
Unit I	Introduction of Distributed Systems	06 Hours
Introduction, Examples of distributed systems, Resource sharing and the Web, Challenges, System models- Architectural models, Fundamental models.		
Unit II	Communication	06 Hours
Inter-Process Communication- Introduction, The API for the Internet protocols, External data representation and marshalling, Client-server communication, Group communication, Inter process communication in UNIX, Distributed Objects and Remote Invocation-Communication between distributed objects, Sun RPC, Events and notifications, Java RMI.		
Unit III	Synchronization	06 Hours
Clocks, events and process states, Synchronizing physical clocks, Logical time and logical clocks, Global states, Mutual exclusion, Elections, Multicast communication, Distributed transactions		
Unit IV	Distributed File Systems	08 Hours
Introduction, File service architecture, Sun Network File System, Andrew File System Name Services-Name services and the Domain Name, Directory services, Global Name Service, X.500 Directory Service, Peer-to-Peer Systems.		
Unit V	Distributed Shared Memory	07 Hours
Design and implementation issues, Sequential consistency, Release consistency, Other consistency models.		
Unit VI	Distributed System Security and Web services	07 Hours
Introduction, Potential attacks to computer systems, Cryptography, Authentication, Access control, Digital signatures, Design principles, DCE security service, Web services-SOAP; Service descriptions and IDL for web services, A directory service for use with web services, XML security, Coordination of web services.		
Books:		
Text: <ol style="list-style-type: none"> 1. George Coulouris, Jean Dollimore and Tim Kindberg, “Distributed Systems, Concepts and Design”, Fourth Edition, Addison Wesley, ISBN 0-13-214301-1 2. Pradeep K. Sinha, "Distributed Operating Systems Concepts and Design" , PHI Publication, ISBN-13: 978-0132143011 		

References:

1. Shvartsman, A.A., Weatherspoon, H.; Zhao, “Future Directions in Distributed Computing Research and Position Papers Series: Lecture Notes in Computer Science” , Vol. 2584 Schiper, (Eds.) 2003, X, 219 p., ISBN: 978-3-540- 00912-2
2. Andrew S. Tanenbaum & Maarten van Steen, “Distributed Systems –Principles and Paradigms” , PHI Publication, ISBN 0-13-239227-5
3. Sape Mullender, “Distributed Systems, (Editor),Addison-Wesley Publication, ISBN 10: 0201624273 - ISBN 13: 9780201624274
4. Kenneth, P. Birman, “Reliable Distributed Systems: Technologies, Web Services, and Applications, Springer; 1 edition, ISBN-10: 0387215093; ISBN-13: 978-0387215099
5. Galli D.L., “Distributed Operating Systems: Concepts and Practice”, Prentice-Hall 2000, ISBN 0-13-079843-6

Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) Elective II 410245(B): Software Testing and Quality Assurance		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 310243- Software Engineering and Project Management, 310263- Software Modeling and Design		
Companion Course: 410247-Laboratory Practice II		
Course Objectives: <ul style="list-style-type: none"> • Introduce basic concepts of software testing • Understand white box, block box, object oriented, web based and cloud testing • Know in details automation testing and tools used for automation testing • Understand the importance of software quality and assurance software systems development. 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> • Define and describe fundamental concepts in software testing such as manual testing, automation testing and software quality assurance. • Design and develop project test plan, design test cases, test data, and conduct test operations • Describe fundamental concepts of automation testing • Apply selenium automation tool for various software testing for testing software • Understand different approaches of quality management, assurance, and apply quality standard to software system • Apply and analyze effectiveness Software Quality Tools 		
Course Contents		
Unit I	Introduction	7 Hours
Introduction, historical perspective, Definition, Core Components, Quality View, Financial Aspect, Customers suppliers and process, Total Quality Management(TQM), Quality practices of TQM, Quality Management through- Statistical process Control, Cultural Changes, Continual Improvement cycle, quality in different areas, Benchmarking and metrics, Problem Solving Techniques, Problem Solving Software Tools. Software Quality- Introduction, Constraints of Software product Quality assessment, Customer is a King, Quality and Productivity Relationship, Requirements of Product, Organization Culture, Characteristics of Software, Software Development Process, Types of Product, Criticality Definitions, Problematic areas of SDLC, Software Quality Management, Why Software has defects, Processes related to Software Quality, Quality Management System's Structure, Pillars of Quality Management System, Important aspects of quality management.		
Unit II	Test Planning and Management	5 Hours

Review of Fundamentals of Software Testing, Testing during development life cycle, Requirement Traceability matrix, essentials, Work bench, Important Features of Testing Process, Misconceptions, Principles, salient and policy of Software testing, Test Strategy, Test Planning, Testing Process and number of defects found, Test team efficiency, Mutation testing, challenges, test team approach, Process problem faced, Cost aspect, establishing testing policy, methods, structured approach, categories of defect, Defect/ error/ mistake in software, Developing Test Strategy and Plan, Testing process, Attitude towards testing, approaches, challenges, Raising management awareness for testing, skills required by tester.

Unit III	Software Test Automation	6 Hours
What is Test Automation, Terms used in automation, Skills needed for automation, What to automate, scope of automation, Design & Architecture of automation, Generic requirement for Test Tool, Process Model for Automation, Selecting Test Tool, Automation for XP/Agile model, Challenges in Automation, Data-driven Testing Automation Tools like JUnit, Jmeter		
Unit IV	Selenium Tool	6 Hours
Introducing Selenium, Brief History of The Selenium Project, Selenium's Tool Suite, Selenium-IDE, Selenium RC, Selenium Web Deiver, Selenium Grid, Test Design Considerations		
Unit V	Quality Management	6 Hours
Quality Concepts Software Quality, Software Quality Dilemma, Achieving Software Quality Software Quality Assurance Elements of SQA, SQA Tasks, Goals, and Metrics, Formal Approaches to SQA, Statistical Software Quality Assurance, Six Sigma for Software Engineering, ISO 9000 Quality Standards, SQA Plan		
Unit VI	Software Quality Tools	6 Hours
Total Quality Management, Product Quality Metrics, In process Quality Metrics, Software maintenance, Ishikawa's 7 basic tools, Checklists, Pareto diagrams, Histogram, Run Charts, Scatter diagrams, Control chart, Cause Effect diagram. Defect Removal Effectiveness & Process Maturity Level		
Books:		
Text:		
1. M G Limaye, "Software Testing Principles, Techniques and Tools", Tata Mcgraw Hill, ISBN: 9780070139909 0070139903 2. Srinivasan Desikan, Gopalswamy Ramesh, "Software Testing Principles and Practices", Pearson, ISBN-10: 817758121X		
References:		
1. Naresh Chauhan, "Software Testing Principles and Practices ", OXFORD, ISBN-10: 0198061846. ISBN-13: 9780198061847 2. Stephen Kan, "Metrics and Models in Software Quality Engineering", Pearson, ISBN-10: 0133988082; ISBN-13: 978-0133988086		

Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) Elective II 410245(C): Operations Research		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 210241- Discrete Mathematics, 310243- Software Engineering and Project Management		
Companion Course: 410247-Laboratory Practice II		
Course Objectives: <ul style="list-style-type: none"> To introduce students to use quantitative methods and techniques for effective analysis of decisions making To understand the model formulation and applications that is used in solving business decision problems. To introduce students to optimization approaches and fundamental solution. To learn a variety of ways in which deterministic and stochastic models in Operations Research can be used 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> Identify the characteristics of different types of decision-making environments Use appropriate decision making approaches and tools Build various dynamic and adaptive models Develop critical thinking and objective analysis of decision problems Apply the OR techniques for efficacy 		
Course Contents		
Unit I	Linear Programming	06 Hours
Introduction, Modeling with Linear Programming, Two variable LP model, Graphical LP solutions for both maximization and minimization models with various application examples, LP model in equation form, simplex method, special case in simplex method, artificial starting solution, Degeneracy in LPP, Unbounded and Infeasible solutions.		
Unit II	Duality in Linear Programming and Revised Simplex Method	06 Hours
Duality theory: a fundamental insight. The essence of duality theory, Economic interpretation of duality, Primal dual relationship; Adapting to other primal forms, The revised simplex method-development of optimality and feasibility conditions, Revised Simplex Algorithms.		
Unit III	The Transportation Problem and Assignment Problem	06 Hours
Finding an initial feasible solution - North West corner method, Least cost method, Vogel's Approximation method, Finding the optimal solution, optimal solution by stepping stone and MODI methods, Special cases in Transportation problems - Unbalanced Transportation problem. Assignment Problem: Hungarian method of Assignment problem, Maximization in Assignment problem, unbalanced problem, problems with restrictions, travelling salesman problems.		
Unit IV	Game Theory and Dynamic Programming	08 Hours

Introduction, 2 person zero sum games, Maximin - Minimax principle, Principle of Dominance, Solution for mixed strategy problems, Graphical method for $2 \times n$ and $m \times 2$ games. Recursive nature of computations in Dynamic Programming, Forward and backward recursion, Dynamic Programming Applications – Knapsack, Equipment replacement, Investment models

Unit V	Integer Programming Problem and Project Management	07 Hours
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Integer Programming Algorithms – B&B Algorithms, cutting plane algorithm, Gomory's All-IPP Method, Project Management: Rules for drawing the network diagram, Application of CPM and PERT techniques in project planning and control; Crashing and resource leveling of operations Simulation and its uses in Queuing theory & Materials Management

Unit VI	Decision Theory and Sensitivity Analysis	07 Hours
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Decision making under certainty, uncertainty and risk, sensitivity analysis, Goal programming formulation and algorithms – The weights method, The preemptive method

Books:

Text:

1. Hamdy A. Taha, "Operations Research", Pearson Education, 8th Edition, ISBN: 978-81-317-1104-0
2. Gillett, "Introduction to Operation Research", TMH, ISBN: 0070232458

References:

1. S.D. Sharma, Kedarnath, Ramnath & Co, "Operations Research", 2009, ISBN: 978-81-224-2288-7
2. Hervey M. Wagner, "Principles of Operations Research", Second Edition, Prentice Hall of India Ltd., 1980, ISBN: 10: 0137095767, 13: 9780137095766..
3. V.K. Kapoor, "Operations Research", S. Chand Publishers, New Delhi, 2004, ISBN: 9788180548543, 8180548546.
4. R. Paneer Selvam, "Operations Research", Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2008, ISBN: 10: 8120329287, 9788120329287.

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective II
410245(D): Mobile Communication

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
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Prerequisite Courses: 310245-Computer Networks

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To understand the Personal Communication Services.
- To learn the design parameters for setting up mobile network.
- To gain the knowledge about MAC for mobile network
- To know GSM architecture and support services.
- To learn current technologies being used on field.

Course Outcomes:

On completion of the course, student will be able to–

- Select components and radio spectrum for PCS based on bandwidth requirement.
- Justify the Mobile Network performance parameters and design decisions.
- Choose the modulation technique for setting up mobile network.
- Formulate GSM/CDMA mobile network layout considering futuristic requirements which conforms to the technology.
- Deploy the 3G/4G technology based network with bandwidth capacity planning.
- Adapt to the requirements of next generation mobile network and mobile applications.

Course Contents

Unit I	Introduction to Cellular Networks	06 Hours
Cell phone generation-1G to 5G, Personal Communication System (PCS), PCS Architecture, Mobile Station,, SIM, Base Station, Base Station Controller, Mobile Switching Center, MSC Gateways, HLR and VLR, AuC/EIR/OSS, Radio Spectrum, Free Space Path Loss, S/N Ratio, Line of sight transmission, Length of Antenna, Fading in Mobile Environment.		
Unit II	Cellular Network Design	06 Hours
Performance Criterion, Handoff/Hanover, Frequency Reuse, Co-channel Interference and System Capacity, Channel Planning, Cell Splitting, Mobility Management in GSM and CDMA.		
Unit III	Medium Access Control	06 Hours
Specialized MAC, SDMA, FDMA, TDMA, CDMA, Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS), GMSK Modulation, 8PSK, 64 QAM, 128 QAM and OFDM		
Unit IV	GSM	08 Hours
GSM – Architecture, GSM Identifiers, Spectrum allocation, Physical and Logical Traffic and Control channels, GSM Bursts, GSM Frame, GSM Speech Encoding and decoding, Location Update, Incoming and Outgoing Call setup, GPRS.		
Unit V	Current 3G and 4G Technologies for GSM and CDMA	07 Hours

EDGE, W-CDMA: Wideband CDMA, CDMA2000, UMTS, HSPA (High Speed Packet Access), HSDPA, HSUPA, HSPA+, LTE (E-UTRA) 3GPP2 family CDMA2000 1x, 1xRTT, EV-DO (Evolution-Data Optimized), Long Term Evolution (LTE) in 4G.

Unit VI**Advances in Mobile Technologies****07 Hours**

5GAA (Autonomous Automation), Millimetre Wave , URLLC, LTEA (Advanced), LTE based MULTIFIRE, Virtual Reality, Augmented Reality.

Books:**Text:**

1. Jochen Schiller, “Mobile Communications”, Pearson Education, Second Edition, 2004, ISBN: 13: 978-8131724262
2. Jason Yi-Bing Lin, Yi-Bing Lin, Imrich Chlamtac, “Wireless and Mobile network Architecture”, 2005, ISBN: 0-471-74922-2.
3. Martin Sauter, “3G, 4G and Beyond: Bringing Networks, Devices and the Web Together”, 2012, ISBN-13: 978-1118341483

References:

1. Theodore S Rappaport, “Wireless Communications – Principles and Practice” , Pearson Education India, Second Edition, 2010, ISBN: 978-81-317-3186-4
2. William Stallings, “Wireless Communication and Networks”, Prentice Hall, Second Edition, 2014, ISBN: 978-0131918351

<p style="text-align: center;">Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) 410246:Laboratory Practice I</p>		
<p>Teaching Scheme: Practical : 04 Hours/Week</p>	<p>Credit 02</p>	<p>Examination Scheme: Term Work: 50 Marks Practical: 25 Marks Oral: 25 Marks</p>
<p>Companion Courses: 410241, 410242 and 410243</p>		
<p>Course Objectives:</p> <ul style="list-style-type: none"> • 		
<p>Course Outcomes: On completion of the course, student will be able to–</p> <ul style="list-style-type: none"> • 		
<p style="text-align: center;">Guidelines for Instructor's Manual</p> <p>The instructor's manual is to be developed as a 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.</p>		
<p style="text-align: center;">Guidelines for Student Journal</p> <p>The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and <u>handwritten write-up</u> of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, <u>Theory- Concept in brief, Database design, test cases, conclusion/analysis.</u> <u>Program codes with sample output of all performed assignments are to be submitted as softcopy.</u></p> <p>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</p>		
<p style="text-align: center;">Guidelines for Assessment</p> <p>Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab 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.</p>		
<p style="text-align: center;">Guidelines for Practical Examination</p> <p>Both internal and external examiners should jointly set problem statements. <u>During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement.</u> The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding of the</p>		

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.

Set of suggested assignments and mini-projects is provided. Each student must perform assignments individually and/or mini-projects in a group of 2-3 students as a part of lab for each lab course under the guidance of subject teacher. Subject teacher is free to frame additional mini-projects as per the need.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming Languages: C++/JAVA/PYTHON/R

Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, Backend : MonoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC, Additional Tools: Octave, Matlab, WEKA

Suggested List of Laboratory Assignments

410241:: High Performance Computing

Students have to implement following four fundamental building assignments individually and any one mini-project in a group of 2-3 students under the guidance of subject teacher. Subject teacher is free to frame additional assignments or mini-projects as per the need.

- | | |
|----|---|
| 1. | Implement Addition of two large vectors in parallel |
| 2. | Implement Parallel reduction using min, max and sum operation |
| 3. | Implement Vector -matrix multiplication in parallel (with very large number of columns in matrix) |
| 4. | Implement of nearest neighbor classifier in parallel |
| 5. | Mini-Project 1: Video Compression Module
RGB To YUV Transform concurrently on many core GPU |
| 6. | Mini Project 2: Generic Compression
Run length encoding concurrently on many core GPU |
| 7. | Mini Project 3: Encoding
Huffman encoding concurrently on many core GPU |
| 8. | Mini Project 4: Database Query Optimization
Long running database Query processing in parallel |
| 9. | Additional Mini Project Areas: Cryptography <ul style="list-style-type: none"> • Pattern recognition • Image processing • Data Analytics |

410242:: : Artificial Intelligence & Robotics

Students have to implement following four fundamental building assignments individually and any one

mini-project in a group of 2-3 students under the guidance of subject teacher. Subject teacher is free to frame additional assignments or mini-projects as per the need.

1.	Assignment on analysis of non-AI and AI technique: Implement Tic-Tac-Toe or any multiplayer game using non-AI and AI technique using minmax algorithm
2.	Assignment on Heuristic Search Techniques: Implement Hill-Climbing Algorithm.
3.	Assignment on Heuristic Search Techniques: Implement Best first search (Best-Solution but not always optimal) and A* algorithm (Always gives optimal solution).
4.	Assignment on Constraint Satisfaction Problem: Implement crypt-arithmetic problem or n-queens or graph coloring problem (Branch and Bound and Backtracking)
5.	Mini-Project 1: on Knowledge Reasoning Using PROLOG: Design and Develop family tree or Monkey Banana Problem using PROLOG
6.	Mini-Project 2: on Expert System Using PROLOG: Design and Develop medical diagnosis system sing PROLOG.(Question-answering)

410243:: Data Analytics

Students have to implement any one mini-project in a group of 2-3 students under the guidance of subject teacher. Subject teacher is free to frame additional assignments or mini-projects as per the need.

1.	Mini-Project 1: On Association Rules Design and Develop a Simple Recommender System based on user buying pattern using a priori Algorithm.
2.	Mini-Project 2: On Inferential Statistics Design and Develop Twitter Sentiment Analysis System using Inferential statistics
3.	Mini-Project 3: On Linear Regression Design and Develop temperature prediction system using linear regression

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410247:Laboratory Practice II

Teaching Scheme: Practical : 04 Hours/Week	Credit 02	Examination Scheme: Term Work: 50 Marks Practical: 25 Marks Oral: 25 Marks
Companion Courses: 410244 and 410245		
Course Objectives: <ul style="list-style-type: none"> • 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> • 		
Guidelines for Instructor's Manual <p>The instructor's manual is to be developed as a 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.</p>		
Guidelines for Student Journal <p>The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and <u>handwritten write-up</u> of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, <u>Theory- Concept in brief, Database design, test cases, conclusion/analysis</u>. <u>Program codes with sample output of all performed assignments are to be submitted as softcopy.</u></p> <p>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</p>		
Guidelines for Assessment <p>Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab 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.</p>		
Guidelines for Practical Examination <p>Both internal and external examiners should jointly set problem statements. <u>During practical assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation of the problem statement.</u> 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</p>		

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.

Set of suggested assignments and mini-projects is provided. Each student must perform assignments individually and/or mini-projects in a group of 2-3 students as a part of lab for each lab course under the guidance of subject teacher. Subject teacher is free to frame additional assignments or mini-projects as per the need.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming Languages: C++/JAVA/PYTHON/R

Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, Backend : MonoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC, Additional Tools: Octave, Matlab, WEKA

Suggested List of Laboratory Assignments

410244(A) : Digital Signal Processing

Students have to carry out any following **six foundation building assignments individually** and **one mini-project in a group of 2-3 students** under the guidance of subject teacher. (Note: For all the mini projects, test the code/execution using MATLAB) **Subject teacher is free to frame additional assignments or mini-projects as per the need.**

1. Develop a program to generate samples of sine, Cosine and exponential signals at specified sampling frequency and signal parameters. (Test the results for different analog frequency (F) and sampling frequency (Fs))
2. Find the output of a system described by given difference equation and initial conditions for given input sequence. (Solution of difference equation) (Obtain the response for different systems by changing Degree of difference equation (N) and coefficients and also for different input sequence $x(n)$. Observe the response by considering system as FIR and IIR system)
3. Write a program to plot the magnitude and phase response of a Fourier Transform (FT). (Observe the spectrum for different inputs. Observe the Periodicity.)
4. Find the N point DFT / IDFT of the given sequence $x(n)$. Plot the magnitude spectrum $|X(K)|$ Vs K. (Analyze the output for different N and the same input sequence $x(n)$. Also observe the periodicity and symmetry property)
5. Find the N point circular convolution of given two sequences. Test it for Linear convolution. Compute the circular convolution of given two sequences using DFT and IDFT.
6. Develop a program to plot the magnitude and phase response of a given system (given: $h(n)$: impulse response of system S) (Observe the frequency response for different systems. Compare the frequency response of a system (filter) for different length $h(n)$ i.e filter coefficients)
7. **Mini-Project 1:** Design and Develop the N-point radix-2 DIT or DIF FFT algorithm to find DFT or IDFT of given sequence $x(n)$. (Analyze the output for different N. Programme should work for any value of N and output should be generated for all intermediate stages.)

8.	Mini-Project 2: Obtain the Fourier transform of different window functions to plot the magnitude and phase spectrums. (Window functions: Rectangular, Triangular, Bartlett, Hamming, Hanning, Kaiser etc. Observe and compare the desirable features of window sequences for different length. Observe the main and side lobes)
9.	Mini-Project 3: Design an FIR filter from given specifications using windowing method. (Application should work for different types of filter specifications i.e. LPF, HPF, BPF etc and all window sequences. Plot the frequency response for different frequency terms i.e. analog and DT frequency)
10.	Mini-Project 4: Design of IIR filter for given specifications using Bilinear Transformation. (Generalized code to accept any filter length for a transfer function $H(Z)$. Application should work for different types of filter specifications i.e. LPF, HPF, BPF etc. and for different transfer functions of an analog filter)
410244(B): Software Architecture and Design Patterns	
Students have to carry out following two mini-projects in a group of 2-3 students under the guidance of subject teacher. Subject teacher is free to frame additional assignments or mini-projects as per the need.	
1.	Mini-Project 1: Narrate concise System Requirements Specification and organize the problem domain area into broad subject areas and identify the boundaries of problem/system. Identify and categorize the target system services with detailed service specifications modeled with component diagram incorporating appropriate architectural style and coupling. Design the service layers and tiers modeled with deployment diagram accommodating abstraction, autonomy, statelessness and reuse. Map the service levels and primitives to appropriate Strategies for data processing using Client-Server Technologies as applicable.
2.	Mini-Project 2: Select a moderately complex system and narrate concise requirement specification for the same. Design the system indicating system elements organizations using applicable architectural styles and design patterns with the help of a detailed Class diagram depicting logical architecture. Specify and document the architecture and design pattern with the help of templates. Implement the system features and judge the benefits of the design patterns accommodated.
410244(C): Pervasive and Ubiquitous Computing	
Students have to carry out any following four foundation building assignments individually and two mini-project in a group of 2-3 students under the guidance of subject teacher. These Assignments / Mini-Projects are designed so as to use,	
<ul style="list-style-type: none"> • No / minimal extra hardware, • uses open source software's, • need hardly any subscription / telephony / data charges. 	
Subject teacher is free to frame additional assignments or mini-projects as per the need.	
1.	Design and build a sensing system using micro-controllers like - Arduino / Raspberry Pi / Intel Galileo to sense the environment around them and act accordingly.
2.	Design and build an mobile application with context awareness to determine the remaining battery level depending on the users current usage patterns.
3.	Design and build an music streaming system and a smart mobile application to use the speakers or headphones of the smartphone of multiple phones to stream stored / live music during a party (instead of using large speakers).
4.	Smart Mobile Application with orientation sensing for users to put the phone in meeting / silent mode- OR- outdoor/ loud mode based on the orientation of the device. -OR- Smart Mobile Application with ambient sound / noise sensing to adjust the volume of the

	<p>phone automatically.</p> <p>-OR-</p> <p>Smart Mobile Application with ambient light sensing to adjust the screen brightness automatically.</p>
5.	<p>Mini-Project 1: Smart Mobile Application for Location-Based Messaging</p> <p>Design and build an Location-Based Messaging system where users have commented on various eating joints in the area you currently are. The mobile application should give you inputs / recommendations / suggestions on which eating joints are preferred by whom and for what eating items, with their ratings etc.</p>
6.	<p>Mini-Project 2: Smart Mobile Application as a Museum Guide</p> <p>Build a Mobile Application as a museum guide, the device scans the QR codes on the artefacts and gives an interactive detailed explanation using Audio / Text / Video about the museum artefact. using location of the user and the list of previously seen artefacts, the mobile application can suggest / recommend which next artefacts to be seen be the user</p>
7.	<p>Mini-Project 3: Smart Mobile Application as a Travel / Route Guide, Scenario -</p> <p>You are visiting an ancient monument. There is no local guide available. The previous users have commented on various locations where artefacts can be seen, photo are uploaded. The smart mobile application will give you directions / recommendations / suggestions on what to see and where, including narratives on the same.</p>
8.	<p>Mini-Project 4: Design and build a 'Multifunctional Application' in the Mobile and Pervasive domain. The choice of application is to be determined so as to leverage the capabilities of typical smart devices.</p> <p>These include such characteristics as,</p> <ul style="list-style-type: none"> • Location awareness and GPS systems • Accelerometers • Messaging • Sensor detection capability • Microphone & Camera • Media Player • Touch screen • Mapping Technology • Mobile Web Services
410244(D): Data Mining& Warehousing	
<p>Students have to carry out following four foundation building assignments individually and one mini-project in a group of 2-3 students under the guidance of subject teacher. Subject teacher is free to frame additional assignments or mini-projects as per the need.</p>	
1.	<p>For an organization of your choice, choose a set of business processes. Design star / snow flake schemas for analyzing these processes. Create a fact constellation schema by combining them. Extract data from different data sources, apply suitable transformations and load into destination tables using an ETL tool.</p> <p>For Example: Business Origination: Sales, Order, Marketing Process</p>
2.	<p>Consider a suitable dataset. For clustering of data instances in different groups, apply different clustering techniques (minimum 2). Visualize the clusters using suitable tool.</p>
3.	<p>Apply Apriori algorithm to find frequently occurring items from given data and generate strong association rules using support and confidence thresholds.</p>

	For Example: Market Basket Analysis
4.	Consider a suitable text dataset. Remove stop words, apply stemming and feature selection techniques to represent documents as vectors. Classify documents and evaluate precision, recall.
5.	<p>Mini project on classification:</p> <p>Consider a labeled dataset belonging to an application domain. Apply suitable data preprocessing steps such as handling of null values, data reduction, discretization. For prediction of class labels of given data instances, build classifier models using different techniques (minimum 3), analyze the confusion matrix and compare these models. Also apply cross validation while preparing the training and testing datasets.</p> <p>For Example: Health Care Domain for predicting disease</p>
410245(A): Distributed Systems	
Students have to carry out following eight assignments individually under the guidance of subject teacher. Subject teacher is free to frame additional assignments or mini-projects as per the need.	
1.	Design and develop a basic prototype distributed system (e.g. a DFS).
2.	Design and implement client server application using RPC/ RMI mechanism (Java)
3.	Design and implement a clock synchronization algorithm for prototype DS
4.	Implement Ring or Bully election algorithm for prototype DS.
5.	Implement Ricart Agrawala's distributed algorithm for mutual exclusion.
6.	Problem solving of Wait-die and Wait –wound scheme for deadlock prevention.
7.	Simulate Wait for Graph based Centralized or Hierarchical or Distributed algorithm for deadlock detection.
8.	Implementation of 2PC / Byzantine Generals Problem
410245(B): Software Testing and Quality Assurance	
Students have to carry out following two mini-projects in a group of 2-3 students under the guidance of subject teacher. Subject teacher is free to frame additional assignments or mini-projects as per the need.	
1.	Mini-Project 1: Create a small application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Prepare Test Cases inclusive of Test Procedures for identified Test Scenarios. Perform selective Black-box and White-box testing covering Unit and Integration test by using suitable Testing tools. Prepare Test Reports based on Test Pass/Fail Criteria and judge the acceptance of application developed.
2.	Mini-Project 2: Create a small web-based application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Narrate scripts in order to perform regression tests. Identify the bugs using Selenium WebDriver and IDE and generate test reports encompassing exploratory testing.

410245(C):: Operation Research

Students have to carry out following **two mini-projects in a group of 2-3 students** under the guidance of subject teacher. **Subject teacher is free to frame additional assignments or mini-projects as per the need.**

1. The Transportation Problem:

Milk in a milk shed area is collected on three routes A, B and C. There are four chilling centers P, Q, R and S where milk is kept before transporting it to a milk plant. Each route is able to supply on an average one thousand liters of milk per day. The supply of milk on routes A, B and C are 150, 160 and 90 thousand liters respectively. Daily capacity in thousand liters of chilling centers is 140, 120, 90 and 50 respectively. The cost of transporting 1000 liters of milk from each route (source) to each chilling center (destination) differs according to the distance. These costs (in Rs.) are shown in the following table

Routes	Chilling Centres			
	P	Q	R	S
A	16	18	21	12
B	17	19	14	13
C	32	11	15	10

The problem is to determine how many thousand liters of milk is to be transported from each route on daily basis in order to minimize the total cost of transportation.

2. Investment Problem:

A portfolio manager with a fixed budget of \$100 million is considering the eight investment opportunities shown in Table 1. The manager must choose an investment level for each alternative ranging from \$0 to \$40 million. Although an acceptable investment may assume any value within the range, we discretize the permissible allocations to intervals of \$10 million to facilitate the modeling. This restriction is important to what follows. For convenience we define a unit of investment to be \$10 million. In these terms, the budget is 10 and the amounts to invest are the integers in the range from 0 to 4. Following table provides the net annual returns from the investment opportunities expressed in millions of dollars. A ninth opportunity, not shown in the table, is available for funds left over from the first eight investments. The return is 5% per year for the amount invested, or equivalently, \$0.5 million for each \$10 million invested. The manager's goal is to maximize the total annual return without exceeding the budget

Returns from Investment Opportunities								
Amount	Opportunity							
Invested (\$10 million)	1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0
1	4.1	1.8	1.5	2.2	1.3	4.2	2.2	1.0
2	5.8	3.0	2.5	3.8	2.4	5.9	3.5	1.7
3	6.5	3.9	3.3	4.8	3.2	6.6	4.2	2.3
4	6.8	4.5	3.8	5.5	3.9	6.8	4.6	2.8

410245(D):: Mobile Communication

Students have to carry out any **four foundation building assignments individually** and **two mini-projects in a group of 2-3 students** under the guidance of subject teacher. Assignments should be implemented on android operating systems. **Subject teacher is free to frame additional assignments or mini-projects as per the need.**

1.	Design simple GUI application with activity and intents e.g. Design an android Application for Phone Call or Calculator
2.	Design an android application for media player.
3.	Design an android Application for SMS Manager
4.	Design an android Application using Google Map To Trace The Location of Device
5.	Design an android Application for Frame Animation
6.	<p>Mini-Project 1: Design mobile app to perform the task of creating the splash screen for the application using timer, camera options and integrate Google map API on the first page of the application. Make sure map has following features:</p> <ul style="list-style-type: none"> • Zoom & View change • Navigation to specific locations • Marker & getting location with touch <p>Monitoring of location</p>
7.	<p>Mini-Project 2: Create an app to add of a product to SQLite database and make sure to add following features</p> <ul style="list-style-type: none"> • SMS messaging and email provision • Bluetooth options • Accessing Web services • Asynchronous remote method call • Use Alert box for user notification
8.	<p>Mini-Project 3: Create the module for collecting cellular mobile network performance parameters using telephony API Manager</p> <ul style="list-style-type: none"> • Nearest Base Station • Signal Strengths • SIM Module Details • Mobility Management Information
9.	<p>Mini-Project 4: Create an application for Bank using spinner, intent</p> <ul style="list-style-type: none"> • Form 1: Create a new account for customer • Form 2: Deposit money in customer account. • Link both forms, after completing of first form the user should be directed to the

	<p>second form</p> <ul style="list-style-type: none">• Provide different menu options
10.	<p>Mini-Project 5: Create the module for payment of fees for College by demonstrating the following methods.</p> <ul style="list-style-type: none">• Fees Method()- for calculation of fees• Use customized Toast for successful payment of fees• Implement an alarm in case someone misses out on the fee submission deadline• Demonstrate the online payment gateway

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410248:Project Work Stage I

Teaching Scheme:

Credit

Examination Scheme:

Practical : 04 Hours/Week

02

Presentation: 50 Marks

Course Objectives:

- To Apply the knowledge for solving realistic problem
- To develop problem solving ability
- To Organize, sustain and report on a substantial piece of team work over a period of several months
- To Evaluate alternative approaches, and justify the use of selected tools and methods,
- To Reflect upon the experience gained and lessons learned,
- To Consider relevant social, ethical and legal issues,
- To find information for yourself from appropriate sources such as manuals, books, research journals and from other sources, and in turn increase analytical skills.
- To Work in TEAM and learn professionalism.

Course Outcomes:

On completion of the course, student will be able to–

- Solve real life problems by applying knowledge.
- Analyze alternative approaches, apply and use most appropriate one for feasible solution.
- Write precise reports and technical documents in a nutshell.
- Participate effectively in multi-disciplinary and heterogeneous teams exhibiting team work, Inter-personal relationships, conflict management and leadership quality.

Guidelines

Project work Stage – I is an integral part of the Project work. In this, the student shall complete the partial work of the Project which will consist of problem statement, literature review, SRS, Model and Design. The student is expected to complete the project up to the design phase. As a part of the progress report of project work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected project topic. The student shall submit the duly certified progress report of Project work Stage-I in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

The examinee will be assessed by a panel of examiners of which one is necessarily an external examiner. The assessment will be broadly based on work undergone, content delivery, presentation skills, documentation, question-answers and report.

Follow guidelines and formats as mentioned in Project Workbook recommended by Board of Studies.

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410249: Audit Course 5

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 190 credits and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course. 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 AP (Audit Course Pass) and shall be included such AP 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 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. (Ref- http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

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

- | | |
|---|--|
| <ul style="list-style-type: none"> • Lectures/ Guest Lectures • Visits (Social/Field) and reports • Demonstrations | <ul style="list-style-type: none"> • Surveys • Mini Project • Hands on experience on specific focused topic |
|---|--|

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

- | | |
|---|---|
| <ul style="list-style-type: none"> • Written Test • Demonstrations/ Practical Test • Presentations | <ul style="list-style-type: none"> • IPR/Publication • Report |
|---|---|

Audit Course 3 Options

AC5- I	Entrepreneurship Development
AC5-II	Botnet of Things
AC5-III	3D Printing
AC5-IV	Industrial Safety and Environment Consciousness
AC5-V	Emotional Intelligence
AC5-VI	MOOC-Learn New Skill

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier
<http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx>

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2017 Course)
410249: Audit Course 5
AC5 – I: Entrepreneurship Development

This Course Aims at Instituting Entrepreneurial skills in the students by giving an overview of, who the entrepreneurs are? and what competences are needed to become an entrepreneur.

Course Objectives:

-

Course Outcome:

On completion of the course, learner will be able to–

-

Course Contents:

- 1. Introduction:** Concept and Definitions, Entrepreneur v/s Intrapreneur; Role of entrepreneurship in economic development; Entrepreneurship process; Factors impacting emergence of entrepreneurship; Managerial versus entrepreneurial Decision Making; Entrepreneur v/s Investors; Entrepreneurial attributes and characteristics; Entrepreneurs versus inventors; Entrepreneurial Culture; Women Entrepreneurs; Social Entrepreneurship; Classification and Types of Entrepreneurs; EDP Programmers; Entrepreneurial Training; Traits/Qualities of an Entrepreneurs.
- 2. Creating Entrepreneurial Venture :** Generating Business idea- Sources of Innovation, methods of generating ideas, Creativity and Entrepreneurship; Challenges in managing innovation; Business planning process; Drawing business plan; Business plan failures; Entrepreneurial leadership – components of entrepreneurial leadership; Entrepreneurial Challenges; Legal issues – forming business entity, considerations and Criteria, requirements for formation of a Private/Public Limited Company, Intellectual Property Protection - Patents Trademarks and Copyrights – importance for startups, Legal Acts Governing Business in India.
- 3. Functional plans:** Marketing plan–for the new venture, environmental analysis, steps in preparing marketing plan, marketing mix, contingency planning; Organizational plan – designing organization structure and Systems; Financial plan – pro forma income statements, pro forma cash budget, funds Flow and Cash flow statements; Pro forma balance sheet; Break Even Analysis; Ratio Analysis.
- 4. Entrepreneurial Finance:** Debt or equity financing, Sources of Finance - Commercial banks, private placements, venture capital, financial institutions supporting entrepreneurs; Lease Financing; Funding opportunities for Startups in India.
- 5. Enterprise Management:** Managing growth and sustenance- growth norms; Factors for growth; Time management, Negotiations, Joint ventures, Mergers & acquisitions

Books:

1. Kumar, Arya, ``Entrepreneurship: Creating and Leading an Entrepreneurial Organization'', Pearson
2. Hishrich., Peters, ``Entrepreneurship: Starting, Developing and Managing a New Enterprise,`` Irwin Taneja, ``Entrepreneurship,`` Galgotia Publishers.
3. Barringer, Brace R., and R. Duane, ``Entrepreneurship,`` Pearson Prentice Hall
4. Hisrich, Robert D., Michael Peters and Dean Shepherd, ``Entrepreneurship,`` Tata McGraw Hill
5. Lall, Madhurima, and Shikha Sahai, ``Entrepreneurship,`` Excel Books
6. Charantimath, Poornima, ``Entrepreneurship Development and Small Business Enterprises,`` Pearson Education

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2017 Course)
410249: Audit Course 5
AC5 – II: Botnet of Things

This course aims to provide an understanding of the various security attacks and knowledge to recognize and remove common coding errors that lead to vulnerabilities. It gives an outline of the techniques for developing a secure application.

Course Objectives:

- To Understand the various IoT Protocols
- To Understand the IoT Reference Architecture and Real World Design Constraints

Course Outcome:

On completion of the course, learner will be able to–

- To implement security as a culture and show mistakes that make applications vulnerable to attacks.
- To understand various attacks like DoS, buffer overflow, web specific, database specific, web - spoofing attacks.
- To demonstrate skills needed to deal with common programming errors that lead to most security problems and to learn how to develop secure applications

Course Contents:

- 1. Introduction**
- 2. IRC-Based Bot Networks**
- 3. Anatomy of a Botnet: The Gaobot Worm**
- 4. IoT Senosors & Security :** Sensors and actuators in IoT, Communication and networking in IoT, Real-time data collection in IoT, Data analytics in IoT , IoT applications and requirements, Security threats and techniques in IoT, Data trustworthiness and privacy in IoT, Balancing utility and other design goals in IoT , Future of Botnets in the Internet of Things, Thingbots, Elements of Typical IRC Bot Attack , Malicious use of Bots & Botnet
- 5. Service Layer Protocols & Security :** Security: PHP Exploits, Cross-Site Scripting and Other Browser-Side Exploits, Bots and Botnets, Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols –MAC 802.15.4 , 6LoWPAN, RPL, Application Layer Transport & Session layer protocols- transport Layer (TCP, MPTCP, UDP, DCCP, SCTP) - (TLS, DTLS) – Session Layer - HTTP, CoAP, XMPP, AMQP, MQTT

Books:

1. Bernd Scholz - Reiter, Florian Michahelles, “Architecting the Internet of Things”, Springer ISBN 978 – 3 – 642 – 19156 - 5 e - ISBN 978 – 3 -642 - 19157 - 2,
2. Threat Modeling, Frank Swiderski and Window Snyder,Microsoft Professional, 1 st Edition 2004
3. Gunter Ollmann 2007. The Phishing Guide Understanding & Preventing Phishing Attacks. IBM Internet Security Systems.
4. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978 – 1 – 118 – 47347 - 4, Willy Publications
5. White Papers :- <https://www.sans.org/reading-room/whitepapers/malicious/bots-botnet-overview-1299>
6. <https://www-01.ibm.com/marketing/iwm/dre>
7. Mike Kuniavsky, “Smart Things: Ubiquitous Computing User Experience Design,” Morgan Kaufmann Publishers.

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2017 Course)
410249: Audit Course 5
AC5 – III: 3D Printing

Course Objectives:

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Course Outcome:

On completion of the course, learner will be able to–

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Course Contents:

- 1. Getting Started with 3D Printing:** How 3D Printers Fit into Modern Manufacturing, Exploring the Types of 3D Printing, Exploring Applications of 3D Printing.
- 2. Outlining 3D Printing Resources:** Identifying Available Materials for 3D Printing, Identifying Available Sources for 3D Printable Objects.
- 3. Exploring the Business Side of 3D Printing:** Commoditizing 3D Printing, Understanding 3D Printing's Effect on Traditional lines of Business, Reviewing 3D Printing Research.
- 4. Employing Personal 3D printing Devices:** Exploring 3D printed Artwork, Considering Consumer level 3D Printers, Deciding on RepEap of Your Own.

Books:

1. Richard Horne, Kalani Kirk Hausman, “ 3D Printing for Dummies”, Taschenbuch, ISBN: 9781119386315
2. Greg Norton, “3D Printing Business - 3D Printing for Beginners - How to 3D Print” , ISBN:9781514785669
3. Liza Wallach Kloski and Nick Kloski, “ Getting Started with 3D Printing: A Hands-on Guide to the Hardware, Software, and Services Behind the New Manufacturing Revolution”, Maker Media, ISBN: 1680450204
4. Jeff Heldrich , “3D Printing: Tips on Getting Started with 3D Printing to Help you make Passive income for your Business”

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2017 Course)
410249: Audit Course 5

AC5 – IV: Industrial Safety and Environment Consciousness

Objective of Industrial Safety, Health Environment and Security covers virtually every important area in administration of SHE. It broadly discusses the major problems in safety management, occupational health and today's dynamic environment management of rapidly changing ambience, technological advances, whole gamut of safety laws, safety policy and its designing and their meticulous implementation

Course Objectives:

-

Course Outcome:

On completion of the course, learner will be able to–

-

Course Contents:

- 1. Introduction:** Elements of safety programming, safety management, Upgrading developmental programmers: safety procedures and performance measures, education, training and development in safety.
- 2. Safety Performance Planning**
Safety Performance: An overview of an accident, It is an accident, injury or incident, The safety professional, Occupational health and industrial hygiene. Understanding the risk: Emergency preparedness and response, prevention of accidents involving hazardous substances.
- 3. Accident Prevention**
What is accident prevention?, Maintenance and Inspection, Monitoring Techniques, General Accident Prevention, Safety Education and Training.
- 4. Safety Organization**
Basic Elements of Organized Safety, Duties of Safety Officer, Safe work Practices, Safety Sampling and Inspection, Job Safety Analysis(JSA), Safety Survey, On- site and Off-site Emergency Plan, Reporting of Accidents and Dangerous Occurrences.
- 5. Environment**
Introduction, Work Environment, Remedy, pollution of Marine Environment and Prevention, Basic Environmental Protection Procedures, Protection of Environment in Global Scenario, Greenhouse Gases, Climate Change Impacts, GHG Mitigation Options, Sinks and Barriers, Clean Technologies by Developing Countries.
- 6. Industrial Security(Industry wise)**
General security Systems in Factories, Activation Security, Computer Security, Banking Security, V.I.P. Security, Women Security, Event Security, Security in Open Environments, Developing a Positive Attitude Towards Security, Private Security Vrs. Govt. Security.

Books:

1. Basudev Panda ,“Industrial Safety, Health Environment and Security”, Laxmi Publications, ISBN-10: 9381159432, 13: 978-9381159439
2. A. K. Gupta, “Industrial safety and Environment”, Laxmi Publications, ISBN:88131804544
3. L.M. Deshmukh, “ Industrial Safety Management” , Tata McGraw-Hill , ISBN: 9780070617681

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2017 Course)
410249: Audit Course 5
AC5 – 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:

- To develop an awareness of EI models
- To recognize the benefits of EI
- To understand how you use emotion to facilitate thought and behavior
- To know and utilize the difference between reaction and considered response

Course Outcomes:

On completion of the course, learner will be able to–

- Expand your knowledge of emotional patterns in yourself and others
- Discover how you can manage your emotions, and positively influence yourself and others
- Build more effective relationships with people at work and at home
- Positively influence and motivate colleagues, team members, managers
- Increase your leadership effectiveness by creating an atmosphere that engages others
- EI behaviors and supports high performance

Course Contents:

- 1. 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
- 2. 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
- 3. 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. 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, 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, Pune
Third Year of Computer Engineering (2017 Course)
410249: Audit Course 5
AC5 – VI: MOOC-learn New Skill

Course Objectives:

- To promote interactive user forums to support community interactions among students, professors, and experts
- To promote learn additional skills anytime and anywhere
- To enhance teaching and learning on campus and online

Course Outcome:

On completion of the course, learner will acquire additional knowledge and skill.

About Course:

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. Whether you're interested in learning for yourself, advancing your career or leveraging online courses to educate your workforce, SWAYAM, NPTEL, edx or similar ones can help.

World's largest SWAYAM MOOCs, a new paradigm of education for anyone, anywhere, anytime, as per your convenience, aimed to provide digital education free of cost and to facilitate hosting of all the interactive courses prepared by the best more than 1000 specially chosen faculty and teachers in the country. SWAYAM MOOCs enhances active learning for improving lifelong learning skills by providing easy access to global resources.

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to the residents in India. More than 1,000 specially chosen faculty and teachers from across the Country have participated in preparing these courses.

The courses hosted on SWAYAM is generally in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology. In order to ensure best quality content are produced and delivered, seven National Coordinators have been appointed: They are NPTEL for engineering and UGC for post-graduation education.

Guidelines:

Instructors are requested to promote students to opt for courses with proper mentoring. The departments will take care of providing necessary infrastructural and facilities for the learners.

References:

1. <https://swayam.gov.in/>
2. <https://onlinecourses.nptel.ac.in/>
3. <https://www.edx.org>

SEMESTER II

Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) 410250: Machine Learning		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 207003- Engineering Mathematics III		
Companion Course: 410254- Laboratory Practice III		
Course Objectives: <ul style="list-style-type: none"> To understand human learning aspect and relate it with machine learning concepts. To understand nature of the problem and apply machine learning algorithm. To find optimized solution for given problem. 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> Distinguish different learning based applications Apply different preprocessing methods to prepare training data set for machine learning. Apply different methods of data preprocessing to input dataset. Design and implement supervised machine learning algorithm. Implement different supervised learning models Learn Meta classifiers and deep learning concepts 		
Course Contents		
Unit I	Introduction to Machine learning	08 Hours
Classic and adaptive machines, Machine learning matters, Beyond machine learning-deep learning and bio inspired adaptive systems, Machine learning and Big data. Important Elements of Machine Learning- Data formats, Learnability, Statistical learning approaches, Elements of information theory.		
Unit II	Feature Selection	08 Hours
Scikit- learn Dataset, Creating training and test sets, managing categorical data, Managing missing features, Data scaling and normalization, Feature selection and Filtering, Principle Component Analysis(PCA)-non negative matrix factorization, Sparse PCA, Kernel PCA. Atom Extraction and Dictionary Learning.		
Unit III	Regression	08 Hours
Linear regression- Linear models, A bi-dimensional example, Linear Regression and higher dimensionality, Ridge, Lasso and ElasticNet, Robust regression with random sample consensus, Polynomial regression, Isotonic regression, Logistic regression- Linear classification, Logistic regression, Implementation and Optimizations, Stochastic gradient descent algorithms, Finding the optimal hyper-parameters through grid search, Classification metric, ROC Curve.		
Unit IV	Naïve Bayes and Support Vector Machine	08 Hours

Bayes' Theorem, Naïve Bayes' Classifiers, Naïve Bayes in Scikit-learn- Bernoulli Naïve Bayes, Multinomial Naïve Bayes, and Gaussian Naïve Bayes.

Support Vector Machine(SVM)- Linear Support Vector Machines, Scikit-learn implementation- Linear Classification, Kernel based classification, Non- linear Examples. Controlled Support Vector Machines, Support Vector Regression.

Unit V	Decision Trees and Ensemble Learning	08 Hours
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Decision Trees- Impurity measures, Feature Importance. Decision Tree Classification with Scikit-learn, Ensemble Learning-Random Forest, AdaBoost, Gradient Tree Boosting, Voting Classifier.

Clustering Fundamentals- Basics, K-means: Finding optimal number of clusters, DBSCAN, Spectral Clustering. Evaluation methods based on Ground Truth- Homogeneity, Completeness, Adjusted Rand Index.

Introduction to Meta Classifier: Concepts of Weak and eager learner, Ensemble methods, Bagging, Boosting, Random Forests.

Unit VI	Clustering Techniques	08 Hours
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Hierarchical Clustering, Expectation maximization clustering, Agglomerative Clustering- Dendrograms, Agglomerative clustering in Scikit-learn, Connectivity Constraints.

Introduction to Recommendation Systems- Naïve User based systems, Content based Systems, Model free collaborative filtering-singular value decomposition, alternating least squares.

Fundamentals of Deep Networks-Defining Deep learning, common architectural principles of deep networks, building blocks of deep networks.

Books:

Text:

1. Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Limited, ISBN-10: 1785889621, ISBN-13: 978-1785889622
2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioners Approach", O'REILLY, SPD, ISBN: 978-93-5213-604-9, 2017 Edition 1st.

References:

1. Ethem Alpaydin, "Introduction to Machine Learning", PHI 2nd Edition-2013, ISBN 978-0-262-01243-0
2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press, Edition 2012, ISBN-10: 1107422221; ISBN-13: 978-1107422223
3. Tom Mitchell "Machine Learning" McGraw Hill Publication, ISBN :0070428077 9780070428072
4. Nikhil Buduma, "Fundamentals of Deep Learning", O'REILLY publication, second edition 2017, ISBN: 1491925612

Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) 410251: Information and Cyber Security		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 310245-Computer Networks		
Companion Course: Laboratory Practice III (410254)		
Course Objectives: <ul style="list-style-type: none"> To offer an understanding of principle concepts, central topics and basic approaches in information and cyber security. To realize the basics of cryptography. To acquire knowledge of standard algorithms and protocols employed to provide confidentiality, integrity and authenticity. To see how to deploy encryption techniques to ensure data in transit across data networks. To enhance awareness about Personally Identifiable Information (PII), Information Management, cyber forensics. 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> Gauge the security protections and limitations provided by today's technology. Identify information security and cyber security threats. Analyze threats in order to protect or defend it in cyberspace from cyber-attacks. Build appropriate security solutions against cyber-attacks. 		
Course Contents		
Unit I	Security Basics	06 Hours
Overview - Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A Model for Network Security. Classical Encryption Techniques- Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography. Block Ciphers and the Data Encryption Standard - Block Cipher Principles, The Data Encryption Standard (DES) , A DES Example , The Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles.		
Unit II	Data Encryption Standards	08 Hours
Basic Concepts in Number Theory and Finite Fields - Divisibility and the Division Algorithm, The Euclidean Algorithm, Modular Arithmetic, Groups, Rings, and Fields, Finite Fields of the Form GF(p), Polynomial Arithmetic , Finite Fields of the Form GF(2 ^N). Advanced Encryption Standard - The Origins AES, AES Structure, AES Round Functions, AES Key Expansion, An AES Example.		
Unit III	Cipher Operation	08 Hours
Block Cipher Operation- Multiple Encryption and Triple DES, Electronic Codebook Mode, Cipher Block Chaining Mode, Cipher Feedback Mode, Output Feedback Mode, Counter Mode. Pseudorandom Number Generation and Stream Ciphers- Principles of Pseudorandom Number Generation, Pseudorandom Number Generators, Pseudorandom Number Generation Using a Block Cipher, Stream Ciphers, RC5, True Random Numbers.		
Unit IV	Key Management	08 Hours

Key Management and Distribution:

Prime Numbers, Fermat's and Euler's Theorems, Testing for Primality, The Chinese Remainder Theorem, Schnorr Digital Signature Scheme, Digital Signature Standard (DSS).

Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, Certificates, Public Key Infrastructure.

Unit V**Network and Internet Security****08 Hours**

User Authentication Protocols- Remote User Authentication Principles, Remote User Authentication Using Symmetric Encryption, Kerberos, Remote User Authentication Using Asymmetric Encryption, Federated Identity Management.

Transport-Level Security- Web Security Issues, Secure Sockets Layer (SSL), Transport Layer Security (TLS), HTTPS, Secure Shell (SSH).

Unit VI**Confidentiality And Cyber Forensic****06 Hours**

Introduction to Personally Identifiable Information (PII), Cyber Stalking, PII impact levels with examples Cyber Stalking, Cybercrime, PII Confidentiality Safeguards, Information Protection Law: Indian Perspective.

Books:**Text:**

1. William Stallings, "Cryptography and network security principles and practices", Pearson, 6th Edition, ISBN : 978-93-325-1877-3
2. Nina Godbole, Sunit Belapure, "Cyber Security", Wiley India, 2014, ISBN No.: 978-81-345-2179-1.

References:

3. Eoghan Casey, "Digital Evidence and Computer Crime Forensic Science, Computers and the Internet", ELSEVIER, 2011, ISBN 978-0-12-374268-1
4. Atul Kahate, "Cryptography and Network Security", Mc Graw Hill Publication, 2nd Edition, 2008, ISBN : 978-0-07-064823-4
5. Bernard Menezes, "Network Security And Cryptography", Cengage Learning India, 2014, ISBN No.: 8131513491

<p align="center">Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) Elective III 410252(A): Advanced Digital Signal Processing</p>		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 410244(A) Digital Signal Processing		
Companion Course: 410255- Laboratory Practice IV		
Course Objectives: <ul style="list-style-type: none"> To learn theory behind signal processing To Understand mathematics of signal processing To know the significance and use of filters To explore the applications DSP 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> Apply various transforms for Digital signal Processing Use appropriate filters to suit to the DSP application Choose the best DS Processor for the application development Design the DSP application for the practical use 		
Course Contents		
Unit I	Sampling And Reconstruction of Signals	Hours
Sampling of Bandpass Signals - Representation of Bandpass Signals, Sampling of Bandpass Signals, Discrete-Time Processing of Continuous-Time Signals, Analog-to-Digital Conversion, Sample-and-Hold, Quantization and Coding, Analysis of Quantization Errors, Oversampling A/D Converters, Digital-to-Analog Conversion, Sample and Hold, First-Order Hold, Linear Interpolation with Delay, Oversampling D/A Converters.		
Unit II	Multirate Digital Signal Processing	Hours
Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for sampling rate Conversion		
Unit III	Multistage Implementation of Sampling Rate Conversion	Hours
Sampling-Rate Conversion of Bandpass Signals, Sampling Rate Conversion of Bandpass Signals, Applications of Multirate Signal Processing		
Unit IV	Linear Prediction And Optimum Linear Filters	Hours
Innovations Representation of a Stationary Random Process, Forward and Backward linear prediction, Solution of the Normal Equations, Properties of linear prediction - Error Filter, AR Lattice and ARMA Lattice- Ladder Filters.		
Unit V	Power Spectral Estimation	Hours
Estimation of Spectra from Finite Duration Observations of a signal, Nonparametric Methods for Power Spectrum Estimation.		
Unit VI	Parametric Method of Power Spectrum Estimation	Hours
Parametric Methods for power spectrum estimation, Minimum Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation.		

Books:**Text:**

1. Proakis JG and Manolakis DG, “Digital Signal Processing Principles, Algorithms and Application”, PHI,
2. Openheim AV & Schafer RW, Discrete Time Signal Processing PHI
3. Alan V. Oppenheim and Ronald W. Schafer, “ Digital Signal Processing”, Pearson, ISBN-10: 0132146355, 13: 978-0132146357
4. Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing – A Practical Approach”, 2nd Edition, Pearson Education, ISBN 10: 020154413X ISBN 13: 9780201544138

References:

1. R. E. Crochiere and L. R. Rabiner, “Multirate Digital Signal Processing”, Pearson , ISBN 0-13-605162-6
2. A. Rabiner and Gol, “Theory and Application of Digital Signal Processing”, Prentice Hall, ISBN 10: 0139141014, 13: 9780139141010.
3. William D. Stanley, “Digital Signal Processing”, Reston, ; ISBN-10: 083591321X, 13: 978-0835913218
4. John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing – Principles, Algorithms, and Applications”, 4th Edition, Pearson Prentice Hall, ISBN: 9788131710005, 8131710009
5. Steven W. Smith., “The Scientist and Engineer’s and Guide”, California Technical Pub, ISBN: 10: 0966017633
6. Dale Grover and John R. (Jack) Deller, “Digital Signal Processing and the Microcontroller”, Prentice Hall, ISBN 0-13-754920-2

Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) Elective III 410252(B): Compiler Construction		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: Theory of Computation(310241), 310251-Systems Programming and Operating System		
Companion Course: 410255-Laboratory Practice IV		
Course Objectives: <ul style="list-style-type: none"> To introduce process of compilation To introduce compiler writing tools To address issues in code generation and optimization 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> Design and implement a lexical analyzer and a syntax analyzer Specify appropriate translations to generate intermediate code for the given programming language construct Compare and contrast different storage management schemes Identify sources for code optimization 		
Course Contents		
Unit I	Notion and Concepts	8 Hours
Introduction to compilers Design issues, passes, phases, symbol table Preliminaries Memory management, Operating system support for compiler, Lexical Analysis Tokens, Regular Expressions, Process of Lexical analysis, Block Schematic, Automatic construction of lexical analyzer using LEX, LEX features and specification.		
Unit II	Parsing	8 Hours
Syntax Analysis CFG, top-down and bottom-up parsers, RDP, Predictive parser, SLR, LR(1), LALR parsers, using ambiguous grammar, Error detection and recovery, automatic construction of parsers using YACC, Introduction to Semantic analysis, Need of semantic analysis, type checking and type conversion.		
Unit III	Syntax Translation Schemes	6 Hours
Syntax Directed Translation - Attribute grammar, S and L attributed grammar, bottom up and top down evaluations of S and L attributed grammar, Syntax directed translation scheme, Intermediate code - need, types: Syntax Trees, DAG, Three-Address codes: Quadruples, Triples and Indirect Triples, Intermediate code generation of declaration statement and assignment statement.		
Unit IV	Run-time Storage Management	8 Hours
Storage Management – Static, Stack & Heap, Activation Record, static and control links, parameter passing, return value, passing array and variable number of arguments, Static and Dynamic scope, Dangling Pointers, translation of control structures – if, if-else statement, Switch-case, while, do -while statements, for, nested blocks, display mechanism, array assignment, pointers, function call and return. Translation of OO constructs: Class, members and Methods.		
Unit V	Code Generation	6 Hours

Code Generation - Issues in code generation, basic blocks, flow graphs, DAG representation of basic blocks, Target machine description, peephole optimization, Register allocation and Assignment, Simple code generator, Code generation from labeled tree, Concept of code generator.

Unit VI	Code Optimization	6 Hours
Need for Optimization, local, global and loop optimization, Optimizing transformations, compile time evaluation, common sub-expression elimination, variable propagation, code movement, strength reduction, dead code elimination, DAG based local optimization, Introduction to global data flow analysis, Data flow equations and iterative data flow analysis.		
Books:		
Text:		
<ol style="list-style-type: none"> 1. V Aho, R Sethi, J D Ullman, "Compilers: Principles, Techniques, and Tools", Pearson Edition, ISBN 81-7758-590-8 2. Dick Grune, Bal, Jacobs, Langendoen, " Modern Compiler Design", Wiley, ISBN 81-265-0418-8 		
References:		
<ol style="list-style-type: none"> 1. Anthony J. Dos Reis, "Compiler Construction Using Java", JavaCC and Yacc Wiley, ISBN 978-0-470-94959-7 2. K Muneeswaran, "Compiler Design", Oxford University press, ISBN 0-19-806664-3 3. J R Levin, T Mason, D Brown, "Lex and Yacc", O'Reilly, 2000 ISBN 81-7366-061-X 		

<p align="center">Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) Elective III 410252(C): Embedded and Real Time Operating System</p>		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 310251-Systems Programming and Operating System		
Companion Course: 410255-Laboratory Practice IV		
Course Objectives: <ul style="list-style-type: none"> To understand a typical embedded system and its constituents To learn the selection process of processor and memory for the embedded systems To learn communication buses and protocols used in the embedded and real-time systems To understand real-time operating system (RTOS) and the types of RTOS To learn various approaches to real-time scheduling To understand resource access control and inter-process communication for RTOS tasks To learn software development process and tools for RTOS applications 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> Recognize and classify embedded and real-time systems Explain communication bus protocols used for embedded and real-time systems Classify and exemplify scheduling algorithms Apply software development process to a given RTOS application Design a given RTOS based application 		
Course Contents		
Unit I	Embedded Systems	08 Hours
Introduction to Embedded systems, Characteristics, Challenges, Processors in Embedded systems, hardware Units and devices in an embedded system – Power source, memory, real-time clocks, timers, reset circuits, watchdog-timer reset, Input-output ports, buses and interfaces, ADC, DAC, LCD, LED, Keypad, pulse dialer, modem, transceivers. embedded software, software are tools for designing an embedded system		
Unit II	Embedded System On Chip (SOC)	07 Hours
Introduction to Embedded systems, Characteristics, Challenges, Processors in Embedded systems, hardware Units and devices in an embedded system – Power source, memory, real-time clocks, timers, reset circuits, watchdog-timer reset, Input-output ports, buses and interfaces, ADC, DAC, LCD, LED, Keypad, pulse dialer, modem, transceivers. embedded software, software are tools for designing an embedded system		
Unit III	I/O communication	08 Hours
Devices and communication buses: Types of I/O communication, types of serial communication, Serial protocols, Devices and buses- RS-232C, RS-485, HDLC, SPI, SCI, SI, SDIO. Parallel ports and interfacing. Parallel device protocols: ISA, PCI, PCI/X, ARM bus, Wireless devices		
Unit IV	Real Time Operating System	08 Hours

Introduction to real-time operating systems. Hard versus soft real-time systems and their timing constraints. Temporal parameters of real-time process: Fixed, Jittered and sporadic release times, execution time. Types of real-time tasks, Precedence constraints and data dependency among real-time tasks, other types of dependencies for real-time tasks. Functional parameters and Resource parameters of real-time process, Real-time applications: Guidance and control, Signal processing, Multimedia, real-time databases

Real-time task and task states, task and data. Approaches to real-time scheduling: clock driver, weighted round-robin, priority-driven- Fixed priority and dynamic priority algorithms –Rate Monotonic (RM), Earliest-Deadline-First (EDF), Latest-Release-Time (LRT), Least-Slack-Time-First (LST). Static and Dynamic systems, on-line and off-line scheduling, Scheduling aperiodic and sporadic real-time tasks

Unit V

Inter-process communication

07 Hours

Resources and resource access control-Assumption on resources and their usage, Enforcing mutual exclusion and critical sections, resource conflicts and blocking, Effects of resource contention and resource access control - priority inversion, priority inheritance.

Inter-process communication-semaphores, message queues, mailboxes and pipes. Other RTOS services-Timer function, events, Interrupts - enabling and disabling interrupts, saving and restoring context, interrupt latency, shared data problem while handling interrupts. Interrupt routines in an RTOS environment

Unit VI

Multiprocessor Scheduling

07 Hours

Multiprocessor Scheduling, resource access control and synchronization in Real-time Operating system. Real-time communication: Model, priority-based service disciplines for switched networks, weighted round-robin service disciplines, Medium access-control protocols for broadcast networks, internet and resource reservation protocols, real-time protocols. Software development process for embedded system: Requirements engineering, Architecture and design of an embedded system, Implementation aspects in an embedded system, estimation modeling in embedded software. Validation and debugging of embedded systems. Embedded software development tools. Debugging techniques

Real-time operating systems: Capabilities of commercial real-time operating systems, QNX/Neutrino, Microc/OS-II, VxWorks, Windows CE and RTLinux

Books:

Text:

1. Raj Kamal, “Embedded Systems: Architecture, programming and Design”, 2nd Edition, McGraw-Hill, ISBN: 13: 9780070151253
2. Jane W. S. Liu, “Real-Time Systems”, Pearson Education, ISBN: 10: 0130996513
1. David E. Simon, “An Embedded Software Primer”, Pearson Education, ISBN: :8177581546

References:

1. Sriram V. Iyer, Pankaj Gupta, “Embedded Real-time Systems Programming”, Tata McGraw-Hill, ISBN: 13: 9780070482845
2. Dr. K. V. K. K. Prasad, “Embedded Real-Time Systems: Concepts: Design and Programming”, Black Book, Dreamtech Press, ISBN: 10: 8177224611, 13: 9788177224610

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective III
410252(D): Soft Computing and Optimization Algorithms

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 310250-Design and Analysis of Algorithm		
Companion Course: 410255-Laboratory Practice IV		
Course Objectives: <ul style="list-style-type: none"> Design and develop intelligent systems in the framework of soft computing, and to acquire knowledge of scientific application-driven environments 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> Have a general understanding of soft computing methodologies, including artificial neural networks, fuzzy sets, fuzzy logic, fuzzy inference systems and genetic algorithms Design and development of certain scientific and commercial application using computational neural network models, fuzzy models, fuzzy clustering applications and genetic algorithms in specified applications. 		
Course Contents		
Unit I	Soft Computing Basics	06 Hours
Introduction, soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing. Basic tools of soft computing – Fuzzy logic, neural network, evolutionary computing. Introduction: Neural networks, application scope of neural networks, fuzzy logic, genetic algorithm, and hybrid systems.		
Unit II	Fuzzy Sets and Logic	06 Hours
Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion. Membership functions, inference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzifications, Fuzzy Controller, Fuzzy rule base and approximate reasoning: truth values and tables in fuzzy logic, fuzzy propositions formation of rules ,decomposition of compound rules, aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference system, fuzzy expert systems.		
Unit III	Evolutionary Computing	06 Hours
Basic Evolutionary Processes, EV : A Simple Evolutionary System, Evolutionary Systems as Problem Solvers, A Historical Perspective, Canonical Evolutionary Algorithms - Evolutionary Programming, Evolution Strategies, A Unified View of Simple EAs- A Common Framework, Population Size.		
Unit IV	Genetic Algorithm	08 Hours
Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, Traditional algorithm vs genetic algorithm, simple GA, general genetic algorithm, schema theorem, Classification of genetic algorithm, Holland classifier systems, genetic programming, applications of genetic algorithm, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method, applications.		
Unit V	Particle Swarm Optimization	06 Hours

Swarm intelligence , PSO Algorithm- Formulations, Pseudocode, parameters, premature convergence, topology, biases, Real valued and binary PSO, Ant colony optimization.		
Unit VI	Applications	07 Hours
Optimization, function regression, Scheduling, Fraud detection, Anomaly detection, Design Robot or agent control, Interactive tools such as music composition, art generation, decision making. * This unit is subject to change		
Books:		
Text:		
<ol style="list-style-type: none"> 1. S. Rajsekaran & G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications” , Prentice Hall of India, ISBN: 0451211243 2. N.P.Padhy,”Artificial Intelligence and Intelligent Systems” Oxford University Press, ISBN 10: 0195671546 3. Neuro-Fuzzy and Soft Computing, J S R Jang, CT Sun and E.Mizutani , PHI PVT LTD, ISBN 0-13-261066-3. 4. De Jong , Evolutionary Computation: A Unified Approach. Cambridge (Massachusetts): MIT Press. ISBN: 0- 262- 04194- 4. 2006 5. Maurice Clerc , Particle Swarm Optimization, ISTE, Print ISBN:9781905209040 Online ISBN:9780470612163 DOI:10.1002/9780470612163 6. Sivandudam and Deepa, John Mikey, “ Principles of soft computing”, Pearson Education 		
References:		
<ol style="list-style-type: none"> 1. Siman Haykin, “Neural Netowrks”, Prentice Hall of India, ISBN: 0-7923-9475-5 2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” , Wiley India, ISBN: 978-0-470-74376-8 3. Eiben and Smith, “Introduction to Evolutionary Computation", Springer, ISBN-10: 3642072852 		

Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) Elective IV 410253(A): Software Defined Networks		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 310245-Computer Networks		
Companion Course: 410255-Laboratory Practice IV		
Course Objectives: <ul style="list-style-type: none"> To understand the challenges of the traditional networks and evolution of next generation networks. To gain conceptual understanding of Software Defined Networking (SDN) & its role in Data Center. To understand role of Open Flow protocol & SDN Controllers. To study industrial deployment use-cases of SDN To Understand the Network Functions Virtualization and SDN. 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> Interpret the need of Software Defined Networking solutions. Analyze different methodologies for sustainable Software Defined Networking solutions. Select best practices for design, deploy and troubleshoot of next generation networks. Develop programmability of network elements. Demonstrate virtualization and SDN Controllers using OpenFlow protocol 		
Course Contents		
Unit I	Introduction to Software Defined Networking (SDN)	7 Hours
Challenges of traditional networks, Traditional Switch Architecture - Control, Data and management Planes, Introduction to SDN, Need of SDN, History of SDN, Fundamental characteristics of SDN (Plane Separation, Simplified Device & Centralized control, Network Automation and Virtualization, and Openness), SDN Operation/Architecture, SDN API's (Northbound API's, Southbound API's, East/West API's), ONF, SDN Devices and SDN Applications.		
Unit II	Open Flow	5 Hours
OpenFlow Overview, The OpenFlow Switch, The OpenFlow Controller, ,OpenFlow Ports, Message Types, Pipeline Processing, Flow Tables, Matching, Instructions, Action Set and List, OpenFlow Protocol, Proactive and Reactive Flow, Timers, OpenFlow Limitations, OpenFlow Advantages and Disadvantages, Open v Switch Features		
Unit III	SDN Controllers	6 Hours
SDN OpenFlow Controllers: Open Source Controllers - NOX, POX, Beacon, Maestro, Floodlight, Ryu and Open Daylight, Applicability of OpenFlow protocol in SDN Controllers, Mininet, and implementing software-defined network (SDN) based firewall.		
Unit IV	SDN in Data Center	6 Hours
Data Center Definition, Data Center Demands (Adding, Moving, Deleting Resources, Failure Recovery, Multitenancy, Traffic Engineering & Path Efficiency), Tunneling Technologies for the Data Center, SDN Use Cases in the Data Center, Comparison of Open SDN, Overlays, and APIs, Real-World Data Center Implementations.		

Unit V	Network Functions Virtualization (NFV)	6 Hours
Definition of NFV, SDN Vs NFV, In-line network functions, Benefits of Network Functions Virtualization, Challenges for Network Functions Virtualization, Leading NFV Vendors, Comparison of NFV and NV.		
Unit VI	SDN Use Cases	6 Hours
Wide Area Networks, Service Provider and Carrier Networks, Campus Networks, Hospitality Networks, Mobile Networks, Optical Networks, SDN vs P2P/Overlay Networks.		
Books:		
Text:		
<ol style="list-style-type: none"> 1. Paul Goransson and Chuck Black, “Software Defined Networks: A Comprehensive Approach”, Morgan Kaufmann, 2014, ISBN: 9780124166752, 9780124166844. 2. Siamak Azodolmolky, “Software Defined Networking with Open Flow, Packt Publishing, 2013, ISBN: 9781849698726 3. Thomas D. Nadeau, Ken Gray, “SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies”, 2013, ISBN : 10:1-4493-4230-2, 978-1-4493-4230-2 		
References:		
<ol style="list-style-type: none"> 1. Vivek Tiwari, “SDN and OpenFlow for Beginners”, Digital Services, 2013, ISBN: 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, 2014, ISBN: 10: 1466572094 3. Open Networking Foundation (ONF) Documents, https://www.opennetworking.org, 2015 		

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective IV
410253(B): Human Computer Interface

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: 210251-Computer Graphics		
Companion Course: 410255-Laboratory Practice IV		
Course Objectives: <ul style="list-style-type: none"> To design, implement and evaluate effective and usable Human Computer Interfaces. To describe and apply core theories, models and methodologies from the field of HCI. To implement simple graphical user interfaces based on principles of HCI. 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> Understand the basics of human and computational abilities and limitations. Understand basic theory, tools and techniques in HCI. Understand the fundamental aspects of designing and evaluating interfaces. Learn a variety of methods for evaluating the quality of a user interface. Apply appropriate HCI techniques to design systems that are usable by people 		
Course Contents		
Unit I	Foundations of Human–Computer Interaction	06 Hours
What is HCI – design, models, evaluation, Need to understand people, computers and methods. Basic human abilities - vision, hearing, touch, memory. Computers – speed, interfaces, widgets, and effects on interaction. Humans – Memory, Attention Span, Visual Perception, psychology, ergonomics. Understanding Users. Methods for evaluation of interfaces with users: goals of evaluation, approaches, ethics, introspection, extracting the conceptual model, direct observation, constructive interaction, interviews and questionnaires, continuous evaluation via user feedback and field studies, choosing an evaluation method.		
Unit II	The Design Process	06 Hours
Interaction Design Basics, Interaction Styles. HCI in the Software Process. HCI design principles and rules: design principles, principles to support usability, golden rules and heuristics, HCI patterns, design rules, HCI design standards. Direct Manipulation - Overview, Scope, Applications. Universal Design, User-centered design, task analysis/GOMS, Graphic Design		
Unit III	Implementation	06 Hours
Implementation Tools, Technology and change designing for the Web, designing for portable devices. Handling errors & Designing Help. Prototyping & UI Software.		
Unit IV	Evaluation and User Support	06 Hours
Evaluation of User Interfaces. Web Browsers - Fonts, Color Palette, Color Depth, Resolution, Layout, Size, Orientation. Mobile devices issues – design, limitations, what next. User Support.		
Unit V	Users Models	06 Hours

Predictive Models, Cognitive Models. Interaction with Natural Languages, Next Generation Interface. Socio-organizational Issues and Stakeholder Requirements. Heuristic Evaluation, Evaluation with Cognitive Models, Evaluation with Users.		
Unit VI	Task Models and Dialogs	06 Hours
Task Analysis, DOET (Design of Everyday Things). Design Dialogs Notations, Warnings, and Error messages. Model-based Evaluation. User Testing, Usability Testing, User Acceptance Testing.		
Books:		
Text:		
<ol style="list-style-type: none"> 1. Alan J, Dix. Janet Finlay, Russell Beale, "Human Computer Interaction", Pearson Education, 3rd Edition, 2004, ISBN 81-297-0409-9 2. Jenny Preece, Rogers, Sharp, "Interaction Design-beyond human-computer interaction", WILEY-INDIA, ISBN 81-265-0393-9 		
References:		
<ol style="list-style-type: none"> 1. Jonathan Lazar, Jinjuan Feng, Harry Hochheiser, "Research Methods in Human-Computer Interaction ", Third Edition, Morgan Kaufmann, 2017, ISBN: 9780128053904. 2. Mary Beth Rosson and John M. Carroll, "Usability Engineering: Scenario-Based Development of Human-Computer Interaction", Morgan Kaufmann, 2001, ISBN-13: 978-1558607125 		

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective IV
410253(C): Cloud Computing

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses:		
Companion Course: 410255-Laboratory Practice IV		
Course Objectives: <ul style="list-style-type: none"> To study cloud computing concepts; Enhancing cloud computing environment. To study various platforms To study the applications that uses cloud computing 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> To install cloud computing environments. To develop any one type of cloud 		
Course Contents		
Unit I	Basics of Cloud Computing	06 Hours
Overview, Applications, Intranets and the Cloud. Your Organization and Cloud Computing- Benefits, Limitations, Security Concerns. Software as a Service (SaaS)- Understanding the Multitenant Nature of SaaS Solutions, Understanding SOA. Platform as a Service (PaaS)-IT Evolution Leading to the Cloud, Benefits of PaaS Solutions, Disadvantages of PaaS Solutions. Infrastructure as a Service (IaaS)-Understanding IaaS, Improving Performance through Load Balancing, System and Storage Redundancy, Utilizing Cloud-Based NAS Devices, Advantages, Server Types. Identity as a Service (IDaaS).		
Unit II	Data Storage and Security in Cloud	06 Hours
Cloud file systems: GFS and HDFS, BigTable, HBase and Dynamo Cloud data stores: Datastore and Simple DB Gautam Shrauf, Cloud Storage-Overview, Cloud Storage Providers. [Anthony T. Velte]3 Securing the Cloud- General Security Advantages of Cloud-Based Solutions, Introducing Business Continuity and Disaster Recovery. Disaster Recovery- Understanding the Threats.		
Unit III	Virtualization	06 Hours
Implementation Levels of Virtualization, Virtualization Structures/Tools and Mechanisms, Types of Hypervisors, Virtualization of CPU, Memory, and I/O Devices, Virtual Clusters and Resource Management, Virtualization for Data-Center Automation. Common Standards: The Open Cloud Consortium, Open Virtualization Format, Standards for Application Developers: Browsers (Ajax), Data (XML, JSON), Solution Stacks (LAMP and LAPP), Syndication (Atom, Atom Publishing Protocol, and RSS), Standards for Security.		
Unit IV	Amazon Web Services	08 Hours

Services offered by Amazon Hands-on Amazon, EC2 - Configuring a server, Virtual Amazon Cloud, AWS Storage & Content Delivery Identify key AWS storage options Describe Amazon EBS Creating an Elastic Block Store Volume Adding an EBS Volume to an Instance Snapshotting an EBS Volume and Increasing Performance Create an Amazon S3 bucket and manage associated objects. AWS Load Balancing Service Introduction Elastic Load Balancer Creating and Verifying Elastic Load Balancer.

Unit V	Ubiquitous Clouds and the Internet of Things	07 Hours
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Cloud Trends in Supporting Ubiquitous Computing, Performance of Distributed Systems and the Cloud, Enabling Technologies for the Internet of Things (RFID, Sensor Networks and ZigBee Technology, GPS), Innovative Applications of the Internet of Things (Smart Buildings and Smart Power Grid, Retailing and Supply-Chain Management, Cyber-Physical System), Online Social and Professional Networking

Unit VI	Future of Cloud Computing	07 Hours
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How the Cloud Will Change Operating Systems, Location-Aware Applications, Intelligent Fabrics, Paints, and More, The Future of Cloud TV, Future of Cloud-Based Smart Devices, Faster Time to Market for Software Applications, Home-Based Cloud Computing, Mobile Cloud, Autonomic Cloud Engine, Multimedia Cloud, Energy Aware Cloud Computing, Jungle Computing. Docker at a Glance: Process Simplification, Broad Support and Adoption, Architecture, Getting the Most from Docker, The Docker Workflow.

Books:

Text:

1. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, 2010, The McGraw-Hill.
2. Dr. Kris Jamsa, “ Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more” , Wiley Publications, ISBN: 978-0-470-97389-9
3. Gautam Shrof, “ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications, Cambridge University Press, ISBN: 9780511778476

References:

1. Dr. Kumar Saurabh, "Cloud Computing", Wiley Publication, ISBN 10: 8126536039
2. Barrie Sosinsky, "Cloud Computing", Wiley India, ISBN: 978-0-470-90356-8
3. Kailash Jayaswal, “Cloud computing”, Black Book, Dreamtech Press
4. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, “Cloud Computing: Concepts, Technology & Architecture”, Pearson, 1st Edition, ISBN :978 9332535923, 9332535922,
5. Rajkumar Buyya, “Clod Computing principles and paradigms” , Wiley Publication, ISBN 978-0-470-88799-8
6. Tim Mather, Subra K, Shahid L., Cloud Security and Privacy, Oreilly, ISBN-13 978-81-8404-815-5

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410254:Laboratory Practice III

Teaching Scheme:	Credit	Examination Scheme:
Practical : 04 Hours/Week	02	Term Work: 50 Marks Practical: 25 Marks Oral: 25 Marks

Companion Courses: 410250 and 410251

Course Objectives:

-

Course Outcomes:

On completion of the course, student will be able to–

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Guidelines for Instructor's Manual

The instructor's manual is to be developed as a 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 in brief, Database 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 lab assignments performance of student. Each lab 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.

Set of suggested assignments and mini-projects is provided. Each student must perform assignments individually and/or mini-projects in a group of 2-3 students as a part of lab for each lab course under the guidance of subject teacher. Subject teacher is free to frame additional mini-projects as per the need.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming Languages: C++/JAVA/PYTHON/R

Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, Backend :

MonoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC, Additional Tools: Octave, Matlab, WEKA

Suggested List of Laboratory Assignments

410250: Machine Learning

Students have to carry out following first four assignments **individually** using either PYTHON or Octave to build the foundations of machine learning and any **two mini-projects in a group of 2-3 students**. **Subject teacher is free to frame additional assignments or mini-projects as per the need.**

1. Assignment on Linear Regression:

The following table shows the results of a recently conducted study on the correlation of the number of hours spent driving with the risk of developing acute backache. Find the equation of the best fit line for this data.

Number of hours spent driving (x)	Risk score on a scale of 0-100 (y)
10	95
9	80
2	10
15	50
10	45
16	98
11	38
16	93

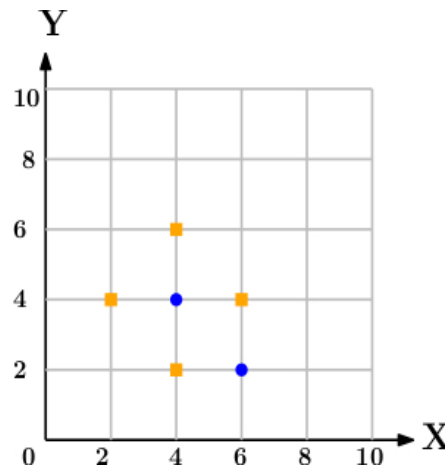
2. Assignment on Decision Tree Classifier:

A dataset collected in a cosmetics shop showing details of customers and whether or not they responded to a special offer to buy a new lip-stick is shown in table below. Use this dataset to build a decision tree, with Buys as the target variable, to help in buying lip-sticks in the future. Find the root node of decision tree. According to the decision tree you have made from previous training data set, what is the decision for the test data: [Age < 21, Income = Low, Gender = Female, Marital Status = Married]?

ID	Age	Income	Gender	Marital Status	Buys
1	< 21	High	Male	Single	No
2	< 21	High	Male	Married	No
3	21-35	High	Male	Single	Yes
4	>35	Medium	Male	Single	Yes
5	>35	Low	Female	Single	Yes
6	>35	Low	Female	Married	No
7	21-35	Low	Female	Married	Yes
8	< 21	Medium	Male	Single	No
9	<21	Low	Female	Married	Yes
10	> 35	Medium	Female	Single	Yes
11	< 21	Medium	Female	Married	Yes
12	21-35	Medium	Male	Married	Yes
13	21-35	High	Female	Single	Yes
14	> 35	Medium	Male	Married	No

3. Assignment on k-NN Classification:

In the following diagram let blue circles indicate positive examples and orange squares indicate negative examples. We want to use k-NN algorithm for classifying the points. If $k=3$, find the class of the point (6,6). Extend the same example for Distance-Weighted k-NN and Locally weighted Averaging



4. Assignment on K-Means Clustering:

We have given a collection of 8 points. $P1=[0.1,0.6]$ $P2=[0.15,0.71]$ $P3=[0.08,0.9]$ $P4=[0.16, 0.85]$ $P5=[0.2,0.3]$ $P6=[0.25,0.5]$ $P7=[0.24,0.1]$ $P8=[0.3,0.2]$. Perform the k-mean clustering with initial centroids as $m1=P1$ =Cluster#1=C1 and $m2=P8$ =cluster#2=C2. Answer the following

- 1] Which cluster does P6 belongs to?
- 2] What is the population of cluster around $m2$?
- 3] What is updated value of $m1$ and $m2$?

5. Mini-Project 1 on Genetic Algorithm:

Apply the Genetic Algorithm for optimization on a dataset obtained from UCI ML repository. For Example: IRIS Dataset or Travelling Salesman Problem or KDD Dataset

6. Mini-Project 2 on SVM:

Apply the Support vector machine for classification on a dataset obtained from UCI ML

	repository. For Example: Fruits Classification or Soil Classification or Leaf Disease Classification
7.	Mini-Project 3 on PCA: Apply the Principal Component Analysis for feature reduction on any Company Stock Market Dataset
410251:: : Information and Cyber Security	
<p>List of Mini-projects: Students have to carry out any five basic fundamental building assignments individually and two mini-projects in a group of 2-3 students as a part of laboratory under the guidance of subject teacher. Teacher may frame multiple mini-projects statements as framed below.</p> <p>Subject teacher is free to frame additional assignments or mini-projects as per the need.</p>	
1.	Implementation of S-DES
2.	Implementation of S-AES
3.	Implementation of Diffie-Hellman key exchange
4.	Implementation of RSA.
5.	Implementation of ECC algorithm.
6.	Mini Project 1: SQL Injection attacks and Cross -Site Scripting attacks are the two most common attacks on web application. Develop a new policy based Proxy Agent, which classifies the request as a scripted request or query based request, and then, detects the respective type of attack, if any in the request. It should detect both SQL injection attack as well as the Cross-Site Scripting attacks.
7.	Mini Project 2: This task is to demonstrate insecure and secured website. Develop a web site and demonstrate how the contents of the site can be changed by the attackers if it is http based and not secured. You can also add payment gateway and demonstrate how money transactions can be hacked by the hackers. Then support your website having https with SSL and demonstrate how secured website is.

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410255:Laboratory Practice IV

Teaching Scheme:	Credit	Examination Scheme:
Practical : 04 Hours/Week	02	Term Work: 50 Marks Practical: 25 Marks Oral: 25 Marks

Companion Courses: 410252 and 410253

Course Objectives:

-

Course Outcomes:

On completion of the course, student will be able to–

-

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a 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 in brief, Database 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 lab assignments performance of student. Each lab 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

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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.

Set of suggested assignments and mini-projects is provided. Each student must perform assignments individually and/or mini-projects as a part of lab for each lab course under the guidance of subject teacher. Subject teacher is free to frame additional assignments or mini-projects as per the need.

Operating System recommended :- 64-bit Open source Linux or its derivative

Programming Languages: C++/JAVA/PYTHON/R

Programming tools recommended: Front End: Java/Perl/PHP/Python/Ruby/.net, Backend : MonoDB/MYSQL/Oracle, Database Connectivity : ODBC/JDBC, Additional Tools: Octave, Matlab, WEKA

Suggested List of Laboratory Assignments

Course: 410252 (A) Advanced Digital Signal Processing

Students have to carry out any four basic fundamental building assignments **individually using sample data and two mini-projects in a group of 2-3 students using datasets** under the guidance of subject teacher. **Subject teacher is free to frame additional assignments or mini-projects as per the need.** Use -

A] MATLAB or other equivalent software working with speech and image signals/files and for analysis purpose.

B] C++ or JAVA for working with sampled data (n – point data samples of DT/Digital signal)

C] JAVA or other for image processing assignments

- | | |
|----|--|
| 1. | Apply 1-D DFT to observe spectral leakage and frequency analysis of different window sequences, plot the frequency spectrums. |
| 2. | Adaptive FIR and IIR filter design:
A] Steepest descent and Newton method, LMS method,
B] Adaptive IIR Filter design: Pade Approximation, Least square design |
| 3. | Power spectrum estimation and analysis:
Take a speech signal and perform
A] Non parametric method: DFT and window sequences
B] Parametric methods: AR model parameters |
| 4. | Multi-rate DSP and applications – Decimation, Interpolation, sampling rate conversion
A] Take a speech signal with specified sampling frequency. Decimate by factor D(e.g. factor 2)
B] Take a speech signal with specified sampling frequency. Interpolate by factor I(e.g. factor 2)
C] Sampling rate conversion by factor of I/D |
| 5. | Write a program to calculate LPC coefficients, reflection coefficients using Levinson Durbin algorithm |
| 6. | Feature Extraction of speech signal
A] Using LPC and other methods |

	B] Apply different coding methods: harmonic coding, vector quantization
7.	Mini-Project 1: Discrete Cosine Transform (DCT) A] To find DCT of NxN image block B] To plot spectrum of the speech signal using DCT and find the correlation of DCT transformed signal C] Image filtering using DCT : LPF, edge detection D] Image compression using DCT, Image resizing
8.	Mini-Project 2: Wavelet Transform (WT) A] To get compression using wavelet decomposition of a signal B] Denoising using wavelet decomposition C] To get compression using wavelet decomposition of a signal (Harr Wavelet) D] To get low-pass filtered and high pass filtered speech signal using Haar wavelet E] Image filtering using WT
9.	Mini-Project 3: Image Processing A] Histogram and Equalization B] Image Enhancement Techniques C] Image Filtering: LPF, HPF, Sobel/Prewitt Masks D] Image Smoothing with special filters: Median, Weiner, Homomorphic filters
Course: 410252 (B) Compiler Construction	
Students have to carry out following first 4 assignments individually and one mini-projects in a group of 2-3 students or all 8 assignments individually as a part of laboratory under the guidance of subject teacher. Subject teacher is free to frame additional assignments or mini-projects as per the need.	
1.	Implement a Lexical Analyzer using LEX for a subset of C. Cross check your output with Stanford LEX.
2.	Implement a parser for an expression grammar using YACC and LEX for the subset of C. Cross check your output with Stanford LEX and YACC.
3.	Generate and populate appropriate Symbol Table.
4.	Implementation of Semantic Analysis Operations (like type checking, verification of function parameters, variable declarations and coercions) possibly using an Attributed Translation Grammar.
5.	Implement the front end of a compiler that generates the three address code for a simple language.
6.	A Register Allocation algorithm that translates the given code into one with a fixed number of registers.
7.	Implementation of Instruction Scheduling Algorithm.
8.	Implement Local and Global Code Optimizations such as Common Sub-expression Elimination, Copy Propagation, Dead-Code Elimination, Loop and Basic-Block Optimizations. (Optional)
9.	Mini-Project 1: Implement POS tagging for simple sentences written Hindi or any Indian Language

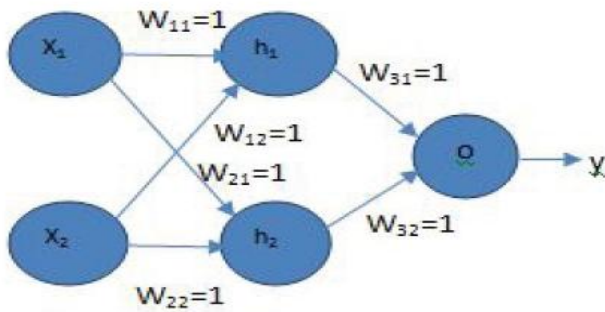
Course: 410252 (C) Embedded and Real Time Operating System

1. Simulation/ Design, planning and modeling of a Real-Time / Embedded System for- (any one)
- Alarm system for elderly people (Fall detection, Heart attack)
 - Medication machine for patients in ICU
 - Smart traffic control
 - Autonomous car
 - Smart home (sound system, temperature, light)
 - Control of an autonomous quadrocopter (e.g. for surveillance tasks)
 - Control of a rail station
 - Video conference system
- Washing machine

Course: 410252 (D) Soft Computing and Optimization Algorithms

Students have to carry out following **first 4 assignments individually** and **one mini-project in a group of 2-3 students** as a part of laboratory under the guidance of subject teacher. **Subject teacher is free to frame additional assignments or mini-projects as per the need.**

1. Implement basic logic gates using Mc-Culloch-Pitts or Hebbnet neural networks
2. Write a program to find the Boolean function to implement following single layer perceptron. Assume all activation functions to be the threshold function which is 1 for all input values greater than zero and 0, otherwise.
-
3. Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.
4. The figure shows a single hidden layer neural network. The weights are initialized to 1's as shown in the diagram and all biases are initialized to 0's. Assume all the neurons have linear activation functions. The neural network is to be trained with stochastic (online) gradient descent. The first training example is $[x_1=1, x_2=0]$ and the desired output is 1. Design the back-propagation algorithm to find the updated value for W_{11} after backpropagation. Choose the value that is the closest to the options given below: [learning rate =0.1]



5. **Mini-Project 1** on Genetic Algorithm:
Apply the Genetic Algorithm for optimization on a dataset obtained from UCI ML repository. For Example: IRIS Dataset or Travelling Salesman Problem or KDD Dataset
6. **Mini-Project 2** on Fuzzy Logic:
Solve Greg Viot's fuzzy cruise controller using MATLAB Fuzzy logic toolbox or Octave or Python.
7. **Mini-Project 3** on Fuzzy Logic:
Solve Air Conditioner Controller using MATLAB Fuzzy logic toolbox or Octave or Python.

Course: 410253 (A) Software Defined Networks

Students have to carry out following **all assignments** as a part of laboratory **individually** under the guidance of subject teacher. **Subject teacher is free to frame additional assignments or mini-projects as per the need.**

1. **Phase I:** Set up Mininet network emulation environment using Virtual Box and Mininet. Demonstrate the basic commands in Mininet and emulate different custom network topology (Simple, Linear, and Tree). View flow tables.
2. **Phase II:** Study open source POX and Floodlight controller. Install controller and run custom topology using remote controller like POX and floodlight controller. Identify inserted flows by the controllers.
3. **Phase III:** Create a SDN environment on Mininet and configure a switch to provide a firewall functionality using POX controller.
Ref: <https://github.com/mininet/openflow-tutorial/wiki/Create-Firewall>
4. **Phase IV:** Build your own Internet Router using Mininet as an Emulator and POX controller. Write a simple router with a static routing table. The router will receive raw Ethernet frames. It will process the packets just like a real router, and then forward them to the correct outgoing interface. Make sure you receive the Ethernet frame and create the forwarding logic so packets go to the correct interface.
Ref: <https://github.com/mininet/mininet/wiki/Simple-Router>
5. **Phase V:** Emulate a Data Center and manage it via a Cloud Network Controller: create a multi-rooted tree-like (Clos) topology in Mininet to emulate a data center. Your second task is to implement specific SDN applications on top of the network controller in order to orchestrate multiple network tenants within a data center environment, in the context of network virtualization and management.
Ref:
https://opencourses.uoc.gr/courses/pluginfile.php/13576/mod_resource/content/2/exercise5.pdf

Course: 410253 (B) Human Computer Interface

Students have to carry out following **all assignments** as a part of laboratory **individually** under the guidance of subject teacher. **Subject teacher is free to frame additional assignments or mini-projects as per the need.**

1. Identify specialized users and related facilities for a selected product / system and make necessary suggestions for its improved accessibility design.
2. Design user persona for the users of selected product / system.
3. Conduct a contextual inquiry for selected product / system.
4. Design an interface prototype for selected product / system.
5. Evaluate an interface using usability evaluation technique.

Course: 410253 (C) Cloud Computing

List of Mini-projects: Students have to carry out following **two mini-projects in a group of 2-3 students** as a part of laboratory under the guidance of subject teacher. **Subject teacher is free to frame additional assignments or mini-projects as per the need.**

3. **Mini-Project 1:** Setup your own cloud for Software as a Service (SaaS) over the existing LAN in your laboratory. In this assignment you have to write your own code for cloud controller using open source technologies **without HDFS**. Implement the basic operations may be like to upload and download file on/from cloud in encrypted form etc.
4. **Mini-Project 2:** Setup your own cloud for Software as a Service (SaaS) over the existing LAN in your laboratory. In this assignment you have to write your own code for cloud controller using open source technologies to implement **with HDFS**. Implement the basic operations may be like to divide the file in segments/blocks and upload/ download file on/from cloud in encrypted form etc.

Course: 410253 (D) Open Elective

Respective College is requested to design suitable programming assignments/Mini-projects and get approved along with course curriculum. It is recommended to refer above list.

<p align="center">Savitribai Phule Pune University Fourth Year of Computer Engineering (2015 Course) 410256:Project Work Stage II</p>		
Teaching Scheme: Practical : 06 Hours/Week	Credit 06	Examination Scheme: Term Work: 100 Marks Presentation: 50 Marks
Companion Course:		
Course Objectives: <ul style="list-style-type: none"> • To follow SDLC meticulously and meet the objectives of proposed work • To test rigorously before deployment of system • To validate the work undertaken • To consolidate the work as furnished report. 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> • Show evidence of independent investigation • Critically analyze the results and their interpretation. • Report and present the original results in an orderly way and placing the open questions in the right perspective. • Link techniques and results from literature as well as actual research and future research lines with the research. • Appreciate practical implications and constraints of the specialist subject 		
<p align="center">Guidelines</p> <p>In Project Work Stage–II, the student shall complete the remaining project work which consists of Selection of Technology and Tools, Installations, UML implementations, testing, Results, performance discussions using data tables per parameter considered for the improvement with existing/known algorithms/systems and comparative analysis and validation of results and conclusions. The student shall prepare the duly certified final report of Project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.</p> <p><u>Follow guidelines and formats as mentioned in Project Workbook recommended by Board of Studies.</u></p>		

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6

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 190 credits and clears all the audit courses specified in the syllabus. The student will be awarded grade as AP on successful completion of audit course. 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 AP (Audit Course Pass) and shall be included such AP 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 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself. (Ref- http://www.unipune.ac.in/Syllabi_PDF/revised-2015/engineering/UG_RULE_REGULATIONS_FOR_CREDIT_SYSTEM-2015_18June.pdf)

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

- | | |
|---|--|
| <ul style="list-style-type: none"> • Lectures/ Guest Lectures • Visits (Social/Field) and reports • Demonstrations | <ul style="list-style-type: none"> • Surveys • Mini Project • Hands on experience on specific focused topic |
|---|--|

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

- | | |
|---|---|
| <ul style="list-style-type: none"> • Written Test • Demonstrations/ Practical Test • Presentations | <ul style="list-style-type: none"> • IPR/Publication • Report |
|---|---|

Audit Course 3 Options

AC6- I	Business Intelligence
AC6-II	Gamification
AC6-III	Quantum Computing
AC6-IV	Usability Engineering
AC6-V	Conversational Interfaces
AC6-VI	MOOC- Learn New Skills

Note: It is permitted to opt one of the audit courses listed at SPPU website too, if not opted earlier
<http://collegecirculars.unipune.ac.in/sites/documents/Syllabus%202017/Forms/AllItems.aspx>

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – I: Business Intelligence

Course Objectives:

- To develop problem solving abilities using Mathematics
- To apply algorithmic strategies while solving problems
- To develop time and space efficient algorithms
- To study algorithmic examples in distributed, concurrent and parallel environments

Course Outcome:

On completion of the course, learner will be able to–

- To solve problem in projects
- To develop SRS in the projects
- To solve problems for multi-core or distributed, concurrent/Parallel environments

Course Contents:

- 1. Concepts with Mathematical treatment :** Introduction to data, Information and knowledge, Decision Support System, Theory of Operational data and informational data, Introduction to Business Intelligence, Deining BI Cycle, BI Environment and Architecture, Identify BI opportunities, Bene_ts of BI. Role of Mathematical model in BI, Factors Responsible for successful BI Project, Obstacle to Business Intelligence in an Organization
- 2. Decision Making Concepts :** Concepts of Decision Making, Techniques of Decision Support System (DSS), Development of Decision Support System (DSS), Applications of DSS, Role of Business Intelligence in DSS.
- 3. Data-Warehouse :** Introduction: Data warehouse Modeling, data warehouse design, data-warehouse technology, Distributed data warehouse, and materialized view
- 4. Data Pre-processing and outliers:** Data Analytics life cycle, Discovery, Data preparation, Preprocessing requirements, data cleaning, data integration, data reduction, data transformation, Data discretization, and concept hierarchy generation, Model Planning, Model building, Communicating Results & Findings, Operationalizing, Introduction to OLAP. Real-world Applications, types of outliers, outlier challenges, Outlier detection Methods, Proximity-Based Outlier analysis, Clustering Based Outlier analysis.
- 5. Designing and managing BI systems :** Determining infrastructure requirements, planning for scalability and availability, managing and maintenance of BI systems, managing BI operations for business continuity
- 6. BI and Data Mining Applications:** Data analytics, business analytics, 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.

Books:

1. R. Sharda, D. Delen, & E. Turban, Business Intelligence and Analytics. Systems for Decision Support, 10th Edition. Pearson/Prentice Hall, 2015. ISBN-13: 978-0-13-305090-5, ISBN-10: 0-13-305090-4;
2. Business Process Automation, Sanjay Mohapatra, PHI.

- 3.** Introduction to business Intelligence and data warehousing, IBM, PHI, ISBN: 8120339274, 9788120339279
- 4.** Data mining concepts and techniques, Jawai Han, Michelline Kamber, Jiran Pie, Morgan Kaufmann Publishers 3rd edition, *ISBN-10*: 0123814790
- 5.** William H Inmon, “Building the data Warehouse”, Wiley Publication 4th edition.
- 6.** Data Mining for Business Intelligence, WILEY
- 7.** Soumendra Mohanty, Analytics in Practice, Tata McGraw Hill Education, 2011, ISBN-13 978 0 07 0707061
- 8.** Ken W. Collier, Agile Analytics: A value driven Approach to Business Intelligence and Data Warehousing, Pearson Education, 2012, ISBN-13 978 8131786826

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – II: Gamification

Gamification is the application of game-design elements and game principles in non-game contexts. Gamification commonly employs game design elements to improve user engagement, organizational productivity, flow, crowd sourcing, employee recruitment and evaluation, ease of use, usefulness of systems, exercise, traffic violations, voter apathy, and more.

Course Objectives:

- To develop problem solving abilities using gamification
- To apply gamifications for Web Applications
- To apply gamifications for Mobile Applications

Course Outcome:

On completion of the course, learner will be able to–

- To write survey on the gamification paradigms.
- To write programs to solve problems using gamification and open source tools.
- To solve problems for multi-core or distributed, concurrent/Parallel environments

Course Contents:

1. **Gaming Foundations:** Introduction, Resetting Behavior, Replaying History, Gaming foundations: Fun Quotient, Evolution by loyalty, status at the wheel, the House always wins.
2. **Developing Thinking:** Re-framing Context, Player Motivation, Case studies for Thinking: Tower of Hanoi.
3. **Opponent Moves in Gamification:** Reclaiming Opposition, Gamed Agencies, Remodeling design, Game Mechanics, Case study of Maze Problem.
4. **Game Design:** Game Mechanics and Dynamics: Feedback and Re-enforcement, Game Mechanics in depth, Putting it together, Case study of 8 queens problem.
5. **Advanced tools, techniques and applications:** Gamification case Studies, Coding basic game Mechanics, Instant Gamification Platforms, Mambo.io(Ref:<http://mambi.io>), Installation and use of BigDoor (Open Source <http://bigdoor.com>), ngageoint/gamification-server (ref: <https://github.com/ngageoint/gamification-server>)

Books:

1. Mathias Fuchs, Sonia Fizek, Paolo Ruffino, Niklas Schrape, Rethinking Gamification, Meson Press, ISBN (Print): 978-3-95796-000-9 , <http://projects.digital-cultures.net/meson-press/files/2014/06/9783957960016-rethinking-gamification.pdf>, ISBN (PDF): 978-3-95796-001-6,
2. , Gabe Zechermann, Christopher Cunningham, Gamification Design, Oreilly, ISBN: 978-1-449-39767-8, <ftp://ftp.ivacuum.ru/i/WooLF/%B2011%5D%20Gamification%20by%20Design.pdf>
3. <http://press.etc.cmu.edu/files/MobileMediaLearning-DikkersMartinCoulter-web.pdf>

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – III: Quantum Computing

Quantum computation and quantum information is the study of the information processing tasks that can be accomplished using quantum mechanical systems. Sounds pretty simple and obvious, doesn't it? Like many simple but profound ideas it was a long time before anybody thought of doing information processing using quantum mechanical systems. To see why this is the case, we must go back in time and look in turn at each of the fields which have contributed fundamental ideas to quantum computation and quantum information -quantum mechanics, computer science, information theory, and cryptography.

Course Objectives:

- To understand basic concepts of quantum computing
- To learn quantum search algorithms
- To apply quantum information for solving real world problem

Course Outcome:

On completion of the course, learner will be able to–

- design efficient quantum algorithms
- apply quantum algorithms for several basic promise problems
- learn the hidden subgroup problems and their role in quantum computing

Course Contents:

- 1. Fundamental concepts:** Introduction and overview, Quantum computation, quantum algorithm, Introduction to quantum mechanics, The postulates of quantum mechanics
- 2. Quantum computation:** Quantum circuits, The quantum Fourier transform and its applications, Quantum search algorithms, Quantum computers: physical realization
- 3. Quantum information:** Quantum noise and quantum operations, Distance measures for quantum information, Quantum error-correction, mEntropy and information, Quantum information theory

Books:

1. Michael A. Nielsen & Isaac L. Chuang, "Quantum Computation and Quantum Information", ISBN: 9780521635035.
2. Mikio Nakahara and Tetsuo Ohmi, "Quantum Computing", CRC Press 2008.
3. N. David Mermin, "Quantum Computer Science", Cambridge 2007

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – IV: Usability Engineering

In this course you will have a hands-on experience with usability evaluation and user-centered design. This course will not help to learn how to implement user interfaces, but rather how to design based on the needs of users, which you will determine, and learn how to evaluate your designs rigorously. This help in knowing more about the usability; human computer interaction, the psychological aspects of computing, evaluation.

Course Objectives:

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Course Outcome:

On completion of the course, learner will be able to–

- Describe the human centered design process and usability engineering process and their roles in system design and development.
- Discuss usability design guidelines, their foundations, assumptions, advantages, and weaknesses.
- The need and reliability of Usability Engineering lifecycle
- Complete a basic human subjects research certification form.
- Design a user interface based on analysis of human needs and prepare a prototype system.
- Assess user interfaces using different usability engineering techniques.
- Make an oral presentation that justifies design decisions

Course Contents:

1. 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
2. Usability in Software Development : The Emergence of Usability, Human Computer Interaction, Usability Engineering
3. The usability Engineering Lifecycle: Requirement Analysis, Design, Testing, Development
4. Usability Assessment Methods beyond Testing
5. International User Interfaces

Books:

1. Mary Beth Rosson, John Millar Carroll, “Usability Engineering: Scenario- based Development of Human- Computer Interaction”
2. Jakob Nielsen, “Usability Engineering”
1. Deborah J. Mayhew, “ The usability engineering lifecycle”

Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 Course)
410257: Audit Course 6
AC6 – V: Conversational Interfaces

Effective information security at the enterprise level requires participation, planning, and practice. It is an ongoing effort that requires management and staff to work together from the same script. Fortunately, the information security community has developed a variety of resources, methods, and best practices to help modern enterprises address the challenge. Unfortunately, employing these tools demands a high degree of commitment, understanding, and skill attributes that must be sustained through constant awareness and training.

Course Objectives:

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Course Outcome:

On completion of the course, learner will be able to–

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Course Contents:

- 1. Introduction to Conversational Interface:** Preliminaries, Developing a speech based Conversational Interface, Conversational Interface and devices.
- 2. A technology of Conversation:** Introduction, Conversation as Action, The structure of Conversation, The language of Conversation.
- 3. Developing a Speech-Based Conversational Interface:** Implementing Text to Speech: Text Analysis, Wave Synthesis, Implementing Speech Recognition: Language Model, Acoustic Model, Decoding. Speech Synthesis Markup Language.
- 4. Advanced voice user interface design**

Books:

1. Cathy Pearl, “Designing Voice User Interfaces: Principles of Conversational Experiences”
2. Michael McTear, Zoraida Callejas, David Griol, “The Conversational Interface: Talking to Smart Devices”
3. Martin Mitrevski, “Developing Conversational Interfaces for iOS: Add Responsive Voice Control”
4. Srinivasan, “Hands-On Chatbots and Conversational UI Development: Build chatbots”

Savitribai Phule Pune University, Pune
Third Year of Computer Engineering (2015 Course)
410249: Audit Course 5
AC5 – VI: MOOC-learn New Skill

Course Objectives:

- To promote interactive user forums to support community interactions among students, professors, and experts
- To promote learn additional skills anytime and anywhere
- To enhance teaching and learning on campus and online

Course Outcome:

On completion of the course, learner will acquire additional knowledge and skill.

About Course:

MOOCs (Massive Open Online Courses) provide affordable and flexible way to learn new skills, pursue lifelong interests and deliver quality educational experiences at scale. Whether you're interested in learning for yourself, advancing your career or leveraging online courses to educate your workforce, SWAYAM, NPTEL, edx or similar ones can help.

World's largest SWAYAM MOOCs, a new paradigm of education for anyone, anywhere, anytime, as per your convenience, aimed to provide digital education free of cost and to facilitate hosting of all the interactive courses prepared by the best more than 1000 specially chosen faculty and teachers in the country. SWAYAM MOOCs enhances active learning for improving lifelong learning skills by providing easy access to global resources.

SWAYAM is a programme initiated by Government of India and designed to achieve the three cardinal principles of Education Policy viz., access, equity and quality. The objective of this effort is to take the best teaching learning resources to all, including the most disadvantaged. SWAYAM seeks to bridge the digital divide for students who have hitherto remained untouched by the digital revolution and have not been able to join the mainstream of the knowledge economy.

This is done through an indigenous developed IT platform that facilitates hosting of all the courses, taught in classrooms from 9th class till post-graduation to be accessed by anyone, anywhere at any time. All the courses are interactive, prepared by the best teachers in the country and are available, free of cost to the residents in India. More than 1,000 specially chosen faculty and teachers from across the Country have participated in preparing these courses.

The courses hosted on SWAYAM is generally in 4 quadrants – (1) video lecture, (2) specially prepared reading material that can be downloaded/printed (3) self-assessment tests through tests and quizzes and (4) an online discussion forum for clearing the doubts. Steps have been taken to enrich the learning experience by using audio-video and multi-media and state of the art pedagogy / technology. In order to ensure best quality content are produced and delivered, seven National Coordinators have been appointed: They are NPTEL for engineering and UGC for post-graduation education.

Guidelines:

Instructors are requested to promote students to opt for courses with proper mentoring. The departments will take care of providing necessary infrastructural and facilities for the learners.

References:

4. <https://swayam.gov.in/>
5. <https://onlinecourses.nptel.ac.in/>
6. <https://www.edx.org>