

Faculty of Engineering
Savitribai Phule Pune University



Syllabus
of
Second Year of Computer Engineering
(Course 2015)
(with effect from June 2016)

Savitribai Phule Pune University

Computer Engineering

Program Educational Objectives

1. To prepare globally competent graduates having strong fundamentals and domain knowledge to provide effective solutions for engineering problems.
2. To prepare the graduates to work as a committed professionals 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 to solve 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 of public health and safety, cultural, societal, and environmental issues.
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 practices of lifelong learning.

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) (With effect from Academic Year 2016-17)												
Semester I												
Course Code	Course Name	Teaching Scheme Hours / Week			Examination Scheme & Marks						Credit	
		Theory	Tutorial	Practical	In-Sem	End-Sem	TW	PR	OR	Total	TH + TUT	PR
210241	<u>Discrete Mathematics</u>	04	--	--	50	50	--	--	--	100	04	--
210242	<u>Digital Electronics and Logic Design</u>	04	--	--	50	50	--	--	--	100	04	--
210243	<u>Data Structures and Algorithms</u>	04	--	--	50	50	--	--	--	100	04	--
210244	<u>Computer Organization and Architecture</u>	04	--	--	50	50	--	--	--	100	04	--
210245	<u>Object Oriented Programming</u>	04	--	--	50	50	--	--	--	100	04	--
210246	<u>Digital Electronics Lab</u>	--	--	02	--	--	25	50	--	75	--	01
210247	<u>Data Structures Lab</u>	--	--	04	--	--	25	50	--	75	--	02
210248	<u>Object Oriented Programming Lab</u>	--	--	02	--	--	25	50	--	75	--	01
210249	<u>Soft Skills</u>	--	--	02	--	--	25	--	--	25	--	01
Total											20	05
210250	<u>Audit Course 1</u>	--	--	--	--	--	--	--	--	--	Grade	
Total		20	--	10	250	250	100	150	--	750	25	

Abbreviations:

TW: Term Work
 OR: Oral
 PR: Practical

TH: Theory
 TUT: Tutorial
 Sem: Semester

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
 (With effect from Academic Year 2016-17)
Semester II

Course Code	Course Name	Teaching Scheme Hours / Week			Examination Scheme & Marks						Credits	
		Theory	Tutorial	Practical	In-Sem	End-Sem	TW	PR	OR	Total	TH+TUT	PR
207003	<u>Engineering Mathematics III</u>	04	01	--	50	50	25	--	--	125	05	--
210251	<u>Computer Graphics</u>	04	--	--	50	50	--	--	--	100	04	--
210252	<u>Advanced Data Structures</u>	04	--	--	50	50	--	--	--	100	04	--
210253	<u>Microprocessor</u>	04	--	--	50	50	--	--	--	100	04	--
210254	<u>Principles of Programming Languages</u>	03	--	--	50	50	--	--	--	100	03	--
210255	<u>Computer Graphics Lab</u>	--	--	02	--	--	25	50	--	75	--	01
210256	<u>Advanced Data Structures Lab</u>	--	--	04	--	--	25	50	--	75	--	02
210257	<u>Microprocessor Lab</u>	--	--	04	--	--	25	50	--	75	--	02
Total											20	05
210258	<u>Audit Course 2</u>		--	--	--	--	--	--	--	--	Grade	
Total		19	01	10	250	250	100	150	--	750	25	

Abbreviations:

TW: Term Work

OR: Oral

PR: Practical

TH: Theory

TUT: Tutorial

Sem: Semester

SEMESTER I

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) 210241: Discrete Mathematics		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem (online): 50 Marks End-Sem (paper): 50 Marks
Prerequisite:- Basic Mathematics		
Course Objectives: - To use appropriate set, function and relation models to understand practical examples, and interpret the associated operations and terminologies in context. - Determine number of logical possibilities of events. - Learn logic and proof techniques to expand mathematical maturity. - Formulate problems precisely, solve the problems, apply formal proof techniques, and explain the reasoning clearly.		
Course Outcomes: On completion of the course, student will be able to– - Solve real world problems logically using appropriate set, function, and relation models and interpret the associated operations and terminologies in context. - Analyze and synthesize the real world problems using discrete mathematics.		
Course Contents		
Unit I	Set Theory and Logic	09 Hours
Discrete Mathematics, Significance of Discrete Mathematics in Computer Engineering, Sets – Naïve Set Theory (Cantorian Set Theory), Axiomatic Set Theory, Need for Sets, Representation of Sets, Set Operations, cardinality of set, principle of inclusion and exclusion, Types of Sets – Countable and Uncountable Sets, Finite and Infinite Sets, Countably Infinite and Uncountably Infinite Sets. Introduction to bounded and unbounded sets and multiset. Countability of Rational Numbers Using Cantor Diagonalization Argument, power set. Propositional Logic - logic, Propositional Equivalences, Application of Propositional Logic-Translating English Sentences, Proof by Mathematical Induction and Strong Mathematical Induction.		
Unit II	Relations and Functions	09 Hours
Relations and Their Properties, n-ary Relations and Their Applications, Representing Relations , Closures of Relations, Equivalence Relations, Partial Orderings, partitions, Hasse Diagram, Lattices, Chains and Anti-Chains, Transitive Closure and Warshall's Algorithm, n-Ary Relations and their Applications. Functions - Surjective, Injective and Bijective functions, Inverse Functions and Compositions of Functions, The Pigeonhole Principle.		

Unit III	Counting	09 Hours
The Basics of Counting, rule of Sum and Product, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, Algorithms for generating Permutations and Combinations.		
Unit IV	Graph Theory	09 Hours
Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Single source shortest path- Dijkstra's Algorithm, Planar Graphs, Graph Colouring. Case Study- Web Graph, Google map.		
Unit V	Trees	09 Hours
Introduction, properties of trees, Binary search tree, decision tree, prefix codes and Huffman coding, cut sets, Spanning Trees and Minimum Spanning Tree, Kruskal's and Prim's algorithms, The Max flow- Min Cut Theorem (Transport network). Case Study- Game Tree, Mini-Max Tree.		
Unit VI	Algebraic Structures and Coding Theory	09 Hours
The structure of algebra, Algebraic Systems, Semi Groups, Monoids, Groups, Homomorphism and Normal Subgroups, and congruence relations, Rings, Integral Domains and Fields, coding theory, Polynomial Rings and polynomial Codes, Case Study- Brief introduction to Galois Theory –Field Theory and Group Theory.		
Books:		
Text:		
1. Kenneth H. Rosen, –Discrete Mathematics and its Applications”, Tata McGraw-Hill, ISBN 978-0-07-288008-3, 7th Edition. 2. C. L. Liu, –Elements of Discrete Mathematics”, TMH, ISBN 10:0-07-066913-9.		
References:		
1. Bernard Kolman, Robert C. Busby and Sharon Ross, –Discrete Mathematical Structures”, Prentice-Hall of India /Pearson, ISBN: 0132078457, 9780132078450. 2. N. Biggs, –Discrete Mathematics”, 3rd Edition, Oxford University Press, ISBN 0 –19 850717 – 8. 3. Narsingh Deo, –Graph with application to Engineering and Computer Science”, Prentice Hall of India, 1990, 0 – 87692 – 145 – 4. 4. Dr. K. D. Joshi, –Foundations of Discrete Mathematics”, New Age International Limited, Publishers, January 1996, ISBN: 8122408265, 9788122408263 5. C.D. Cantrell, –Modern Mathematical Methods for Engineers”, Cambridge University Press, ISBN-0521670497 6. Eric Gossett, –Discrete Mathematical Structures with Proofs”, Wiley India Ltd, ISBN:978-81-265-2758-8. 7. Sriram P & Steven S, –Computational Discrete Mathematics”, Cambridge University Press, ISBN 13: 978-0-521-73311-3.		

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) 210242: Digital Electronics & Logic Design		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem (online): 50 Marks End-Sem (paper): 50 Marks
Prerequisite: - Basic Electronics Engineering		
Course Objectives: • To understand the functionality and design of Combinational and Sequential Circuits • To understand and compare the functionalities, properties and applicability of Logic Families. • To understand concept of programmable logic devices and ASM chart and get acquainted with design of synchronous state machines. • To design and implement digital circuits using VHDL.		
Course Outcomes: On completion of the course, student will be able to– • Realize and simplify Boolean Algebraic assignments for designing digital circuits using K-Maps. • Design and implement Sequential and Combinational digital circuits as per the specifications. • Apply the knowledge to appropriate IC as per the design specifications. • Design simple digital systems using VHDL. • Develop simple embedded system for simple real world application.		
Course Contents		
Unit I	Combinational Logic Design	09 Hours
Logic minimization: Representation of truth-table, Sum of Product (SOP) form, Product of Sum (POS) form, Simplification of logical functions, Minimization of SOP and POS forms using K-Maps up to 4 variables and Quine-McCluskey Technique, realization of logic gates. Design of Combinational Logic: Code converter - BCD, Excess-3, Gray code, Binary Code. Half- Adder, Full Adder, Half Subtractor, Full Subtractor, Binary Adder (IC 7483), BCD adder, Look ahead carry generator, Multiplexers (MUX): MUX (IC 74153, 74151), MUX tree, Demultiplexers (DEMUX)- Decoder. (IC 74138, IC 74154). DMUX Tree, Implementation of SOP and POS using MUX, DMUX, Comparators, Parity generators and Checker, Priority Encoders.		
Unit II	Sequential Logic Design	09 Hours
Flip- flop: SR, JK, D, T; Preset & Clear, Master and Slave Flip Flops, Truth Tables and Excitation tables, Conversion from one type to another type of Flip Flop. Registers: Buffer register, shift register, Applications of shift registers. Counters: Asynchronous counter. Synchronous counter, ring counters, BCD Counter, Johnson Counter, Modulus of the counter (IC 7490). Synchronous Sequential Circuit Design: Models – Moore and Mealy, State diagram and State Tables, Design Procedure, Sequence generator and detector. Asynchronous Sequential Circuit Design: Difference with synchronous circuit design, design principles and procedure, applications.		

Unit III	Algorithmic State Machines	09 Hours
Algorithmic State Machines: Finite State Machines (FSM) and ASM, ASM charts, notations, construction of ASM chart and realization for sequential circuits, Sequence Generator, Types of Counters. VHDL: Introduction to HDL, Data Objects & Data Types, Attributes., VHDL- Library, Design Entity, Architecture, Modeling Styles, Concurrent and Sequential Statements, Design Examples: VHDL for Combinational Circuits-Adder, MUX, VHDL for Sequential Circuits, Synchronous and Asynchronous Counter.		
Unit IV	Programmable Logic Devices	09 Hours
ROM as PLD, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Designing combinational circuits using PLDs.		
Unit V	Logic Families	09 Hours
Classification of logic families: Unipolar and Bipolar Logic Families, Characteristics of Digital ICs: Speed, power dissipation, figure of merits, fan-out, Current and voltage parameters, Noise immunity, operating temperature range, power supply requirements. Transistor-Transistor Logic: Operation of TTL, Current sink logic, TTL with active pull up, TTL with open collector output, Schottkey TTL, TTL characteristics, TTL 5400/7400 series, CMOS: CMOS Inverter, CMOS characteristics, CMOS configurations- Wired Logic, Open drain outputs, Interfacing: TTL to CMOS and CMOS to TTL. Tristate Logic and Tristate TTL inverter.		
Unit VI	Microcontrollers	09 Hours
Comparison of typical microprocessor and microcontroller. Microcontroller 8051: Features, architecture, Pin description, Programming model – Special Function Registers, addressing modes, instruction set, Timers and Counters, serial communication, interrupts, interfacing with ADC and DAC.		
Books:		
Text:		
1. R.P. Jain, —Modern Digital Electronics”, TMH, 2012, ISBN–13: 978-0-07- 066911-6. 2. Stephen Brown, Zvonko Vranesic, —Fundamentals of Digital Logic with VHDL Design”, McGraw-Hill, ISBN–13:978-1-25-902597-6. 3. Muhammas Mazidi, Janice Mazidi and Rolin McKinlay, —The 8051 Microcontroller and Embedded Systems using Assembly and C”, Pearson Education, ISBN-13: 9788131758991		
References:		
1. John Yarbrough, —Digital Logic applications and Design”, Cengage Learning, ISBN – 13: 978-81-315-0058-3 2. D. Leach, Malvino, Saha, —Digital Principles and Applications”, Tata McGraw Hill, ISBN – 13:978-0-07-014170-4. 3. Anil Maini, —Digital Electronics: Principles and Integrated Circuits”, Wiley India Ltd, ISBN:978-81-265-1466-3. 4. Norman B & Bradley, —Digital Logic Design Principles, Wiley India Ltd, ISBN:978-81-265-1258-4. 5. Scott Mackenzie, —The 8051 Microcontroller”, Prentice Hall India, ISBN-13: 978-0130195623		

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) 210243: Data Structures and Algorithms		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem (online): 50 Marks End-Sem (paper): 50 Marks
Prerequisites: - FPL I and FPL II		
Course Objectives: - To understand the standard and abstract data representation methods. - To acquaint with the structural constraints and advantages in usage of the data. - To understand the memory requirement for various data structures. - To operate on the various structured data. - To understand various data searching and sorting methods with pros and cons. - To understand various algorithmic strategies to approach the problem solution.		
Course Outcomes: On completion of the course, student will be able to– - To discriminate the usage of various structures in approaching the problem solution. - To design the algorithms to solve the programming problems. - To use effective and efficient data structures in solving various Computer Engineering domain problems. - To analyze the problems to apply suitable algorithm and data structure. - To use appropriate algorithmic strategy for better efficiency		
Course Contents		
Unit I	Introduction to Algorithm and Data Structures	09 Hours
Algorithms- Problem Solving, Introduction to Algorithms, Characteristics of algorithms, Algorithm design tools: Pseudo code and flowchart, Analysis of Algorithms, Complexity of algorithms- Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and Omega, standard measures of efficiency. Data Structures- Data structure, Abstract Data Types (ADT), Concept of linear and Non-linear, static and dynamic, persistent and ephemeral data structures, and relationship among data, data structure, and algorithm, From Problem to Program. Algorithmic Strategies- Introduction to algorithm design strategies- Divide and Conquer, and Greedy strategy. Recurrence relation - Recurrence Relation, Linear Recurrence Relations, With constant Coefficients, Homogeneous Solutions. Solving recurrence relations		
Unit II	Linear Data Structures Using Sequential Organization	09 Hours
Sequential Organization, Linear Data Structure Using Sequential Organization, Array as an Abstract Data Type, Memory Representation and Address Calculation, Inserting an element into an array, Deleting an element, Multidimensional Arrays, Two-dimensional arrays, n- dimensional arrays, Concept of Ordered List, Single Variable Polynomial, Representation using arrays, Polynomial as array of structure, Polynomial addition, Polynomial multiplication, Sparse Matrix, Sparse matrix representation, Sparse matrix addition, Transpose of sparse matrix, String Manipulation Using Array. Case Study- Use of sparse matrix in Social Networks and Maps.		
Unit III	Linked Lists	09 Hours

Concept, Comparison of sequential and linked organizations, Primitive operations, Realization of Linked Lists, Realization of linked list using arrays, Dynamic Memory Management, Linked list using dynamic memory management, Linked List Abstract Data Type, Linked list operations, Head pointer and header node, **Types of linked list**- Linear and circular linked lists, Doubly Linked List and operations, Circular Linked List, Singly circular linked list, Doubly circular linked list, **Polynomial Manipulations** - Polynomial addition, Multiplication of two polynomials using linked list. **Generalized Linked List (GLL)** concept, representation of polynomial and sets using GLL. **Case Study**- Garbage Collection.

Unit IV	Stacks	09 Hours
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Stacks- concept, Primitive operations, Stack Abstract Data Type, Representation of Stacks Using Sequential Organization, stack operations, Multiple Stacks, Applications of Stack- Expression Evaluation and Conversion, Polish notation and expression conversion, Need for prefix and postfix expressions, Postfix expression evaluation, Linked Stack and Operations.

Recursion- concept, **variants of recursion**- direct, indirect, tail and tree, Backtracking algorithmic strategy, use of stack in backtracking. **Case Study**- 4 Queens problem, Android-multiple tasks/multiple activities and back stack.

Unit V	Queues	09 Hours
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Concept, Queue as Abstract Data Type, Realization of Queues Using Arrays, Circular Queue, Advantages of using circular queues, Multi-queues, Deque, Priority Queue, Array implementation of priority queue, Linked Queue and operations. **Case study**- Priority queue in bandwidth management.

Unit VI	Sorting and Searching	09 Hours
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Searching- Search Techniques, Sequential search, variant of sequential search- sentinel search, Binary search, Fibonacci search. **Case Study**- Use of Fibonacci search in non-uniform access memory storage and in Optimization of Unimodal Functions. **Sorting**- Types of sorting-Internal and external sorting, General sort concepts-sort order, stability, efficiency, number of passes, Sorting methods- Bubble sort, Insertion sort, Selection sort, Quick sort, Heap sort, Shell sort, Bucket sort, Radix sort, Comparison of All Sorting Methods. **Case Study**- Timsort as a hybrid stable sorting algorithm.

Books:

Text:

1. Brassard & Bratley, —Fundamentals of Algorithmics”, Prentice Hall India/Pearson Education, ISBN 13-9788120311312.
2. Horowitz and Sahani, —Fundamentals of Data Structures in C++”, University Press, ISBN 10: 0716782928 ISBN 13: 9780716782926.
3. Goodrich, Tamassia, Goldwasser, —Data Structures and Algorithms in C++”, Wiley publication, ISBN-978-81-265-1260-7

References:

1. R. Gillberg, B. Forouzn, —Data Structures: A Pseudo code approach with C”, Cenage Learning, ISBN 9788131503140.
2. Horowitz, Sahani and Rajshekar, —Fundamentals of Computer Algorithms”, University Press, ISBN-13, 9788175152571.
3. Yedidyah Langsam, Moshe J Augenstein, Aron M Tenenbaum, —Data Structures using C and C++”, Pearson Education, ISBN 81-317-0328-2.
4. A Michael Berman, —Data Structures via C++: Objects by Evolution”, Oxford University Press, ISBN:0-19-510843-4.
5. M. Weiss, —Data Structures and Algorithm Analysis in C++”, 2nd edition, Pearson Education, 2002, ISBN-81-7808-670-0.

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) 210244: Computer Organization and Architecture		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem (online): 50 Marks End-Sem (paper): 50 Marks
Prerequisites: - - Fundamentals of Programming Languages-I & II and - Basics of Electronics Engineering		
Course Objectives: - To understand the structure, function and characteristics of computer systems. - To understand the design of the various functional units and components of digital computers. - To identify the elements of modern instructions sets and explain their impact on processor design. - To explain the function of each element of a memory hierarchy, identify and compare different methods for computer I/O. - To compare simple computer architectures and organizations based on established performance metrics.		
Course Outcomes: On completion of the course, student will be able to– - Demonstrate computer architecture concepts related to design of modern processors, memories and I/Os. - Analyze the principles of computer architecture using examples drawn from commercially available computers. - Evaluate various design alternatives in processor organization.		
Course Contents		
Unit I	Computer Evolution and Performance	09 Hours
Computer Organization and Architecture, Structure and Function, Evolution (a brief history) of computers, Designing for Performance, Evolution of Intel processor architecture- 4 bit to 64 bit, performance assessment. A top level view of Computer function and interconnection- Computer Components, Computer Function, Interconnection structure, bus interconnection, Computer Arithmetic- The Arithmetic and Logic Unit, addition and subtraction of signed numbers, design of adder and fast adder, carry look ahead addition, multiplication of positive numbers, signed operand multiplication, booths algorithm, fast multiplication, integer division. Floating point representation and operations – IEEE standard, arithmetic operations, guard bits and truncation.		
Unit II	Computer Memory System	09 Hours
Characteristics of memory system, The memory hierarchy. Cache Memory- Cache memory principles, Elements of cache design- cache address, size, mapping functions, replacement algorithms, write policy, line size, number of cache, one level and two level cache, performance characteristics of two level cache- locality & operations. Case Study- PentiumIV cache organization. Internal Memory- semiconductor main memory, advanced DRAM organization. External Memory- Hard Disk organization, RAID- level 1 to level 6.		

Unit III	Input and Output System	09 Hours
External devices, I/O modules- Module function and I/O module structure, Programmed I/O- overview, I/O commands, I/O instructions, Interrupt driven I/O- interrupt processing, design issues. Case Study- Study of Programmable Interrupt Controller Intel 82C59A in brief. Direct Memory Access- drawbacks of programmed and interrupt driven I/O, DMA functions, Case Study- DMA Controller Intel 8237A-study in brief, I/O channels and processors- evolution and characteristics, The external Interface- Thunderbolt and Infinite Band.		
Unit IV	Instruction Sets	09 Hours
Characteristics and Functions- machine instruction characteristics, types of operands, Case Study-Intel 8086, Types of operations- data transfer, arithmetic, logical, conversion, input-output, system control, and transfer of control, Case Study-Intel 8086 operation types. Addressing modes and Formats- Addressing modes- immediate, direct, indirect, register, register indirect, displacement and stack, Case Study-8086 addressing modes, Instruction Formats- instruction length, allocation of bits, variable length instructions. Case Study- 8086 instruction formats.		
Unit V	Processor Organization	09 Hours
Processor organization, Register organization- user visible registers, control and status registers, Case Study- register organization of microprocessor 8086. Instruction Cycle- The machine cycle and Data flow. Instruction Pipelining- Pipelining Strategy, pipeline performance, pipeline hazards, dealing with branches, Case Study- pipelining in Pentium. Instruction level parallelism and superscalar processors- Super scalar verses super pipelined, constraints, Design Issues- instruction level and machine parallelism, Instruction issue policy, register renaming, machine parallelism, branch prediction, superscalar execution and implementation. Case study- Pentium IV.		
Unit VI	Basic Processing Unit	09 Hours
Fundamental Concepts- register transfer, performing arithmetic or logic operations, fetching a word from memory, storing a word in memory, Execution of a complete instruction- branch instructions, Hardwired control, Micro-programmed control- micro instructions, micro program sequencing, wide branch addressing, microinstruction with next address field, pre-fetching microinstructions and emulation.		
Books:		
Text:		
1. W. Stallings, –Computer Organization and Architecture: Designing for performance”, Pearson Education/ Prentice Hall of India, 2003, ISBN 978-93-325-1870-4, 7th Edition. 2. Zaky S, Hamacher, –Computer Organization”, 5th Edition, McGraw-Hill Publications, 2001, ISBN- 978-1-25-900537-5, 5th Edition.		
References:		
1. John P Hays, –Computer Architecture and Organization”, McGraw-Hill Publication, 1998, ISBN:978-1-25-902856-4, 3rd Edition. 2. Miles Murdocca and Vincent Heuring, –Computer Architecture and Organization- an integrated approach, Wiley India Pvt. Ltd, ISBN:978-81-265-1198-3, 2nd Edition 3. A. Tanenbaum, –Structured Computer Organization”, Prentice Hall of India, 1991 ISBN: 81 – 203 – 1553 – 7, 4th Edition 4. Patterson and Hennessy, –Computer Organization and Design”, Morgan Kaufmann Publishers In, ISBN 978-0-12-374750-1, 4th Edition.		

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) 210245: Object Oriented Programming		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem (online): 50 Marks End-Sem (paper): 50 Marks
Prerequisites: Fundamentals of Programming Languages-I and II		
Course Objectives: - To explore the principles of Object Oriented Programming (OOP). - To understand object-oriented concepts such as data abstraction, encapsulation, inheritance, dynamic binding, and polymorphism. - To use the object-oriented paradigm in program design. - To lay a foundation for advanced programming. - Provide programming insight using OOP constructs.		
Course Outcomes: On completion of the course, student will be able to– - Analyze the strengths of object oriented programming - Design and apply OOP principles for effective programming - Develop programming application using object oriented programming language C++ - Percept the utility and applicability of OOP		
Course Contents		
Unit I	Classes and Objects	09 Hours
Need of Object-Oriented Programming (OOP), Object Oriented Programming Paradigm, Basic Concepts of Object-Oriented Programming, Benefits of OOP, C++ as object oriented programming language. C++ Programming- C++ programming Basics, Data Types, Structures, Enumerations, control structures, Arrays and Strings, Class, Object, class and data abstraction, class scope and accessing class members, separating interface from implementation, controlling access to members. Functions- Function, function prototype, accessing function and utility function, Constructors and destructors, Copy Constructor, Objects and Memory requirements, Static Class members, data abstraction and information hiding, inline function.		
Unit II	Polymorphism and Inheritance	09 Hours
Operator Overloading- concept of overloading, operator overloading, Overloading Unary Operators, Overloading Binary Operators, Data Conversion, Type casting (implicit and explicit), Pitfalls of Operator Overloading and Conversion, Keywords explicit and mutable. Inheritance- Base Class and derived Class, protected members, relationship between base Class and derived Class, Constructor and destructor in Derived Class, Overriding Member Functions, Class Hierarchies, Inheritance, Public and Private Inheritance, Levels of Inheritance, Multiple Inheritance, Ambiguity in Multiple Inheritance, Aggregation, Classes Within Classes. Polymorphism- concept, relationship among objects in inheritance hierarchy, abstract classes, polymorphism.		

Unit III	Virtual Functions	09 Hours
Virtual Functions- Pointers- indirection Operators, Memory Management: new and delete, Pointers to Objects, A Linked List Example, accessing Arrays using pointers, Function pointers, Pointers to Pointers, A Parsing Example, Debugging Pointers, Dynamic Pointers, smart pointers, shared pointers, Case Study : Design of Horse Race Simulation. Virtual Function- Friend Functions, Static Functions, Assignment and Copy Initialization, this Pointer, virtual function, dynamic binding, Virtual destructor.		
Unit IV	Templates and Exception Handling	09 Hours
Templates- function templates, Function overloading, overloading Function templates, class templates, class template and Nontype parameters, template and inheritance, template and friends Generic Functions, Applying Generic Function, Generic Classes, The typename and export keywords, The Power of Templates. Exception Handling- Fundamentals, other error handling techniques, simple exception handling- Divide by Zero, rethrowing an exception, exception specifications, processing unexpected exceptions, stack unwinding, constructor, destructor and exception handling, exception and inheritance.		
Unit V	Files and Streams	09 Hours
Data hierarchy, Stream and files, Stream Classes, Stream Errors, Disk File I/O with Streams, File Pointers, and Error Handling in File I/O, File I/O with Member Functions, Overloading the Extraction and Insertion Operators, memory as a Stream Object, Command-Line Arguments, Printer output, Early vs. Late Binding.		
Unit VI	Standard Template Library (STL)	09 Hours
Introduction to STL, Containers, algorithms and iterators, Containers- Sequence container and associative containers, container adapters, Algorithms- basic searching and sorting algorithms, min-max algorithm, set operations, heap sort, Iterators- input, output, forward, bidirectional and random access. Object Oriented Programming – a road map to future		
Books:		
Text: 1. Bjarne Stroustrup, –The C++ Programming language”, Third edition, Pearson Education. ISBN 9780201889543. 2. Deitel, –C++ How to Program”, 4th Edition, Pearson Education, ISBN:81-297-0276-2		
References:		
1. Robert Lafore, –Object-Oriented Programming in C++”, fourth edition, Sams Publishing, ISBN:0672323087 (ISBN 13: 9780672323089) 2. Herbert Schildt, –C++ The complete reference”, Eighth Edition, McGraw Hill Professional, 2011, ISBN:978-00-72226805 3. Matt Weisfeld, –The Object-Oriented Thought Process”, Third Edition Pearson ISBN-13:075-2063330166 4. Cox Brad, Andrew J. Novobilski, –Object –Oriented Programming: An Evolutionary Approach”, Second Edition, Addison–Wesley, ISBN:13:978-020-1548341		

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210246: Digital Electronics Lab

Teaching Scheme:
PR: 02 Hours/Week

Credit
01

Examination Scheme:
TW: 25 Marks
PR: 50 Marks

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, data sheets of various ICs, 8051 simulator and references.

Guidelines for Student's Lab 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, circuit diagram, pin configuration, conclusion/analysis).

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.

Guidelines for Lab /TW Assessment

Continuous assessment of laboratory work is done based on overall performance and lab performance of student. Each lab assignment assessment should 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, efficiency, punctuality and neatness.

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. Student should perform at least 14 experiments-5 experiments from group A and 5 assignments from group B, 2 from group C and 2 from group D.

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.

Suggested List of Laboratory Assignments	
Sr No	Group A
1.	Realize Full Adder and Subtractor using a) Basic Gates and b) Universal Gates
2.	Design and implement Code converters-Binary to Gray and BCD to Excess-3
3.	Design of n-bit Carry Save Adder (CSA) and Carry Propagation Adder (CPA). Design and Realization of BCD Adder using 4-bit Binary Adder (IC 7483).
4.	Realization of Boolean Expression for suitable combination logic using MUX 74151 / DMUX 74154
5.	Verify the truth table of one bit and two bit comparators using logic gates and comparator IC
6.	Design & Implement Parity Generator using EX-OR.
Group B	
7.	Flip Flop Conversion: Design and Realization
8.	Design and implement a system using flip-flops, to monitor number of vehicles entering and exiting from a car parking area with maximum capacity of 15 and having separate entry and exit gates.
9.	Design of Ripple Counter using suitable Flip Flops
10.	a. Realization of 3 bit Up/Down Counter using MS JK Flip Flop / D Flip Flop b. Realization of Mod -N counter using (7490 and 74193)
11.	Assume a scenario of a hall where students are entering to attend seminar. Design and implement a system which will increment count if student is entering in the hall and will decrement count if student is exiting the hall. Assume seating capacity of a hall is 63.
12.	Design and Realization of Ring Counter and Johnson Ring counter.
13.	Design and implement Sequence generator using JK flip-flop.
14.	Design and implement pseudo random sequence generator.
15.	Design and implement Sequence detector using JK flip-flop
16.	Design of ASM chart using MUX controller Method.
Group C	
17.	Design and Implementation of Combinational Logic using PLAs.
18.	Design and simulation of - Full adder , Flip flop, MUX using VHDL (Any 2) Use different modeling styles.
19.	Design & simulate asynchronous 3- bit counter using VHDL.
20.	Design and Implementation of Combinational Logic using PALs.
Group D (Study Assignments)	
21.	Study of Shift Registers (SISO,SIPO, PISO,PIPO)
22.	Study of TTL Logic Family: Feature, Characteristics and Comparison with CMOS Family
23.	Study of Microcontroller 8051 : Features, Architecture and Programming Model

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210247: Data Structures Lab

Teaching Scheme:
PR: 04 Hours/Week

Credit
02

Examination Scheme:
TW: 25 Marks
PR: 50 Marks

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, algorithm, flowchart, 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.

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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 assignment list is provided in groups- A, B, C, D, and E. Each student must perform at least 13 assignments as at least 3 from group A, 3 from group B, 2 from group C, 2 from group D and 3 from group E.

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

Programming tools recommended: - Open Source C++ Programming tool like G++/GCC

Suggested List of Laboratory Assignments

Group A

- | | |
|----|---|
| 1. | In Second year Computer Engineering class of M students, set A of students play cricket and set B of students play badminton. Write C/C++ program to find and display- <ol style="list-style-type: none"> i. Set of students who play either cricket or badminton or both ii. Set of students who play both cricket and badminton iii. Set of students who play only cricket iv. Set of students who play only badminton v. Number of students who play neither cricket nor badminton (Note- While realizing the set duplicate entries are to avoided) |
| 2. | Write C/C++ program to store marks scored for first test of subject 'Data Structures and Algorithms' for N students. Compute <ol style="list-style-type: none"> I. The average score of class ii. Highest score and lowest score of class iii. Marks scored by most of the students iv. list of students who were absent for the test |
| 3. | Department library has N books. Write C/C++ program to store the cost of books in array in ascending order. Books are to be arranged in descending order of their cost. Write function for <ol style="list-style-type: none"> a) Reverse the contents of array without using temporary array. b) Copy costs of books those with cost less than 500 in new array c) Delete the duplicate entries using temporary array d) Delete duplicate entries without using temporary array e) Count number of books with cost more than 500. |
| 4. | Set A={1,3, a, s, t, i} represent alphanumeric characters permitted to be used to set the password of length 4. Write C/C++ program to generate all possible passwords. |
| 5. | A magazine committee is to be formed that consists of any 3 members to be selected from { Nikhita, Aboli, Megha, Sanika, Pratik, Saurabh}. Write C/C++ program to list all possible committees. |
| 6. | It is decided that weekly greetings are to be furnished to wish the students having their birthdays in that week. The consolidated sorted list with desired categorical information is |

	to be provided to the authority. Write C++ program for array of structures to store students PRNs with date and month of birth. Let Array_A and Array_B be the two arrays for two SE Computer divisions. Arrays are sorted on date and month. Merge these two arrays into third array Array_SE_Comp_DOB resulting in sorted information about Date of Birth of SE Computer students.																									
7.	A magic square is an $n \times n$ matrix of the integers 1 to n^2 such that the sum of each row, column, and diagonal is the same. The figure given below is an example of magic square for case $n=5$. In this example, the common sum is 65. Write C/C++ Program for magic square. <table><tr><td>15</td><td>8</td><td>1</td><td>24</td><td>17</td></tr><tr><td>16</td><td>14</td><td>7</td><td>5</td><td>23</td></tr><tr><td>22</td><td>20</td><td>13</td><td>6</td><td>4</td></tr><tr><td>3</td><td>21</td><td>19</td><td>12</td><td>10</td></tr><tr><td>9</td><td>2</td><td>25</td><td>18</td><td>11</td></tr></table>	15	8	1	24	17	16	14	7	5	23	22	20	13	6	4	3	21	19	12	10	9	2	25	18	11
15	8	1	24	17																						
16	14	7	5	23																						
22	20	13	6	4																						
3	21	19	12	10																						
9	2	25	18	11																						
8.	An $m \times n$ matrix is said to have a saddle point if some entry $a[i][j]$ is the smallest value in row i and the largest value in j . Write C/ C++ function that determines the location of a saddle point if one exists.																									
9.	Write C/C++ program for storing matrix. Write functions for - Check whether given matrix is upper triangular or not - Compute summation of diagonal elements - Compute transpose of matrix - Add, subtract and multiply two matrices																									
10.	Write C++ program with class for String. Write a function <i>frequency</i> that determines the frequency of occurrence of particular character in the string. <i>delete</i> that accepts two integers, <i>start</i> and <i>length</i>. The function computes a new string that is equivalent to the original string, except that <i>length</i> characters being at <i>start</i> have been removed. <i>chardelete</i> that accepts a character <i>c</i>. The function returns the string with all occurrences of <i>c</i> removed. <i>replace</i> to make an in-place replacement of a substring <i>w</i> of a string by the string <i>x</i>. note that <i>w</i> may not be of same size of <i>x</i> <i>palindrome</i> to check whether given string is palindrome or not																									
11.	Write C++ program for sparse matrix realization and operations on it- Transpose, Fast Transpose and addition of two matrices																									
12.	Write C++ program for string operations- copy, concatenate, check substring, equal, reverse and length																									
13.	Write a C++ program to realize polynomial equation and perform operations. Write function - To input and output polynomials represented as $b_mx^{em} + b_{m-1}x^{em-1} + \dots + b_0x^{e0}$. Your functions should overload the $<<$ and $>>$ operators. - Evaluates a polynomial at given value of x - Add two polynomials - Multiplies two polynomials																									
Group B																										
14.	Department of Computer Engineering has student's club named 'Pinnacle Club'. Students of Second, third and final year of department can be granted membership on request. Similarly one may cancel the membership of club. First node is reserved for president of club and last node is reserved for secretary of club. Write C++ program to maintain club member's information using singly linked list. Store student PRN and Name. Write functions to																									

	a) Add and delete the members as well as president or even secretary. b) Compute total number of members of club c) Display members d) Display list in reverse order using recursion e) Two linked lists exists for two divisions. Concatenate two lists.				
15.	The ticket booking system of Cinemax theater has to be implemented using C++ program. There are 10 rows and 7 seats in each row. Doubly circular linked list has to be maintained to keep track of free seats at rows. Assume some random booking to start with. Use array to store pointers (Head pointer) to each row. On demand a) The list of available seats is to be displayed b) The seats are to be booked c) The booking can be cancelled.				
16.	Write C++ program for storing appointment schedule for day. Appointments are booked randomly using linked list. Set start and end time and min and max duration for visit slot. Write functions for- a) Display free slots b) Book appointment c) Cancel appointment (check validity, time bounds, availability etc) d) Sort list based on time e) Sort list based on time using pointer manipulation				
17.	Second year Computer Engineering class, set A of students like Vanilla Ice-cream and set B of students like butterscotch ice-cream. Write C/C++ program to store two sets using linked list. compute and display- i. Set of students who like either vanilla or butterscotch or both ii. Set of students who like both vanilla and butterscotch iii. Set of students who like only vanilla not butterscotch iv. Set of students who like only butterscotch not vanilla v. Number of students who like neither vanilla nor butterscotch				
18.	Write C++ program to store set of negative and positive numbers using linked list. Write functions to a) Insert numbers b) Delete nodes with negative numbers c) Create two more linked lists using this list, one containing all positive numbers and other containing negative numbers d) For two lists that are sorted; Merge these two lists into third resultant list that is sorted				
19.	Write C++ program for storing binary number using doubly linked lists. Write functions- a) to compute 1's and 2's complement b) add two binary numbers				
20.	Let $x = (x_1, x_2, \dots, x_n)$ and $y = (y_1, y_2, \dots, y_m)$ be two doubly linked lists. Assume that in each linked list, the nodes are in non-decreasing order of their data-field values. Write C/C++ program to merge the two lists to obtain a new linked list z in which the nodes are also in this order. Following the merge, x and y should represent empty lists because each node initially in x or y is now in z. No additional nodes may be used.				
21.	Design a linked allocation system to represent and manipulate univariate polynomials with integer coefficients (use circular linked lists with head nodes). Each term of the polynomial will be represented as a node Thus. a node in this system will have three data members as below: <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">Exponent</td><td style="text-align: center;">Link</td></tr> <tr> <td colspan="2" style="text-align: center;">Coefficient</td></tr> </table>	Exponent	Link	Coefficient	
Exponent	Link				
Coefficient					

	To erase polynomials efficiently, we need to use an available-space list and associated functions. The external (i.e., for input or output) representation of a univariate polynomial will be assumed to be a sequence of integers of the form: $n, c_1, e_1, c_2, e_2, c_3, e_3, \dots, c_n, e_n$ where e_i represents an exponent and c_i a coefficient; n gives the number of terms in the polynomial. The exponents are in decreasing order — i.e., $e_1 > e_2 > \dots > e_n$. Write and test the following functions: 1. istream&operator >>(istream& is, Polynomial& x): Read in an input polynomial and convert it to its circular list representation using a head node. 2. ostream&operator <<(ostream& os, Polynomial& x): Convert x from its linked list representation to its external representation and output it. 3. Polynomial:: Polynomial(const Polynomial& a) [Copy Constructor]: Initialize the polynomial *this to the polynomial a. 4. const Polynomial& Polynomial :: operator=(const Polynomial& a) [Assignment Operator]: Assign polynomial a to *this. 5. Polynomial:: Polynomial () [Destructor]: Return all nodes of the polynomial *this to the available-space list. 6. Polynomial operator+ (const Polynomial& a, const Polynomial& b) [Addition]: Create and return the polynomial $a + b$. a and b are to be left unaltered. 7. Polynomial operator* (const Polynomial& a, const Polynomial& b) [Multiplication]: Create and return the polynomial $a * b$. a and b are to be left unaltered. 8. float Polynomial :: Evaluate(float x): Evaluate the polynomial *this at x and return the result.
22.	Write C++ program to realize Set using Generalized Linked List (GLL) Ex. $A = \{ a, b, \{c, d, e, \}, \{f, g\}, h, i, \{j, k\}, l, m \}$. Store and print as set notation.
Group C	
23.	A palindrome is a string of character that's the same forward and backward. Typically, punctuation, capitalization, and spaces are ignored. For example, "Poor Dan is in a droop" is a palindrome, as can be seen by examining the characters "pooR danisIna droop" and observing that they are the same forward and backward. One way to check for a palindrome is to reverse the characters in the string and then compare with them the original—in a palindrome, the sequence will be identical. Write C++ program with functions- 1. To check whether given string is palindrome or not that uses a stack to determine whether a string is a palindrome. 2. to remove spaces and punctuation in string, convert all the Characters to lowercase, and then call above Palindrome checking function to check for a palindrome 3. to print string in reverse order using stack
24.	In any language program mostly syntax error occurs due to unbalancing delimiter such as (), {}, []. Write C++ program using stack to check whether given expression is well parenthesized or not.
25.	Implement C++ program for expression conversion as infix to postfix and its evaluation using stack based on given conditions i. Operands and operator, both must be single character. ii. Input Postfix expression must be in a desired format. iii. Only '+', '-', '*', and '/' operators are expected.
26.	Implement C++ program for expression conversion- a) infix to prefix, b) prefix to postfix, c) prefix to infix, d) postfix to infix and e) postfix to prefix.
27.	A classic problem that can be solved by backtracking is called the Eight Queens problem, which comes from the game of chess. The chess board consists of 64 square arranged in an

	8 by 8 grid. The board normally alternates between black and white square, but this is not relevant for the present problem. The queen can move as far as she wants in any direction, as long as she follows a straight line, Vertically, horizontally, or diagonally. Write C++ program with recursive function for generating all possible configurations for 4-queen's problem.
Group D	
28.	Queues are frequently used in computer programming, and a typical example is the creation of a job queue by an operating system. If the operating system does not use priorities, then the jobs are processed in the order they enter the system. Write C++ program for simulating job queue. Write functions to add job and delete job from queue.
29.	Write program to implement a priority queue in C++ using an inorder List to store the items in the queue. Create a class that includes the data items(which should be template) and the priority (which should be int)The inorder list should contain these objects ,with operator <= overloaded so that the items with highest priority appear at the beginning of the list (which will make it relatively easy to retrieve the highest item.)
30.	A double-ended queue(deque) is a linear list in which additions and deletions may be made at either end. Obtain a data representation mapping a deque into a one-dimensional array. Write C++ program to simulate deque with functions to add and delete elements from either end of the deque.
31.	Pizza parlor accepting maximum M orders. Orders are served in first come first served basis. Order once placed cannot be cancelled. Write C++ program to simulate the system using circular queue using array.
Group E	
32.	Write C++ program to store roll numbers of student in array who attended training program in random order. Write function for- a) Searching whether particular student attended training program or not using linear search and sentinel search. b) Searching whether particular student attended training program or not using binary search and Fibonacci search.
33.	Write C++ program to store names and mobile numbers of your friends in sorted order on names. a) Search your friend from list using binary search (recursive and non recursive). Insert friend if not present in phonebook. b) Search your friend from list using Fibonacci search. Insert friend if not present in phonebook.
34.	Write C++ program to maintain club members, sort on roll numbers in ascending order. Write function '_Ternary_Search' to search whether particular student is member of club. Ternary search is modified binary search that divides array into 3 halves instead of two.
35.	Write C++ program to store first year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using a) Selection Sort b) Bubble sort and display top five scores.
36.	Write C++ program to store second year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using a) Insertion sort b) Shell Sort and display top five scores.
37.	Write C++ program to store first year percentage of students in array. Sort array of floating point numbers in ascending order using quick sort and display top five scores.
38.	Write C++ program to store XII percentage of students in array. Sort array of floating point numbers in ascending order using bucket sort and display top five scores.
39.	Write C++ program to store X percentage of students in array. Sort array of floating point numbers in ascending order using radix sort and display top five scores.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210248: Object Oriented Programming Lab

Teaching Scheme:
PR: 02 Hours/Week

Credit
01

Examination Scheme:
TW: 25 Marks
PR: 50 Marks

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Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

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

Programming tools recommended: - Open Source C++ Programming tool like G++/GCC.

First assignment is compulsory. Set of suggested assignment list is provided in 3 groups- A, B, and C. Instructor is suggested to design assignments list by selecting/designing at least **12** suitable assignments from group A, B, and C- **compulsory assignment, 5** from group A, **4** from group B, **3** from group C.

Suggested List of Laboratory Assignments

Compulsory Assignment

1. Install, Configure 64 bit Linux Operating Systems, study basic architecture, memory system, and learn basic administration.

Group A

2. Implement a class Complex which represents the Complex Number data type. Implement the following operations:
 1. Constructor (including a default constructor which creates the complex number $0+0i$).
 2. Overloaded **operator+** to add two complex numbers.
 3. Overloaded **operator*** to multiply two complex numbers.
 4. Overloaded **<<** and **>>** to print and read Complex Numbers.
3. Implement a class Quadratic that represents degree two polynomials i.e., polynomials of type ax^2+bx+c . The class will require three data members corresponding to a, b and c. Implement the following operations:
 1. A constructor (including a default constructor which creates the 0 polynomial).
 2. Overloaded **operator+** to add two polynomials of degree 2.
 3. Overloaded **<<** and **>>** to print and read polynomials. To do this, you will need to decide what you want your input and output format to look like.
 4. A function eval that computes the value of a polynomial for a given value of x.
 5. A function that computes the two solutions of the equation $ax^2+bx+c=0$.
4. Implement a class CppArray which is identical to a one-dimensional C++ array (i.e., the index set is a set of consecutive integers starting at 0) except for the following :
 1. It performs range checking.
 2. It allows one to be assigned to another array through the use of the assignment operator (e.g. `cp1= cp2`)
 3. It supports a function that returns the size of the array.
 4. It allows the reading or printing of array through the use of **cout** and **cin**.
5. Write a C++ program create a calculator for an arithmetic operator (+, -, *, /). The program should take two operands from user and performs the operation on those two operands depending upon the operator entered by user. Use a switch statement to select the operation. Finally, display the result.
Some sample interaction with the program might look like this:


```
Enter first number, operator, second number: 10 / 3
Answer = 3.333333
Do another (y/n)? y
Enter first number, operator, second number: 12 + 100
Answer = 112
Do another (y/n)? n
```

6.	Develop an object oriented program in C++ to create a database of student information system containing the following information: Name, Roll number, Class, division, Date of Birth, Blood group, Contact address, telephone number, driving license no. etc Construct the database with suitable member functions for initializing and destroying the data viz constructor, default constructor, Copy constructor, destructor, static member functions, friend class, this pointer, inline code and dynamic memory allocation operators-new and delete.
7.	Create a class template to represent a generic vector. Include following member functions: • To create the vector. • To modify the value of a given element • To multiply by a scalar value • To display the vector in the form (10,20,30,...)
8.	Create a class Rational Number (fractions) with the following capabilities: a) Create a constructor that prevents a 0 denominator in a fraction, reduces or simplifies fractions that are not in reduced form and avoids negative denominators. b) Overload the addition, subtraction, multiplication and division operators for this class. c) Overload the relational and equality operators for this class.
9.	Imagine a publishing company which does marketing for book and audiocassette versions. Create a class publication that stores the title (a string) and price (type float) of a publication. From this class derive two classes: book, which adds a page count (type int), and tape, which adds a playing time in minutes (type float). Write a program that instantiates the book and tape classes, allows user to enter data and displays the data members. If an exception is caught, replace all the data member values with zero values.
10.	Write a function in C++ to count and display the number of lines not starting with alphabet 'A' present in a text file "STORY.TXT". Example: If the file "STORY.TXT" contains the following lines, The roses are red. A girl is playing there. There is a playground. An aeroplane is in the sky. Numbers are not allowed in the password. The function should display the output as 3.
11.	Write C++ Program with base class convert declares two variables, val1 and val2, which hold the initial and converted values, respectively. It also defines the functions getinit() and getconv(), which return the initial value and the converted value. These elements of convert are fixed and applicable to all derived classes that will inherit convert. However, the function that will actually perform the conversion, compute(), is a pure virtual function that must be defined by the classes derived from convert. The specific nature of compute() will be determined by what type of conversion is taking place.

12.	A book shop maintains the inventory of books that are being sold at the shop. The list includes details such as author, title, price, publisher and stock position. Whenever a customer wants a book, the sales person inputs the title and author and the system searches the list and displays whether it is available or not. If it is not, an appropriate message is displayed. If it is, then the system displays the book details and requests for the number of copies required. If the requested copies book details and requests for the number of copies required. If the requested copies are available, the total cost of the requested copies is displayed; otherwise the message –Required copies not in stock” is displayed. Design a system using a class called books with suitable member functions and Constructors. Use new operator in constructors to allocate memory space required. Implement C++ program for the system.
13.	Create employee bio-data using following classes i) Personal record ii))Professional record iii) Academic record Assume appropriate data members and member function to accept required data & print bio-data. Create bio-data using multiple inheritance using C++.
Group B	
14.	Crete User defined exception to check the following conditions and throw the exception if the criterion does not meet. - User has age between 18 and 55 - User stays has income between Rs. 50,000 – Rs. 1,00,000 per month - User stays in Pune/ Mumbai/ Bangalore / Chennai - User has 4-wheeler Accept age, Income, City, Vehicle from the user and check for the conditions mentioned above. If any of the condition not met then throw the exception.
15.	Write a menu driven program that will create a data file containing the list of telephone numbers in the following form <pre> John 23456 Ahmed 9876 </pre> Use a class object to store each set of data, access the file created and implement the following tasks - Determine the telephone number of specified person - Determine the name if telephone number is known - Update the telephone number, whenever there is a change.
16.	Write a C++ program that creates an output file, writes information to it, closes the file and open it again as an input file and read the information from the file.
17.	Write a C++ program using command line arguments to search for a word in a file and replace it with the specified word. The usage of the program is shown below. <pre>\$ change <old word> <new word> <file name></pre>
18.	Write a function template selection Sort. Write a program that inputs, sorts and outputs an integer array and a float array.

	You are the owner of a hardware store and need to keep an inventory that can tell you what different tools you have, how many of each you have on hand and the cost of each one. Write a program that initializes the random-access file hardware.dat to 100 empty records, lets you input the data concerning each tool, enables you to list all your tools, lets you delete a record for a tool that you no longer have and lets you update any information in the file. The tool identification number should be the record number. Use the following information to start your file:																								
19.	<table><tr><th>Record #</th><th>Tool name</th><th>Quantity</th><th>Cost</th></tr><tr><td>3</td><td>Electric sander</td><td>7</td><td>57.98</td></tr><tr><td>17</td><td>Hammer</td><td>76</td><td>11.99</td></tr><tr><td>24</td><td>Jig saw</td><td>21</td><td>11.00</td></tr><tr><td>39</td><td>Lawn mower</td><td>3</td><td>79.50</td></tr><tr><td>56</td><td>Power saw</td><td>18</td><td>99.99</td></tr></table>	Record #	Tool name	Quantity	Cost	3	Electric sander	7	57.98	17	Hammer	76	11.99	24	Jig saw	21	11.00	39	Lawn mower	3	79.50	56	Power saw	18	99.99
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56	Power saw	18	99.99																						
Group C																									
20.	Write C++ program using STL for implementation of Singly, doubly and circular linked list.																								
21.	Write C++ program using STL for implementation of stack & queue using SLL																								
22.	Write C++ program using STL to add binary numbers (assume one bit as one number); use STL stack.																								
23.	Write C++ program using STL for Dqueue (Double ended queue)																								
24.	Write C++ program using STL for Sorting and searching with user-defined records such as Person Record (Name, birth date, telephone no), item record (item code, item name, quantity and cost)																								
Mini-projects																									
25.	Design and develop the Tic-Tac-Toe Game using C++																								
26.	Develop a Supermarket Billing System using C++. The key features of this application are listed below : • Bill Report: It shows the bill report of all the items added in supermarket billing system. • Add, Remove or Edit items: With this feature one can add, remove and modify item details. In add items, one can add information or details such as item no., item name, manufacturing date, price, quantity, tax percent, and many more. • Show item details: This feature allows users to see the items and the corresponding details given for the item while adding the item. Use file to store the data.																								
27.	Design an E-mail Verifier which accepts the email address from the user. Depending upon the input given by user display appropriate results. Use the following concepts in the Project – Constructor, Destructor, new, delete, exceptional handling, string handling functions, etc.																								
28.	Design and Develop Library Management system using OOP Concepts.																								
29.	Write a C++ program to implement a small database mini project to understand persistent objects and operations on sequential files (ex- library information, inventory systems, automated banking system, reservation systems etc.) For example, write a program to create a database for reservation system using information such as Name, sex, age, starting place of journey and destination. Program should have following facilities a) To display entire passenger list b) To display particular record c) To update record d) To delete and sort record. Use Exception Handling for data verification																								

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) 210249: Soft Skills		
Teaching Scheme:	Credit	Examination Scheme:
PR: 02 Hours /Week	01	TW: 25 Marks
Course Objectives:		
• To encourage the all round development of students by focusing on soft skills. • To make the engineering students aware of the importance, the role and the content of soft skills through instruction, knowledge acquisition, demonstration and practice. • To develop and nurture the soft skills of the students through individual and group activities. • To expose students to right attitudinal and behavioral aspects and to build the same through activities		
Course Outcomes:		
On completion of the course, student will be able to–		
• Effectively communicate through verbal/oral communication and improve the listening skills • Write precise briefs or reports and technical documents. • Actively participate in group discussion / meetings / interviews and prepare & deliver presentations. • Become more effective individual through goal/target setting, self motivation and practicing creative thinking. • Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality.		
Course Contents		
Unit I	Self-Development	
Introduction to soft skills, Self-Management: Self-Evaluation, Self-Discipline, Self-Criticism, Self-Awareness, Self-Esteem, Positive Thinking, Perceptions and Attitudes, Values and Belief Systems, Personal success factors, Handling failure, Knowing Yourself, identifying one's strengths and weaknesses, SWOT analysis, Johari's Window, Career Planning & Goal setting, prioritization, Managing self – emotions, ego, pride, stress; Personality development.		
Unit II	Communication Skills	

Significance of Communication- types, barriers of communication, effective communication, Verbal and non-verbal Communication, Speaking Skills – Importance of speaking effectively, speech process, message, audience, speech. Style, feedback, conversation and oral skills, fluency and self expression, body language phonetics and spoken English, speaking techniques, word stress, correct stress patterns, voice quality, correct tone, types of tones, positive image projection techniques, Public Speaking, Group discussion, Listening Skills: Virtues of Listening, Barriers and filters, Fundamentals of Good Listening, Reading Skills: Comprehension, reading research papers, Communication in a Digital World.

Unit III	Language and Writing Skills
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Vocabulary: One - Word Substitutes, Words often Confused - Pairs of Words, Synonyms and Antonyms, Foreign Phrases, Phrasal verbs derived from the dynamic verbs, Business Writing: Note Making, Letter writing, Writing Formal Letters. Technical Report Writing, Memo, Notices/Circulars Agenda and Minutes of a Meeting, E-Mail, Essay writing. Employment Communication: Job Application, Preparation of CV and Resume writing. Presentation skills: Professional Presentation, Nature of Oral Presentation, Planning a Presentation, Preparing the Presentation, Delivering the Presentation.

Unit IV	Leadership and Team Building
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Introduction, Leader and Leadership, Leadership Traits, Culture and Leadership: Salient Features of Corporate Culture, Leadership Styles, Leadership Trends, Team Building: Team Development Stages, Types of Teams: Cross-functional Team, Problem-solving Team, Inter- personal relations: Types of feelings, steps to deal with complex feelings. Assertiveness and Confidence building. Types of Conflict and resolutions. Emotions, emotional empathy and emotional intelligence.

Unit V	Stress and Time Management
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Introduction, Stress in Today's Time: Identify the Stress Source, Signs of Stress, Ways to Cope with Stress : Healthier Ways to Combat Stress, Steps to be Taken in the Organizations : Open communication, Time Management, Working towards Your Goals, Smart Work, Prioritize your Tasks, 4 Ds of Decision Making.

Unit VI	Ethics, Etiquette and Mannerism
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Professional Etiquette: Etiquette at Meetings, Etiquette at Dining. Involuntary Awkward Actions, Public Relations Office(PRO)'s Etiquettes, Technology Etiquette : Phone Etiquette, Email Etiquette, Social Media Etiquette, Video Conferencing Etiquette, Interview Etiquette, Dressing Etiquettes : for Interview, offices and social functions, Ethical Values: Importance of Work Ethics, Problems in the Absence of Work Ethics.

Books:

Text:

1. Gajendra Singh Chauhan, Sangeeta Sharma: Soft Skills – An Integrated Approach to Maximize Personality, WILEY INDIA, ISBN:13:9788126556397.

References:

1. Indrajit Bhattacharya, –An Approach to Communication Skills”, Delhi, Dhanpat Rai, 2008.
2. Simon Sweeney, –English for Business Communication”, Cambridge University Press, ISBN 13:978-0521754507.
3. Sanjay Kumar and Pushpa Lata, –Communication Skills”, Oxford University Press, ISBN 10:9780199457069.
4. Atkinson and Hilgard's, –Introduction to Psychology”, 14th Edition, Geoffrey Loftus, ISBN-10:0155050699 © 2003
5. Kenneth G. Mcgee, –Heads Up: How to Anticipate Business Surprises & Seize Opportunities First”, Harvard Business School Press, Boston, Massachusetts, 2004, ISBN 10:1591392993.
6. Krishnaswami, N. and Sriraman, T, –Creative English for Communication”, Macmillan.

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, guidelines, references.

Guidelines for Student's Lab Journal and TW Assessment

The student must prepare the journal in the form of **report** elaborating the activities performed in the lab. Continuous assessment of laboratory work is to be 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, punctuality, neatness, enthusiasm, participation and contribution in various activities-SWOT analysis, presentations, team activity, event management, group discussion, Group exercises and interpersonal skills and similar other activities/assignments.

Guidelines for Soft skills Lab Conduction

The instructor may frame assignments to enhance skills supporting career aspects. Multiple set of activity based assignments can be prepared and distributed among batches. Every student must be given adequate opportunity to participate actively in each activity. An exercise can be designed to allow multiple skills exposure for example a group task encouraging discussions, team building, value sharing, leadership and role play all at the same time.

Suggested List of Laboratory Assignments

1.	SWOT analysis The students should be made aware of their goals, strengths and weaknesses, attitude, moral values, self confidence, etiquettes, non-verbal skills, achievements etc. through this activity. SWOT Analysis, Confidence improvement, values, positive attitude, positive thinking and self esteem. The concern teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects.
2.	Personal & Career Goal setting – Short term & Long term The teacher should explain to them on how to set goals and provide template to write their short term and long term goals.

3.	Public Speaking Any one of the following activities may be conducted : 1. Prepared speech (Topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver.) 2. Extempore speech (Students deliver speeches spontaneously for 5 minutes each on a given topic) 3. Story telling (Each student narrates a fictional or real life story for 5 minutes each) 4. Oral review (Each student orally presents a review on a story or a book read by them)
4.	Reading and Listening skills The batch can be divided into pairs. Each pair will be given an article (any topic) by the teacher. Each pair would come on the stage and read aloud the article one by one. After reading by each pair, the other students will be asked questions on the article by the readers. Students will get marks for correct answers and also for their reading skills. This will evaluate their reading and listening skills. The teacher should give them guidelines on improving their reading and listening skills. The teacher should also give passages on various topics to students for evaluating their reading comprehension.
5.	Group discussion Group discussions could be done for groups of 5-8 students at a time Two rounds of a GD for each group should be conducted and teacher should give them feedback.
6.	Letter/Application writing Each student will write one formal letter, and one application. The teacher should teach the students how to write the letter and application. The teacher should give proper format and layouts.
7.	Report writing The teacher should teach the students how to write report .The teacher should give proper format and layouts. Each student will write one report based on visit / project / business proposal etc.
8.	Resume writing- Guide students and instruct them to write resume.
9.	Presentation Skill Students should make a presentation on any informative topic of their choice. The topic may be technical or non-technical. The teacher should guide them on effective presentation skills. Each student should make a presentation for at least 10 minutes.
10.	Team games for team building - Students should make to participate in team activity.
11.	Situational games for role playing as leaders
12.	Faculty may arrange one or more sessions from following: Yoga and meditation. Stress management, relaxation exercises, and fitness exercises. Time management and personal planning sessions.
13.	Mock interviews- guide students and conduct mock interviews

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210250: Audit Course 1

In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year to supplement knowledge and skills. A 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 from 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 details 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/revise-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)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations

- Surveys
- Mini Project
- Hands on experience on specific focused topic

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

- Written Test
- Demonstrations/ Practical Test
- Presentations

- IPR/Publication
- Report

Audit Course 1 Options

Course Code	Audit Course Title
AC1-I	Road Safety
AC1-II	Humanities and Social Sciences
AC1-III	Environmental Studies
AC1-IV	Smart Cities
AC1-V	Foreign Language (one of Japanese/Spanish/French/German). <u>Course contents for Japanese (Module 1) are provided. For other languages institute may design suitably.</u>

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210250: Audit Course 1
AC1-I: Road Safety

Road transport remains the least safe mode of transport, with road accidents representing the main cause of death of people. The boom in the vehicle population without adequate road infrastructure, poor attention to driver training and unsatisfactory regulation has been responsible for increase in the number of accidents. India's vehicle population is negligible as compared to the World statistics; but the comparable proportion for accidents is substantially large.

The need for stricter enforcement of law to ensure greater safety on roads and an environment-friendly road transport operation is of paramount importance. Safety and security are growing concerns for businesses, governments and the traveling public around the world, as also in India. It is, therefore, essential to take new initiatives in raising awareness, skill and knowledge of students as one of the ibid stake holders who are expected to follow the rules and policies of the government in order to facilitate safety of individual and safe mobility of others.

Course Contents:

1. Existing Road Transport Scenario
2. Accident Causes & Remedies
3. Road Accident Investigation & Investigation Methods
4. Vehicle Technology – CMVR & Road Safety
5. Regulatory / Legislative Provisions for Improving Road Safety
6. Behavioral Training for Drivers for Improving Road Safety
7. Road Safety Education
8. Road Engineering Measures for Improving Road Safety

References:

1. –Road Accidents in India Issues & Dimensions” , Ministry of Road Transport & Highways Government of India (www.unescap.org/sites/default/files/2.12.India_.pdf)
2. –Road Safety in India- Insights and analysis”, http://indiatransportportal.com/wp-content/uploads/2012/11/Road_safety_2012.pdf
3. Road User's Handbook, ROADS & MARITIME PUBLICATIONS
4. –Improving Road Safety in Developing Countries”, The national Academic Press

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210250: Audit Course 1
AC1-II: Humanities and Social Sciences

Objective of Humanities and Social Science (HSS) is to produce well-rounded engineers, not only having good technological skills but also with the ability to interact with different organs of an organization.

HSS is concerned with society and the relationships among individuals within a society. It in turn has many branches, each of which is considered a "social science". The main social sciences include economics, political science, human geography, demography and sociology. In a wider sense, social science also includes some fields in the humanities such as anthropology, archaeology, psychology, history, law and linguistics.

Course Objectives:

- Human and social development;
- Contemporary national and international affairs;
- Emergence of Indian society and Economics

Course Outcomes:

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

- Making engineering and technology students aware of the various issues concerning man and society.
- These issues will help to sensitize students to be broader towards the social, cultural, economic and human issues, involved in social changes
- Able to understand the nature of the individual and the relationship between the self and the community
- Understanding major ideas, values, beliefs, and experiences that have shaped human history and cultures

Course Contents

- 1. Indian Society :** Structure of Indian Society, Indian Social Demography– Social and Cultural, Differentiations: caste, class, gender and tribe; Institutions of marriage, family and kinship- Secularization –Social Movements and Regionalism- Panchayatraj Institutions; Indian constitution; Affirmative Action Programme of the Government- various reservations and commissions.
- 2. Social Development:** Scientific approach to the study of human beings. Evolution of human kind, social change and evolution. Industrial revolution. National policy on education, health and health care and human development.

3. **Sectoral Development: Agriculture:** Technology changes, Green revolutions, Employment Rural & Urban, Government Schemes. Industrial Development: Strategies, Public & Private Sectors, Categories, infrastructure, transport & communication, Consumer Awareness.
4. **Environment & Ecology:** Ecosystems: Structure, Working, components. Pollution: Water & Air Pollution, Global Warming, Control Strategies, International Treaties. Energy Sources: Renewable & Non Renewable, Hydro power, Biomass, Ocean, Geothermal & Tidal. Global Environmental Issues: Population Growth, Soil Degradation, Loss of Biodiversity.

References:

1. Krugman, —International Economics”, Pearson Education, ISBN-13:000-01334-23646
2. Prakash, —The Indian Economy”, Pearson Education, ISBN-8131758931
3. Thursen Gerald, —Engineering Economics”, Prentice Hall, ISBN-10:0138221227
4. C.S. Rao, —Environmental Pollution Control Engineering”, New Age International Pvt. Ltd, ISBN-812241835X
5. Rangarajan, —Environmental Issues in India, Pearson Education”, ISBN-10:8131708101
6. University of Delhi, —The Individual & Society”, Pearson Education. ISBN-8131704173
7. Wikipedia.org / wiki /social studies.
8. M. N. Srinivas, —Social change in modern India, 1991”, Orient Longman, ISBN-10:812500422X
9. David Mandelbaum, —Society in India”, 1990, Popular, ISBN-10:8171540139
10. David Newman, —Exploring the architecture of everyday life”, Pine Forge Press, 7th edition, ISBN-10:1452275947

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210250: Audit Course 1
AC1-III: Environmental Studies

Environmental studies are the field that examines this relationship between people and the environment. An environmental study is an interdisciplinary subject examining the interplay between the social, legal, management, and scientific aspects of environmental issues.

Course Objectives:

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures.
- Understand and realize the multi-disciplinary nature of the environment, its components, and inter-relationship between man and environment
- Understand the relevance and importance of the natural resources in the sustenance of life on earth and living standard

Course Outcomes:

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

- Comprehend the importance of ecosystem and biodiversity
- To correlate the human population growth and its trend to the environmental degradation and develop the awareness about his/her role towards environmental protection and prevention
- Identify different types of environmental pollution and control measures
- To correlate the exploitation and utilization of conventional and non-conventional resources

Course Contents:

- 1. Natural Resources:** Introduction, Renewable and non-renewable, Forest, water, mineral, food, energy and land resources, Individual and conservation of resources, Equitable use of resources.
- 2. Ecosystems:** Concept, Structure, Function, Energy flow, Ecological succession, Forest, grassland, desert and aquatic ecosystems - Introduction, characteristic features, structure and function.
- 3. Biodiversity:** Genetic, Species and ecological diversity, Biogeographical classification of India, Value and hot spots, Biodiversity at global, national and local levels, India as mega-biodiversity nation, Threats to biodiversity, Endangered and endemic species of India, Conservation of Biodiversity, Endangered and endemic species, Conservation of biodiversity.
- 4. Pollution:** Definition, Causes, effects and control measures of the pollution – Air, soil, Noise, Water, Marine and Thermal and Nuclear Pollution, Solid waste management, Role of Individual in Prevention of Pollution, Pollution case studies, Disaster management

References:

1. Bharucha, E., –Textbook of Environmental Studies”, Universities Press (2005), ISBN-10:8173715408
2. Mahua Basu, —Environmental Studies”, Cambridge University Press, ISBN-978-1-107-5317-3

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210250: Audit Course 1
AC1-IV: Smart Cities

We breathe in a world defined by urbanization and digital ubiquity, where mobile broadband connections outnumber fixed ones, machines dominate a new "internet of things," and more people live in cities than in the countryside. This course enables us to take a broad historical look at the forces that have shaped the planning and design of cities and information technologies from the rise of the great industrial cities of the nineteenth century to the present. This course considers the motivations, aspirations, and shortcomings of them all while offering a new civics to guide our efforts as we build the future together, one click at a time.

Course Objectives:

- To identify urban problems
- To study Effective and feasible ways to coordinate urban technologies.
- To study models and methods for effective implementation of Smart Cities.
- To study new technologies for Communication and Dissemination.
- To study new forms of Urban Governance and Organization.

Course Outcomes:

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

- Better understanding of the dynamic behavior of the urban system by going beyond the physical appearance and by focusing on representations, properties and impact factors
- Exploration of the city as the most complex human-made organism with a metabolism that can be modeled in terms of stocks and flows
- Knowledge about data-informed approaches for the development of the future city, based on crowd sourcing and sensing
- Knowledge about the latest research results in for the development and management of future cities
- Understanding how citizens can benefit from data-informed design to develop smart and responsive cities

Course Contents:

Urbanization and Ubiquity - The slow emergence of learning cities in an urbanizing world
 Cities as collective learners, what do we know?- Framing a view -A gamut of learning types -
 Secrets of knowing and accelerating change - Why some cities learn and others do not.

References:

1. Anthony M. Townsend, W. W. Norton & Company –Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia”, ISBN: 0393082873, 9780393082876.
2. Tim Campbell, Routledge –Beyond Smart Cities: How Cities Network, Learn and Innovate”, Routledge, ISBN: 9781849714266.
3. Stan Geertman, Joseph Ferreira, Jr. Robert Goodspeed, John Stillwell, –Planning Support System ms and Smart Cities”, Lecture notes in Geo information and Cartography, Springer.

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210250: Audit Course 1
AC1-V: Foreign Language- Japanese (Module 1)

About course:

With changing times, the competitiveness has gotten into the nerves and 'Being the Best' at all times is only the proof of it. Nonetheless, 'being the best' differs significantly from 'Communicating the best'. The best can merely be communicated whilst using the best suited Language!

Japanese is the new trend of 21st century. Not only youngsters but even the professionals seek value in it. It is the engineer's companion in current times with an assertion of a thriving future. Pune has indisputably grown to become a major center of Japanese Education in India while increasing the precedence for Japanese connoisseurs.

Japanese certainly serves a great platform to unlock a notoriously tough market & find a booming career. While the companies prefer candidates having the knowledge of the language, it can additionally help connect better with the native people thus prospering in their professional journey. Learning Japanese gives an extra edge to the 'resume' since the recruiters consciously make note of the fact it requires real perseverance and self-discipline to tackle one of the most complex languages.

It would be easy for all time to quit the impossible; however it takes immense courage to reiterate the desired outcomes, recognize that improvement is an ongoing process and ultimately soldier on it. The need of an hour is to introduce Japanese language with utmost professionalism to create awareness about the bright prospects and to enhance the proficiency and commitment. It will then prove to be the ultimate path to the quest for professional excellence!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcomes:

On completion of the course student

- will have ability of basic communication.
- will have the knowledge of Japanese script.
- will get introduced to reading , writing and listening skills
- will develop interest to pursue professional Japanese Language course.

Course Contents:

- 1 : Introduction to Japanese Language. Hiragana basic Script, colors, Days of the week
- 2 : Hiragana : modified Kana, double consonant, Letters combined with ya, yu, yo
Long vowels, Greetings and expressions
- 3 : Self Introduction, Introducing other person, Numbers, Months, Dates, Telephone numbers, Stating one's age.

References:

1. Minna No Nihongo, "Japanese for Everyone", Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.
2. <http://www.tcs.com> (http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx)

SEMESTER II

Savitribai Phule Pune University Second Year of Computer Engineering/IT (2015 Course) 207003: Engineering Mathematics III		
Teaching Scheme: TH: 04 Hours/Week TUT: 01 Hour/Week	Credit 05	Examination Scheme: In-Sem(online): 50 Marks End-Sem(paper): 50 Marks TW: 25 Marks
Prerequisites: Differential and Integral Calculus, Taylor series and Infinite series, Differential equations of first order and first degree, Fourier series, Measures of Central tendency and dispersion, Vector algebra, Algebra of complex numbers.		
Course Objectives: After completing this course, student will have adequate mathematical background, conceptual clarity, computational skills and algorithm design for problem solving related to: - Linear differential equations of higher order applicable to Control systems, Computer vision and Robotics. - Transform techniques such as Fourier transform, Z-transform and applications to Image processing. - Statistical methods such as correlation, regression analysis and probability theory to analyze data and to make predictions applicable to machine intelligence. - Vector calculus necessary to analyze and design complex electrical and electronic devices as appropriate to Computer engineering. - Complex functions, conformal mappings and contour integration applicable to Image processing, Digital filters and Computer graphics.		
Course Outcomes: On completion of the course, student will be able to– - Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits. - Solve problems related to Fourier transform, Z-Transform and applications to Signal and Image processing. - Apply statistical methods like correlation, regression analysis and probability theory for analysis and prediction of a given data as applied to machine intelligence. - Perform vector differentiation and integration to analyze the vector fields and apply to compute line, surface and volume integrals. - Analyze conformal mappings, transformations and perform contour integration of complex functions required in Image processing, Digital filters and Computer graphics.		
Course Contents		
Unit I	Linear Differential Equations (LDE) and Applications	09 Hours
LDE of n^{th} order with constant coefficients, Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous & Symmetric simultaneous DE. Modeling of Electrical circuits.		
Unit II	Transforms	09 Hours
Fourier Transform (FT): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine and Cosine transforms and their inverses, Discrete Fourier Transform.		
Z - Transform (ZT): Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.		

Unit III	Statistics	09 Hours
Measures of central tendency, Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting: fitting of straight line, parabola and related curves, Correlation and Regression, Reliability of Regression Estimates.		
Unit IV	Probability and Probability Distributions	09 Hours
Probability, Theorems on Probability, Bayes Theorem, Random variables, Mathematical Expectation, Probability density function, Probability distributions: Binomial, Poisson, Normal and Hypergeometric, Test of Hypothesis: Chi-Square test, t-distribution.		
Unit V	Vector Calculus	09 Hours
Vector differentiation, Gradient, Divergence and Curl, Directional derivative, Solenoid and Irrigational fields, Vector identities. Line, Surface and Volume integrals, Green's Lemma, Gauss's Divergence theorem and Stoke's theorem.		
Unit VI	Complex Variables	09 Hours
Functions of Complex variables, Analytic functions, Cauchy-Riemann equations, Conformal mapping, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula, Laurent's series, and Residue theorem.		
Books:		
Text:		
1. Erwin Kreyszig, –Advanced Engineering Mathematics”. 9e, Wiley India, ISBN - 10: 9780470458365, 13: 978-0470458365. 2. Peter V. O'Neil, –Advanced Engineering Mathematics”, 7e, Cengage Learning, ISBN - 10: 1111427410.		
References:		
1. M. D. Greenberg, –Advanced Engineering Mathematics”, 2e, Pearson Education, ISBN: 10: 0133214311, 13: 978-0133214314. 2. Wylie C.R. & Barrett L.C., –Advanced Engineering Mathematics”, McGraw-Hill, Inc., ISBN: 0-07-072188-2. 3. B. S. Grewal, –Higher Engineering Mathematics”, Khanna Publication, Delhi, ISBN : 92 803-11026 4. P. N. Wartikar & J. N. Wartikar,” Applied Mathematics”, Vidyarthi Griha Prakashan, Pune, ISBN: 0-7923-0594-9. 5. B.V. Ramana, –Higher Engineering Mathematics”, Tata McGraw-Hill, ISBN: 007063419X. 6. Thomas L. Harman, Dabney and Norman Richert, –Advanced Engineering Mathematics with MATLAB”, 2e, Thomson Learning, ISBN: 13: 978-0534371647		
Guidelines for Tutorial and Term Work:		
• Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division • Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests		

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) 210251: Computer Graphics		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem(online): 50 Marks End-Sem(paper): 50 Marks
Prerequisite: • Data Structures and algorithms • Basic Mathematics, Geometry, linear algebra, vectors and matrices.		
Course Objectives: • To acquaint the learner with the basic concepts of Computer Graphics • To learn the various algorithms for generating and rendering graphical figures • To get familiar with mathematics behind the graphical transformations • To understand and apply various methods and techniques regarding projections, animation, shading, illumination and lighting		
Course Outcomes: On completion of the course, student will be able to– • Apply mathematics and logic to develop Computer programs for elementary graphic operations • Develop scientific and strategic approach to solve complex problems in the domain of Computer Graphics • Develop the competency to understand the concepts related to Computer Vision and Virtual reality • Apply the logic to develop animation and gaming programs		
Course Contents		
Unit I	Graphics Primitives and Scan Conversion	09 Hours
Concepts, applications of computer graphics, pixel, frame buffer, resolution, aspect ratio. Plotting Primitives: Scan conversions, lines, line segments, vectors, pixels and frame buffers, vector generation Scan Conversion: Line and line segments, qualities of good line drawing algorithms, line drawing algorithms: Digital Differential Analyzer (DDA), Bresenham and parallel line algorithms, Line styles: thick, dotted and dashed. Circle drawing algorithm: DDA, Bresenham. Character generating methods: stroke and bitmap method. Display Files: display file structure, algorithms and display file interpreter. Primitive operations on display file.		
Unit II	Polygons and Clipping Algorithms	09 Hours
Introduction to polygon, types: convex, concave and complex. Representation of polygon, Inside test, polygon filling algorithms – flood fill, seed fill, scan line fill and filling with patterns. Windowing and clipping: viewing transformations, 2-D clipping: Cohen – Sutherland algorithm, Polygon clipping: Sutherland Hodgeman algorithm, generalized clipping.		

Unit III	2-D, 3-D Transformations and Projections	09 Hours
2-D transformations: introduction, matrices, Translation, scaling, rotation, homogeneous coordinates and matrix representation, translation, coordinate transformation, rotation about an arbitrary point, inverse and shear transformation. 3-D transformations: introduction, 3-D geometry, primitives, 3-D transformations and matrix representation, rotation about an arbitrary axis, 3-D viewing transformations, 3-D Clipping Projections : Parallel (Oblique: Cavalier, Cabinet and orthographic: isometric, diametric, trimetric) and Perspective (Vanishing Points – 1 point, 2 point and 3 point)		
Unit IV	Segment and Animation	09 Hours
Segment: Introduction, Segment table, Segment creation, closing, deleting and renaming, Visibility. Animation: Introduction, Design of animation sequences, Animation languages, Key-frame, Morphing, Motion specification. Colour models and applications: Properties of Light, CIE chromaticity Diagram, RGB, HSV, CMY, YIQ, colour Selection and applications.		
Unit V	Shading, and Hidden Surfaces	09 Hours
Illumination Models: Light Sources, Ambient Light, Diffuse reflection, Specular Reflection, and the Phong model, Combined diffuse and Specular reflections with multiple light sources, warn model, Shading Algorithms: Halftone, Gauraud and Phong Shading. Hidden Surfaces Introduction, Back face detection and removal, Algorithms: Depth buffer (z), Depth sorts (Painter), Area subdivision (Warnock), BSP tree, and Scan line.		
Unit VI	Curves and Fractals	09 Hours
Curves: Introduction, Interpolation and Approximation, Blending function, B-Spline curve, Bezier curve, Fractals: Introduction, Classification, Applications, Fractal generation: snowflake, Triadic curve, Hilbert curve. Gaming: Introduction, Gaming platform (NVIDIA, i8060 etc.), Advances in Gaming, Graphics Tools: Introduction, Interactive graphics tool: OpenGL		
Books:		
Text:		
1. S. Harrington, —Computer Graphics”, 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0 – 07 – 100472 – 6. 2. D. Rogers, —Procedural Elements for Computer Graphics”, 2nd Edition, Tata McGraw-Hill Publication, 2001, ISBN 0 – 07 – 047371 – 4. 3. Donald D. Hearn, —Computer Graphics with Open GL”, 4th Edition, ISBN-13: 9780136053583.		
References:		
1. J. Foley, V. Dam, S. Feiner, J. Hughes, —Computer Graphics Principles and Practice”, 2nd Edition, Pearson Education, 2003, ISBN 81 – 7808 – 038 – 9. 2. D. Rogers, J. Adams, —Mathematical Elements for Computer Graphics”, 2nd Edition, Tata McGrawHill Publication, 2002, ISBN 0 – 07 – 048677 – 8. 3. Mario Zechner, Robert Green, —Beginning Android 4 Games Development”, Apress, ISBN: 978-81- 322-0575-3.		

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) 210252: Advanced Data Structures		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem(online): 50 Marks End-Sem(paper): 50 Marks
Prerequisite: - Data Structures and algorithms - Basic Mathematics, Geometry, linear algebra, vectors and matrices.		
Course Objectives: - To develop a logic for graphical modelling of the real life problems. - To suggest appropriate data structure and algorithm for graphical solutions of the problems. - To understand advanced data structures to solve complex problems in various domains. - To operate on the various structured data - To build the logic to use appropriate data structure in logical and computational solutions. - To understand various algorithmic strategies to approach the problem solution.		
Course Outcomes: On completion of the course, student will be able to– - To apply appropriate advanced data structure and efficient algorithms to approach the problems of various domain. - To design the algorithms to solve the programming problems. - To use effective and efficient data structures in solving various Computer Engineering domain problems. - To analyze the algorithmic solutions for resource requirements and optimization - To use appropriate modern tools to understand and analyze the functionalities confined to the data structure usage.		
Course Contents		
Unit I	Trees	09 Hours
Tree- basic terminology, General tree and its representation, representation using sequential and linked organization, Binary tree- properties, converting tree to binary tree, binary tree traversals- inorder, preorder, post order, level wise -depth first and breadth first, Operations on binary tree. Binary Search Tree (BST), BST operations, Threaded binary tree- concepts, threading, insertion and deletion of nodes in in-order threaded binary tree, in order traversal of in-order threaded binary tree. Case Study- Use of binary tree in expression tree-evaluation and Huffman's coding		
Unit II	Graphs	09 Hours
Basic Concepts, Storage representation, Adjacency matrix, adjacency list, adjacency multi list, inverse adjacency list. Traversals-depth first and breadth first, Introduction to Greedy Strategy, Minimum spanning Tree, Greedy algorithms for computing minimum spanning tree- Prims and Kruskal Algorithms, Dijkstra's Single source shortest path, Topological ordering. Case study- Data structure used in Webgraph and Google map.		

Unit III	Hashing	09 Hours
Hash Table- Concepts-hash table, hash function, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, issues in hashing, hash functions- properties of good hash function, division, multiplication, extraction, mid-square, folding and universal, Collision resolution strategies- open addressing and chaining, Hash table overflow- open addressing and chaining, extendible hashing. Dictionary- Dictionary as ADT, ordered dictionaries. Skip List- representation, searching and operations- insertion, removal.		
Unit IV	Search Trees	09 Hours
Symbol Table- Representation of Symbol Tables- Static tree table and Dynamic tree table, Introduction to Dynamic Programming, Weight balanced tree, Optimal Binary Search Tree (OBST), OBST as an example of Dynamic Programming, Height Balanced Tree- AVL tree.		
Unit V	Indexing and Multiway Trees	09 Hours
Indexing and Multiway Trees- Indexing, indexing techniques, Types of search tree- Multiway search tree, B-Tree, B+Tree, Trie Tree, Splay Tree, Red-Black Tree, K-dimensional tree, AA tree. Set- Set ADT, realization of Set and operations. Heap- Basic concepts, realization of heap and operations, Heap as a priority queue, heap sort		
Unit VI	File Organization	09 Hours
Sequential file organization- concept and primitive operations, Direct Access File- Concepts and Primitive operations, Indexed sequential file organization- concept, types of indices, structure of index sequential file, Linked Organization- multi list files, coral rings, inverted files and cellular partitions. External Sort- Consequential processing and merging two lists, multiday merging- a k way merge algorithm.		
Books:		
Text:		
1. Horowitz, Sahani, Dinesh Mehata, –Fundamentals of Data Structures in C++”, Galgotia Publisher, ISBN: 8175152788, 9788175152786. 2. M Folk, B Zoellick, G. Riccardi, –File Structures”, Pearson Education, ISBN:81-7758-37-5 3. Peter Brass, –Advanced Data Structures”, Cambridge University Press, ISBN: 978-1-107-43982-5		
References:		
1. A. Aho, J. Hopcroft, J. Ulman, –Data Structures and Algorithms”, Pearson Education, 1998, ISBN-0-201-43578-0. 2. Michael J Folk, –File Structures an Object Oriented Approach with C++”, Pearson Education, ISBN: 81-7758-373-5. 3. Sartaj Sahani, –Data Structures, Algorithms and Applications in C++”, Second Edition, University Press, ISBN:81-7371522 X. 4. G A V Pai, –Data Structures and Algorithms”, The McGraw-Hill Companies, ISBN - 9780070667266. 5. Goodrich, Tamassia, Goldwasser, –Data Structures and Algorithms in Java”, Wiley Publication, ISBN: 9788126551903.		

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) 210253: Microprocessor		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem(online): 50 Marks End-Sem(paper): 50 Marks
Prerequisite: Digital Electronics and Logic Design		
Course Objectives: - To learn the architecture and programmer's model of advanced processor - To understand the system level features and processes of advanced processor - To acquaint the learner with application instruction set and logic to build assembly language programs. - To understand debugging and testing techniques confined to 80386 DX		
Course Outcomes: On completion of the course, student will be able to– - To apply the assembly language programming to develop small real life embedded application. - To understand the architecture of the advanced processor thoroughly to use the resources for programming - To understand the higher processor architectures descended from 80386 architecture		
Course Contents		
Unit I	80386DX- Basic Programming Model and Applications Instruction Set	09 Hours
Memory Organization and Segmentation- Global Descriptor Table, Local Descriptor Table, Interrupt Descriptor Table, Data Types, Registers, Instruction Format, Operand Selection, Interrupts and Exceptions Applications Instruction Set- Data Movement Instructions, Binary Arithmetic Instructions, Decimal Arithmetic Instructions, Logical Instructions, Control Transfer Instructions, String and Character Transfer Instructions, Instructions for Block Structured Language, Flag Control Instructions, Coprocessor Interface Instructions, Segment Register Instructions, Miscellaneous Instructions.		
Unit II	Systems Architecture and Memory Management	09 Hours
Systems Architecture- Systems Registers, Systems Instructions. Memory Management- Segment Translation, Page Translation, Combining Segment and Page Translation.		
Unit III	Protection and Multitasking	09 Hours
Protection- Need of Protection, Overview of 80386DX Protection Mechanisms, Segment Level Protection, Page Level Protection, Combining Segment and Page Level Protection. Multitasking- Task State Segment, TSS Descriptor, Task Register, Task Gate Descriptor, Task Switching, Task Linking, Task Address Space.		

Unit IV	Input-Output, Exceptions and Interrupts	09 Hours
Input-Output- I/O Addressing, I/O Instructions, Protection and I/O Exceptions and Interrupts- Identifying Interrupts, Enabling and Disabling Interrupts, Priority among Simultaneous Interrupts and Exceptions, Interrupt Descriptor Table (IDT), IDT Descriptors, Interrupt Tasks and Interrupt Procedures, Error Code, and Exception Conditions.		
Unit V	Initialization of 80386DX, Debugging and Virtual 8086 Mode	09 Hours
Initialization- Processor State after Reset, Software Initialization for Real Address Mode, Switching to Protected Mode, Software Initialization for Protected Mode, Initialization Example, TLB Testing Debugging- Debugging Features of the Architecture, Debug Registers, Debug Exceptions, Breakpoint Exception Virtual 8086 Mode- Executing 8086 Code, Structure of V86 Stack, Entering and Leaving Virtual 8086 Mode.		
Unit VI	80386DX Signals, Bus Cycles and 80387 Coprocessor	09 Hours
80386DX Signals- Signal Diagram, Description of Signals 80386DX Bus Cycles- System Clock, Bus States, Pipelined and Non-pipelined Bus Cycles. 80387 NDP- Control Register bits for Coprocessor support, 80387 Register Stack, Data Types, Load and Store Instructions, Trigonometric and Transcendental Instructions, Interfacing signals of 80386DX with 80387.		
Books:		
Text:		
1. Intel 80386 Programmer's Reference Manual 1986, Intel Corporation, Order no.: 231630-011, December 1995. 2. James Turley, –Advanced 80386 Programming Techniques”, McGraw-Hill, ISBN: 10: 0078813425, 13: 978-0078813429. 3. Intel 387DX Math coprocessor, Order no.: 240448-005, March1992.		
References:		
1. Chris H. Pappas, William H. Murray, –80386 Microprocessor Handbooks”, McGraw-Hill Osborne Media, ISBN-10: 0078812429, 13: 978-0078812422. 2. Walter A. Triebel, –The 80386Dx Microprocessor: Hardware”, Software, and Interfacing, Pearson Education, ISBN: 0137877307, 9780137877300. 3. Brey, Barry B, –8086/8088, 80286, 80386 and 80486 Assembly Language Programming”, Prentice Hall, ISBN: 13: 9780023142475. 4. Mohammad Rafiquzzaman, –Microprocessors: Theory and Applications: Intel and Motorola", Prentice Hall, ISBN:-10:0966498011, 13:978:0966498011. 5. K. Bhurchandi, A. Ray, –Advanced Microprocessors and Peripherals”, McGraw Hill Education, Third Edition, ISBN: 978-1-25-900613-5. 6. Introduction to 64 bit Intel Assembly Language Programming for Linux, 2nd Edition, Ray Seyfarth, ISBN10: 1478119209, ISBN-13: 9781478119203, 2012. 7. Assembly Language Step-by-step: Programming with Linux, 3rd Edition, Jeff Duntemann, Wiley ISBN:-10 0470497025, ISBN-13: 978-0470497029, 2009.		

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) 210254: Principles of Programming Languages		
Teaching Scheme: TH: 03 Hours/Week	Credit TH: 03	Examination Scheme: In-Sem(online): 50 Marks End-Sem(paper): 50 Marks
Prerequisite: Data Structures & Algorithms and Object Oriented Programming		
Course Objectives: • To learn principles of programming language • To understand structural, computational and logical implications regarding programming languages • To explore main programming paradigms • To understand and apply Object Oriented Programming (OOP) principles using C++ and Java		
Course Outcomes: On completion of the course, student will be able to– • To analyze the strengths and weaknesses of programming languages for effective and efficient program development. • To inculcate the principles underlying the programming languages enabling to learn new programming languages. • To grasp different programming paradigms • To use the programming paradigms effectively in application development.		
Course Contents		
Unit I	Programming Language Syntax and semantics	07 Hours
Software development process, language and software development environments, language and software design methods, languages and computer architecture, programming language qualities, languages and reliability, languages and maintainability, languages and efficiency, a brief historical perspective and early high level languages, a bird's eye view of programming language concepts. Syntax and semantics -language definition, syntax, abstract syntax, concrete syntax, and pragmatics, semantics, an introduction to formal semantics, languages, language processing, interpretation, translation, the concept of binding, variables, name and scope, Type, l-value, r-value, reference and unnamed variables, routines, generic routines, aliasing and overloading, an abstract semantic processor, run time structure. Case study- run time structure of C.		
Unit II	Structuring the Data, Computations and Program	07 Hours
Structuring of Data - Built in and primitive types, Data aggregates and type constructors, Cartesian product, Finite mapping User-defined types and abstract data types, Type systems, Static versus dynamic program checking, Strong typing and type checking, Type compatibility, Type conversions, Types and subtypes, Generic types, monomorphic versus polymorphic type systems, Case Study- The type structure of C++, Java. Structuring of Computations - Structuring the computation, Expressions and statements, Conditional execution and iteration, Routines, Style issues: side effects and aliasing, Exceptions, Case Study-Exception handling in C++.		
Unit III	Structuring of Program	07 Hours

Structuring of Program-

Software design method, Concepts in support of modularity, Encapsulation, Interface and implementation, Separate and independent compilation, Libraries of modules, Language features for programming in the large, Program organization, Grouping of units, Encapsulation, Interface and implementation, Abstract data types, classes, and modules, Generic units, Generic data structures, Generic algorithms, Generic modules, Higher levels of genericity.

Programming paradigms- Introduction to programming paradigms, Introduction to four main Programming paradigms- procedural, object oriented, functional, and logic & rule based.

Study of Java as Object oriented programming language.

Unit IV	Java as Object Oriented Programming Language-Overview	07 Hours
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Java History, Java Features, Java and Internet, Java and Word Wide Web, Web Browsers, Java Virtual Machine, **Data Types and Size** (Signed vs. Unsigned, User Defined vs. Primitive Data Types, Explicit Pointer type) **Arrays:** one dimensional array, multi-dimensional array, alternative array declaration statements. **Control Statements** Revision of identical selection Statements in brief (if, else if, Nested if, Switch, Nested Switch), Iterative Statements For Each version of For Loop, Declaring Loop Control Variables Inside the for loop, Using comma in for loop), Jump Statements (Labeled Break and Labeled Continue), **String Handling:** String class methods.

Unit V	Inheritance, Polymorphism, Encapsulation using Java	07 Hours
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Classes and Methods: class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize() method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable-length arguments. **Inheritances:** member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class. **Packages and Interfaces:** defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator.

Unit VI	Exception Handling in Java	07 Hours
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fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally, multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception sub classes). **Managing I/O:** Streams, Byte Streams and Character Streams, Predefined Streams, Reading console Input, Writing Console Output, Print Writer class, **Applet:** Applet Fundamental, Applet Architecture, Applet Skeleton, Requesting Repainting, status window, HTML Applet tag, passing parameters to Applets, Difference between Applet and Application Program.

Books:**Text:**

1. Carlo Ghezzi, Mehdi Jazayeri, "Programming Language Concepts", 3rd Ed, Wiley Publication ISBN : 978-81-265-1861-6.
2. Herbert Schildt, "The Complete Reference Java", 9th Ed, TMH, ISBN: 978-0-07-180856-9.

References:

1. Sebesta R., "Concepts of Programming Languages", 4th Edition, Pearson Education, ISBN-81-7808-161-X.
2. Deugo, "Java Gems", Cambridge University Press, ISBN 10: 0521648246 ISBN 13: 9780521648240
3. T. W. Pratt, M. V. Zelkowitz, "Programming Languages Design and Implementation", 4th Ed, PHI, ISBN 81-203-2035-2.

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) 210255: Computer Graphics Lab		
Lab Scheme: PR: 02 Hours/Week	Credit 01	Examination Scheme: TW: 25 Marks PR: 50 Marks
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, algorithm, flowchart, test cases, conclusion/analysis. <u>Program codes with sample output of all performed assignments are to be submitted as softcopy.</u> 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. <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 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. Encourage students for the use of industry coding standards such as appropriate use of Hungarian notation, Indentation and comments. <u>Use Display file where ever suitable.</u>		

Use of open source software is 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.

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

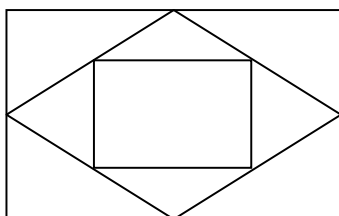
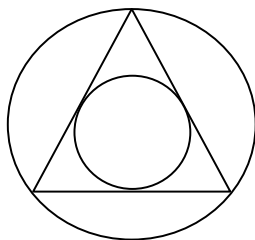
Programming tools recommended: - Open Source C++ Programming tool like G++/GCC.

Set of suggested assignment list is provided in groups- A, B, and C. Instructor is suggested to design lab assignments list by selecting/designing **12** suitable assignments- any 5 of group A, 5 from group B, **2** from group C (assignment number 26 is mandatory).

Suggested List of Laboratory Assignments

Group A

1.	Write C++/Java program to draw line using DDA and Bresenham's algorithm. Inherit pixel class and Use function overloading.
2.	Write C++/Java program to draw circle using Bresenham's algorithm. Inherit pixel class.
3.	Write C++/Java program to draw 2-D object and perform following basic transformations, a) Scaling b) Translation c) Rotation Use operator overloading.
4.	Write C++/Java program to fill polygon using scan line algorithm. Use mouse interfacing to draw polygon.
5.	A Mandelbrot Set is a set of complex number z that does not diverge under the transformation $x_{n+1} = x_n^2 + z$ with $x_0 = 0$. Where, both x and z represent the complex numbers. Write C++/Java program to a). Plot the Mandelbrot set for the threshold $ x = 2$. b) Plot Julia set choosing $z \neq 0$. Use 254 colors for plotting in both cases.
6.	Write C++/Java program to draw the polygons by using the mouse. Choose colors by clicking on the designed color pane. Use window port to draw. Use DDA algorithm for line drawing.
7.	Write C++/Java program to draw inscribed and Circumscribed circles in the triangle as shown as an example below. (Use any Circle drawing and Line drawing algorithms)
8.	Write C++/Java program to draw the following pattern using any Line drawing algorithms.



9.	Write C++/Java program to draw a 4X4 chessboard rotated 45° with the horizontal axis. Use Bresenham algorithm to draw all the lines. Use seed fill algorithm to fill black squares of the rotated chessboard.
Group B	
10.	Write C++/Java program for line drawing using DDA or Bresenham's algorithm with patterns such as solid, dotted, dashed, dash dot and thick.
11.	Write C++/Java program to draw a convex polygon and fill it with desired color using Seed fill algorithm. Use mouse interfacing to draw polygon.
12.	Write C++/Java program to draw a concave polygon and fill it with desired pattern using scan line algorithm. Use mouse interfacing to draw polygon.
13.	Write C++/Java program to implement Cohen-Sutherland line clipping algorithm for given window. Draw line using mouse interfacing to draw polygon
14.	Write C++/Java program to draw any object such as flower, waves using any curve generation techniques
15.	Write C++/Java program to implement Painter's algorithm for hidden surface removal
16.	Write C++/Java program to implement reflection of 2-D object about X axis, Y axis and about X=Y axis. Also rotate object about arbitrary point given by user.
17.	Write C++/Java program to generate Hilbert curve using concept of fractals.
18.	Write C++/Java program to generate snowflake using concept of fractals.
19.	Write C++/Java program to generate Bouncing ball animation using Direct3D/Maya/Blender
20.	Write program to implement Cohen Sutherland Hodgman algorithm to clip any polygon. Provide the vertices of the polygon to be clipped and pattern of clipping interactively.
21.	Write C++/Java program to implement translation, shear, rotation and scaling transformations on equilateral triangle and rhombus.
Group C	
22.	Write C++/Java program to draw 3-D cube and perform following transformations on it using OpenGL. a) Scaling b) Translation c) Rotation about one axis
23.	Design and simulate any data structure like stack, queue, and trees using graphics. Simulation should include all operations performed on designed data structure. Implement the same using OpenGL.
24.	Write C++/Java program to draw implement Cube rotation about vertical axis passing through its centroid.
25.	Write C++/Java program to generate fractal patterns by using Koch curves.
26.	Write C++/Java program to simulate any one of or similar scene- • Clock with pendulum • National Flag hoisting • Vehicle/boat locomotion • Water drop falling into the water and generated waves after impact • Kaleidoscope views generation (at least 3 colorful patterns)
Mini Project (Optional)- Design and implement game / animation clip / Graphics Editor using open source graphics library.	

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210256: Advanced Data Structures Lab

Lab Scheme: PR: 04 Hours/Week	Credit 02	Examination Scheme: TW: 50 Marks PR: 50 Marks
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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, algorithm, flowchart, 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, Indentation and comments. Use of open source software is 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 assignment list is provided in six groups. Each student must perform at least 13 assignments as at least 02 from group A, 02 from group B, 2 from group C, 2 from group D, 01 from group E, 01 from group F and 3 from group G.

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

Programming tools recommended: Open Source C++ Programming tool like G++/GCC

Suggested List of Laboratory Assignments

Write C++/Java program for following-

Group A

- | | |
|----|--|
| 1. | A book consists of chapters, chapters consist of sections and sections consist of subsections. Construct a tree and print the nodes. Find the time and space requirements of your method. |
| 2 | Beginning with an empty binary search tree, Construct binary search tree by inserting the values in the order given. After constructing a binary tree - <ol style="list-style-type: none"> i. Insert new node ii. Find number of nodes in longest path iii. Minimum data value found in the tree iv. Change a tree so that the roles of the left and right pointers are swapped at every node v. Search a value |
| 3 | For given expression eg. $a-b*c-d/e+f$ construct inorder sequence and traverse it using postorder traversal(non recursive). |
| 4 | Read for the formulas in propositional calculus. Write a function that reads such a formula and creates its binary tree representation. What is the complexity of your function? |
| 5 | Given binary tree with n nodes, assign this tree to another [operator=] and then erase all nodes in a binary tree. |
| 6 | Convert given binary tree into threaded binary tree. Analyze time and space complexity of the algorithm. |
| 7 | Consider threading a binary tree using preorder threads rather than inorder threads. Design an algorithm for traversal without using stack and analyze its complexity. |
| 8 | A Dictionary stores keywords & its meanings. Provide facility for adding new keywords, deleting keywords, updating values of any entry. Provide facility to display whole data sorted in ascending/ Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Binary Search Tree for implementation. |

Group B

9	Write a function to get the number of vertices in an undirected graph and its edges. You may assume that no edge is input twice. i. Use adjacency list representation of the graph and find runtime of the function ii. Use adjacency matrix representation of the graph and find runtime of the function
10	There are flight paths between cities. If there is a flight between city A and city B then there is an edge between the cities. The cost of the edge can be the time that flight takes to reach city B from A, or the amount of fuel used for the journey. Represent this as a graph. The node can be represented by airport name or name of the city. Use adjacency list representation of the graph or use adjacency matrix representation of the graph. Justify the storage representation used.
11	You have a business with several offices; you want to lease phone lines to connect them up with each other; and the phone company charges different amounts of money to connect different pairs of cities. You want a set of lines that connects all your offices with a minimum total cost. Solve the problem by suggesting appropriate data structures.
12	Tour operator organizes guided bus trips across the Maharashtra. Tourists may have different preferences. Tour operator offers a choice from many different routes. Every day the bus moves from starting city S to another city F as chosen by client. On this way, the tourists can see the sights alongside the route travelled from S to F. Client may have preference to choose route. There is a restriction on the routes that the tourists may choose from, the bus has to take a short route from S to F or a route having one distance unit longer than the minimal distance. Two routes from S to F are considered different if there is at least one road from a city A to a city B which is part of one route, but not of the other route.
13	Consider the scheduling problem. n tasks to be scheduled on single processor. Let $t_1, \dots, t_n$ be durations required to execute on single processor is known. The tasks can be executed in any order but one task at a time. Design a greedy algorithm for this problem and find a schedule that minimizes the total time spent by all the tasks in the system. (The time spent by one is the sum of the waiting time of task and the time spent on its execution.)
Group C	
14	Consider telephone book database of N clients. Make use of a hash table implementation to quickly look up client's telephone number.
15	Implement all the functions of a dictionary (ADT) using hashing. Data: Set of (key, value) pairs, Keys are mapped to values, Keys must be comparable, Keys must be unique Standard Operations: Insert(key, value), Find(key), Delete(key)
16	For given set of elements create skip list. Find the element in the set that is closest to some given value.
17	The symbol table is generated by compiler. From this perspective, the symbol table is a set of name-attribute pairs. In a symbol table for a compiler, the name is an identifier, and the attributes might include an initial value and a list of lines that use the identifier. Perform the following operations on symbol table: (1) Determine if a particular name is in the table (2) Retrieve the attributes of that name (3) Modify the attributes of that name (4) Insert a new name and its attributes (5) Delete a name and its attributes
Group D	

18	Given sequence $k = k_1 < k_2 < \dots < k_n$ of n sorted keys, with a search probability p_i for each key k_i . Build the Binary search tree that has the least search cost given the access probability for each key.
19	A Dictionary stores keywords & its meanings. Provide facility for adding new keywords, deleting keywords, updating values of any entry. Provide facility to display whole data sorted in ascending/ Descending order. Also find how many maximum comparisons may require for finding any keyword. Use Height balance tree and find the complexity for finding a keyword
Group E	
20	To create ADT that implements the SET concept. a. Add (newElement) -Place a value into the set b. Remove (element) Remove the value c. Contains (element) Return true if element is in collection d. Size () Return number of values in collection Iterator () Return an iterator used to loop over collection e. Intersection of two sets, f. Union of two sets, g. Difference between two sets, h. Subset
21	Read the marks obtained by students of second year in an online examination of particular subject. Find out maximum and minimum marks obtained in that subject. Use heap data structure. Analyze the algorithm.
Group F	
22	Assume we have two input and two output tapes to perform the sorting. The internal memory can hold and sort m records at a time. Write a program in java for external sorting. Find out time complexity.
23	Department maintains a student information. The file contains roll number, name, division and address. Allow user to add, delete information of student. Display information of particular employee. If record of student does not exist an appropriate message is displayed. If it is, then the system displays the student details. Use sequential file to main the data.
24	Company maintains employee information as employee ID, name, designation and salary. Allow user to add, delete information of employee. Display information of particular employee. If employee does not exist an appropriate message is displayed. If it is, then the system displays the employee details. Use index sequential file to maintain the data.
Group G	
25	Implement the Heap/Shell sort algorithm implemented in Java demonstrating heap/shell data structure with modularity of programming language.
26	Any application defining scope of Formal parameter, Global parameter, Local parameter accessing mechanism and also relevance to private, public and protected access. Write a Java program which demonstrates the scope rules of the programming mechanism.
27	Write a Java program which will demonstrate a concept of Interfaces and packages: In this assignment design and use of customized interfaces and packages for a specific application are expected.
28	Write a Java program which will demonstrate a concept of cohesion and coupling of the various modules in the program.
29	Write a program on template and exception handling in Java: in this assignment multiple templates are to be designed as a pattern and these patterns to be used to take decisions.
30	Write a Java program for the implementation of different data structures using JAVA collection libraries (Standard toolkit library): at least 5 data structures are used to design a suitable application.
31	Design a mini project using JAVA which will use the different data structure with or without Java collection library and show the use of specific data structure on the efficiency (performance) of the code.

Savitribai Phule Pune University Second Year of Computer Engineering (2015 Course) 210257: Microprocessor Lab		
Teaching Scheme: PR: 04 Hours/Week	Credit 02	Examination Scheme: TW: 25 Marks PR: 50 Marks
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), University syllabus, conduction & Assessment guidelines, topics under consideration concept objectives, outcomes, set of typical applications/assignments/ guidelines, and references.		
Guidelines for Student's Lab Journal The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and 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, instructions/features used, test cases, conclusion/analysis and references). 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 Lab /TW Assessment Continuous assessment of laboratory work is 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. <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 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. Use of open source software is 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.

Operating System: Latest 64-bit Version and update of Microsoft Windows 7/ Windows 8 Operating System onwards or 64-bit Open source Linux or its derivative.

Programming Tools: Preferably using Linux equivalent or MASM 64x or equivalent, Microsoft Visual Studio x64 Intrinsic.

Suggested List of Laboratory Assignments (Any 12)

1.	Write X86/64 ALP to count number of positive and negative numbers from the array
2.	Write X86/64 ALP to perform non-overlapped and overlapped block transfer (with and without string specific instructions). Block containing data can be defined in the data segment.
3.	Write X86/64 ALP to convert 4-digit Hex number into its equivalent BCD number and 5-digit BCD number into its equivalent HEX number. Make your program user friendly to accept the choice from user for: (a) HEX to BCD b) BCD to HEX (c) EXIT. Display proper strings to prompt the user while accepting the input and displaying the result. (wherever necessary, use 64-bit registers)
4.	Write X86/64 ALP to perform multiplication of two 8-bit hexadecimal numbers. Use successive addition and add and shift method. (use of 64-bit registers is expected)
5.	Write X86 ALP to find, a) Number of Blank spaces b) Number of lines c) Occurrence of a particular character. Accept the data from the text file. The text file has to be accessed during Program_1 execution and write FAR PROCEDURES in Program_2 for the rest of the processing. Use of PUBLIC and EXTERN directives is mandatory.
6.	Write X86/64 ALP to switch from real mode to protected mode and display the values of GDTR, LDTR, IDTR, TR and MSW Registers.
7.	Write X86 program to sort the list of integers in ascending/descending order. Read the input from the text file and write the sorted data back to the same text file using bubble sort
8.	Write X86 menu driven Assembly Language Program (ALP) to implement OS (DOS) commands TYPE, COPY and DELETE using file operations. User is supposed to provide command line arguments in all cases.
9.	Write x86 ALP to find the factorial of a given integer number on a command line by using recursion. Explicit stack manipulation is expected in the code.
10.	Write 80387 ALP to find the roots of the quadratic equation. All the possible cases must be considered in calculating the roots.
11.	Write 80387 ALP to plot Sine Wave, Cosine Wave and Sinc function. Access video memory directly for plotting.
12.	Write 80387 ALP to obtain: i) Mean ii) Variance iii) Standard Deviation Also plot the histogram for the data set. The data elements are available in a text file.
13.	Write a Terminate but Stay Resident (TSR) program for a key-logger. The key-presses during the stipulated time need to be displayed at the center of the screen. <u>OR</u> Write a TSR to generate the pattern of the frequency tones by reading the Real Time Clock (RTC). The duration of the each tone is solely decided by the programmer.
14.	Write 80386 ALP to implement multitasking. Where each task is supposed to change the color of the text displayed at the center of the screen

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210258: Audit Course 2

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)

- Lectures/ Guest Lectures
- Visits (Social/Field) and reports
- Demonstrations

- Surveys
- Mini Project
- Hands on experience on specific focused topic

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

- Written Test
- Demonstrations/ Practical Test
- Presentations

- IPR/Publication
- Report

Audit Course 2 Options

Audit Course Code	Audit Course Title
AC2-I	Water Management
AC2-II	Intellectual Property Rights and Patents
AC2-III	The Science of Happiness
AC2-IV	Stress Relief: Yoga and Meditation
AC2-V	Foreign Language (one of Japanese/Spanish/French/German) <u>Course contents for Japanese(Module 2) are provided. For other languages institute may design suitably.</u>

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210258: Audit Course 2
AC2-I: Water Management

Water is a vital resource for all life on the planet. Only three percent of the water resources on Earth are fresh and two-thirds of the freshwater is locked up in ice caps and glaciers. One fifth of the remaining one percent is in remote, inaccessible areas. As time advances, water is becoming scarcer and having access to clean, safe, drinking water is limited among countries. Pure water supply and disinfected water treatment are prerequisites for the well-being of communities all over the world. One of the biggest concerns for our water-based resources in the future is the sustainability of the current and even future water resource allocation. This course will provide students a unique opportunity to study water management activities like planning, developing, distributing and optimum use of water resources. This course covers the topics that management of water treatment of drinking water, industrial water, sewage or wastewater, management of water resources, management of flood protection.

Course Objectives:

- To develop understanding of water resources.
- To study global water cycle and factors that affect this cycle.
- To analyze the process for water resources and management.
- To study the research and development areas necessary for efficient utilization and management of water resources.

Course Outcomes:

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

- Understanding of the global water cycle and its various processes
- Understanding of climate change and their effects on water systems
- Understanding of Drinking treatment and quality of groundwater and surface water
- Understanding of the Physical, chemical, and biological processes involved in water treatment and distribution.

Course Contents:

1. Understanding _water'-Climate change and the global water cycle, Understanding global hydrology
2. Water resources planning and management-Water law and the search for sustainability: a comparative analysis, Risk and uncertainty in water resources planning and management
3. Agricultural water use -The role of research and development for agriculture water use
4. Urban water supply and management - The urban water challenge, Water sensitive urban design

References:

1. R. Quentin Graft, Karen Hussey, Quentin Graft, Karen Hussey, Publisher, "Water Resources Planning and Management", Cambridge University Press, ISBN: 9780511974304, 9780521762588.
2. P. C. Basil, "Water Management in India", ISBN: 8180690970, 2004.
3. C.A. Brebbia, "Water Resources Management", ISBN: 978-1-84564-960-9

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AC2-II: Intellectual Property Rights and Patents

Intellectual property is the area of law that deals with protecting the rights of those who create original works. It covers everything from original plays and novels to inventions and company identification marks. The purpose of intellectual property laws is to encourage new technologies, artistic expressions and inventions while promoting economic growth.

Innovation and originality have great potential value. Whatever line of activity you are engaged in, future success depends on them. The last few years have seen intellectual property rights become an issue of general interest: the smart phone “patent wars”, the introduction of Digital Rights management (DRM) and the rise of generic pharmaceuticals and open-source software are just some examples that have been in the public eye. Protecting your intellectual rights appropriately should be a top priority. Yet too many people embark on their chosen professions without even a basic awareness of intellectual property.

Course Objectives:

- To encourage research, scholarship, and a spirit of inquiry
- To encourage students at all levels to develop patentable technologies.
- To provide environment to the students of the Institute for creation, protection, and commercialization of intellectual property and to stimulate innovation.

Course Outcomes:

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

- Understand the fundamental legal principles related to confidential information, copyright, patents, designs, trademarks and unfair competition
- Identify, apply and assess principles of law relating to each of these areas of intellectual property
- Apply the appropriate ownership rules to intellectual property you have been involved in creating

Course Contents:

- **Introduction to Intellectual Property Law** – The Evolutionary Past - The IPR Tool Kit- Para -Legal Tasks in Intellectual Property Law
- **Introduction to Trade mark** – Trade mark Registration Process – Post registration Procedures – Trade mark maintenance - Transfer of Rights – Inter partes Proceeding – Infringement - Dilution Ownership of Trade mark
- **Introduction to Copyrights** – Principles of Copyright Principles -The subjects Matter of Copy right – The Rights Afforded by Copyright Law – Copy right Ownership, Transfer and duration – Right to prepare Derivative works
- **Introduction to Trade Secret** – Maintaining Trade Secret – Physical Security – Employee Limitation - Employee confidentiality agreement

References:

1. Debirag E. Bouchoux: “Intellectual Property”. Cengage learning ISBN-10:1111648573
2. Ferrera, Bird, Darrow, “Cyber Law. Texts & Cases”, South- ISBN:0-324-39972-3
3. Prabhuddha Ganguli: “Intellectual Property Rights” TMH, ISBN-10:0070077177

Savitribai Phule Pune University
Second Year of Computer Engineering (2015 Course)
210258: Audit Course 2
AC2-III : The Science of Happiness

Everybody wants to be happy. One can explore innumerable ideas about what happiness is and how we can get some. But not many of those ideas are based on science. That's where this course comes in. The subject "Science of Happiness" aims to teach the pioneering science of positive psychology, which explores the ancestry of a happy and meaningful life. Clinical psychologists have been dealing with miserable feelings since their discipline was established. In the last 30 years, neuroscientists have made major headway in the understanding of the sources of anger, depression, and fear.

Today, whole industries profit from this knowledge—producing pills for every sort of pathological mood disturbance. But until recently, few neuroscientists focused on the subject of happiness. This course focuses on discovering how cutting-edge research can be applied to their lives. Students will learn about the Intra-disciplinary research supporting this view, spanning the fields of psychology, neuroscience, evolutionary biology, and beyond. The course offers students practical strategies for tapping into and nurturing their own happiness, including trying several research-backed activities that foster social and emotional well-being, and exploring how their own happiness changes along the way.

Course Objectives:

- To understand the feeling of happiness
- To study the sources of positive feelings
- To analyze the anatomy of the happiness system
- To study the effect of thoughts and emotions on the happiness system

Course Outcomes:

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

- Ability to understand what happiness is and why it matters to you
- Ability to learn how to increase your own happiness
- Understanding of the power of social connections and the science of empathy
- Ability to understand what is mindfulness and its real world applications

Course Contents:

- | | |
|--------------------------------------|---|
| 1. Happiness: what is it? | 2. The secret of smiling |
| 3. The autonomy of positive feelings | 4. Positive feelings as a compass |
| 5. The happiness system | 6. Foundations: Emotions, Motivation and nature of Well being |
| 7. Subjective well being | 8. Love and well being |
| 9. Optimal well being | 10. Religion, Spirituality and well being |

References:

1. Happier, Stefan Klein , "The Science of Happiness, How Our Brains Make Us Happy and what We Can Do to Get", Da Capo Press, ISBN 10: 156924328X, 13: 978-1569243282.
2. C. Compton, Edward Hoffman, "Positive Psychology: The Science of Happiness and Flourishing", William, Cengage Learning, 2012, ISBN10: 1111834121.

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Second Year of Computer Engineering (2015 Course)
210258: Audit Course 2

AC2-IV: Stress Relief: Yoga and Meditation

The concepts and practices of Yoga originated in India about several thousand years ago. Its founders were great Saints and Sages. The great Yogis presented rational interpretation of their experiences of Yoga and brought about a practical and scientifically sound method within every one's reach. Yoga today, is no longer restricted to hermits, saints, and sages; it has entered into our everyday lives and has aroused a worldwide awakening and acceptance in the last few decades. The science of Yoga and its techniques have now been reoriented to suit modern sociological needs and lifestyles.

Yoga is one of the six systems of Vedic philosophy. The Yoga advocates certain restraints and observances, physical discipline, breathe regulations, restraining the sense organs, contemplation, meditation and Samadhi. The practice of Yoga prevents psychosomatic disorders and improves an individual's resistance and ability to endure stressful situations.

Course Objectives:

- To impart knowledge about the basic technique and practice of yoga, including instruction in breath control, meditation, and physical postures
- To gain an intellectual and theoretical understanding of the principles embodied in the Yoga Sutras, the Bhagavad-Gita, and other important texts and doctrines
- Relaxation and stress reduction ,Personal insight and self understanding, Personal empowerment, Gaining wisdom and spiritual discernment
- Awakening the abilities or powers of the Super conscious mind

Course Outcomes:

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

- Students understanding of philosophy and religion as well as daily life issues will be challenged and enhanced.
- Enhances the immune system.
- Intellectual and philosophical understanding of the theory of yoga and basic related Hindu scriptures will be developed.
- Powers of concentration, focus, and awareness will be heightened.

Course Contents:

1. Meaning and definition of yoga – Scope of Yoga - Aims and Objectives of Yoga – Misconception about yoga.
2. Ayurveda: an introduction to this system of health care derived from the Vedic tradition
Anatomy and Physiology as they relate to Yoga
3. Yoga Philosophy and Psychology

References:

1. B.K.S. Iyengar, –BKS Iyengar Yoga The Path to Holistic Health”, DK publisher, ISBN-13: 978-1409343479
2. Osho, –The Essence of Yoga”, Osho International Foundation, ISBN: 9780918963093

Savitribai Phule Pune University, Pune
Second Year of Computer Engineering (2015 Course)
210258: Audit Course 2
AC2-V: Foreign Language (Japanese) Module 2

With changing times, the competitiveness has gotten into the nerves and ‘_Bāng the Best’ at all times is only the proof of it. Nonetheless, ‘_bāng the best’ differs significantly from ‘_Communicating the best’. The best can merely be communicated whilst using the best suited Language!!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcomes:

On completion of the course student-

- will have ability of basic communication.
- will have the knowledge of Japanese script.
- will get introduced to reading, writing and listening skills for language Japanese.
- will develop interest to pursue professional Japanese Language course.

Course Contents:

- Katakana basic Script, Denoting things (nominal & prenominal demonstratives), Purchasing at the Market / in a shop / mall (asking & stating price)
- Katakana : Modified kana, double consonant, letters with ya, yu, yo, Long vowels, Describing time, describing starting & finishing time (kara ~ made), Point in time (denoting the time when any action or the movement occurs)
- Means of transport (Vehicles), Places, Countries, Stating Birth date, Indicating movement to a certain place by a vehicle

References:

1. Minna No Nihongo, “Japanese for Everyone”, (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.
2. <http://www.tcs.com> (http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx)

Faculty of Engineering

Savitribai Phule Pune University, Pune



Syllabus

for

Third Year of Computer Engineering (2015 Course)

(With effect from 2017-18)

It is with great pleasure and honor that I share the syllabi for Third 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.

While revising syllabus, honest and sincere efforts are put to tune Computer Engineering program syllabus in tandem with the objectives of Higher Education of India, AICTE, UGC and affiliated University (SPPU) by keeping an eye on the technological advancements and industrial requirements globally.

Syllabus revision is materialized with sincere efforts, active participation, expert opinions and suggestions from domain professionals. Sincere efforts have been put by members of BOS, teachers, alumni, industry experts in framing the draft with guidelines and recommendations.

For better perception and appropriate applicability the case Studies are included in majority of courses. Course instructor is recommended to discuss appropriate related recent technology/upgrade/Case Studies to encourage students to study from course to the scenario and think through the largest issues/ recent trends/ utility/ developing real world/ professional skills.

I am sincerely indebted to all the minds and hands who work adroitly to materialize this task.

Thanks

Dr. Varsha H. Patil

Coordinator, Board of Studies (Computer Engineering), SPPU, Pune

Tuesday, March 28, 2017

[This document contents Program Educational Objectives - Program Outcomes- Program Specific Outcomes (page 3), Courses (teaching scheme, examination, marks and credit) (page 4-5), Courses syllabi (page 6-62), all four year courses (page 63), Course-Credit share (page 64)]

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.

Semester I												
Course Code	Course	Teaching Scheme Hours / Week			Examination Scheme and Marks						Credit	
		Theory	Tutorial	Practical	In-Sem	End-Sem	TW	PR	OR	Total	TH/TUT	PR
310241	Theory of Computation	03	--	--	30	70	--	--	--	100	03	--
310242	Database Management Systems (DBMS)	03	--	--	30	70	--	--	--	100	03	--
310243	Software Engineering & Project Management	03	--	--	30	70	--	--	--	100	03	--
310244	Information Systems & Engineering Economics	03	--	--	30	70	--	--	--	100	03	--
310245	Computer Networks (CN)	04	--	--	30	70	--	--	--	100	04	--
310246	Skills Development Lab	--	02	04	--	--	50	--	50	100	02	02
310247	DBMS Lab	--	--	04	--	--	25	50	--	75	--	02
310248	CN Lab	--	--	02	--	--	25	50	--	75	--	01
Total Credit											18	05
Total		16	02	10	150	350	100	100	50	750	23	
310249	Audit Course 3										Grade	

310249-Audit Course 3 (AC3) Options:

AC3-I: Cyber Security

AC3-II: Professional Ethics and Etiquettes

AC3-III: Emotional Intelligence

AC3-IV: MOOC- Learn New Skills

AC3-V: Foreign Language (Japanese- Module 3)

Abbreviations:

TW: Term Work **TH:** Theory **OR:** Oral **TUT:** Tutorial **PR:** Practical **Sem:** Semester

Semester II												
Course Code	Course	Teaching Scheme Hours / Week			Examination Scheme and Marks						Credit	
		Theory	Tutorial	Practical	In-Sem	End-Sem	TW	PR	OR	Total	TH/TUT	PR
310250	Design & Analysis of Algorithms	04	--	--	30	70	--	--	--	100	04	
310251	Systems Programming & Operating System (SP & OS)	04	--	--	30	70	--	--	--	100	04	--
310252	Embedded Systems & Internet of Things (ES & IoT)	04	--	--	30	70	--	--	--	100	04	--
310253	Software Modeling and Design	03	--	--	30	70	--	--	--	100	03	--
310254	Web Technology	03	--	--	30	70	--	--	--	100	03	--
310255	Seminar & Technical Communication	--	01	--	--	--	50	--	--	50	01	--
310256	Web Technology Lab	--	--	02	--	--	25	50	--	75	--	01
310257	SP & OS Lab	--	--	04	--	--	25	50	--	75	--	02
310258	ES & IoT Lab	--	--	02	--	--	50	--	--	50	--	01
Total Credit											19	04
Total		18	01	08	150	350	150	100	--	750	23	
310259	Audit Course 4										Grade	

310259-Audit Course 4(AC4) Options:

AC4-I: Digital and Social Media Marketing

AC4-II: Green Computing

AC4-III: Sustainable Energy Systems

AC4-IV: Leadership and Personality Development

AC4-V: Foreign Language (Japanese- Module 4)

Abbreviations:

TW: Term Work **TH:** Theory **OR:** Oral **TUT:** Tutorial **PR:** Practical **Sem:** Semester

SEMESTER I

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: Discrete Mathematics (210241), Principles of Programming Languages (210254)		
Course Objectives: • To Study abstract computing models • To learn Grammar and Turing Machine • To learn about the theory of computability and complexity.		
Course Outcomes: On completion of the course, student will be able to— • Able to design deterministic Turing machine for all inputs and all outputs • Able to subdivide problem space based on input subdivision using constraints • Able to apply linguistic theory		
Course Contents		
Unit I	Formal Language Theory and Finite Automata	08 Hours
Introduction to Formal language, introduction to language translation logic, Essentials of translation, Alphabets and languages, Finite representation of language, Finite Automata (FA): An Informal Picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language, Deterministic and Nondeterministic FA(DFA and NFA), epsilon- NFA, FA with output: Moore and Mealy machines -Definition, models, inter-conversion. Case Study: FSM for vending machine, spell checker		
Unit II	Regular Expressions (RE)	07 Hours
Operators of RE, Building RE, Precedence of operators, Algebraic laws for RE, Conversions: NFA to DFA, RE to DFA Conversions: RE to DFA, DFA to RE Conversions: State/loop elimination, Arden's theorem Properties of Regular Languages: Pumping Lemma for Regular languages, Closure and Decision properties. Case Study: RE in text search and replace		
Unit III	Context Free Grammars (CFG) and Languages	08 Hours
Introduction, Regular Grammar, Context Free Grammar- Definition, Derivation, Language of grammar, sentential form, parse tree, inference, derivation, parse trees, ambiguity in grammar and Language- ambiguous Grammar, Simplification of CFG: Eliminating unit productions, useless production, useless symbols, and ϵ -productions, Normal Forms- Chomsky normal form, Greibach normal form, Closure properties of CFL, Decision properties of CFL, Chomsky Hierarchy, Application of CFG: Parser, Markup languages, XML and Document Type Definitions. Case Study- CFG for Palindromes, Parenthesis Match,		
Unit IV	Turing Machines (TM)	08 Hours

Machines, The Model of Linear Bounded Automata , TM & Type 0 grammars, TM's Halting Problem.

Unit V	Pushdown Automata(PDA)	07 Hours
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Basic Definitions, Equivalence of Acceptance by Finite State & Empty stack, PDA & Context Free Language, Equivalence of PDA and CFG, Parsing & PDA: Top-Down Parsing, Top-down Parsing Using Deterministic PDA, Bottom-up Parsing, Closure properties and Deterministic PDA.

Unit VI	Undecidability & Intractable Problems	07 Hours
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A Language that is not recursively enumerable, An un-decidable problem that is RE, Post Correspondence Problem, The Classes P and NP : Problems Solvable in Polynomial Time, An Example: Kruskal's Algorithm, Nondeterministic Polynomial Time, An NP Example: The Traveling Salesman Problem, Polynomial-Time Reductions NP Complete Problems, An NP-Complete Problem: The Satisfiability Problem, Tractable and Intractable Representing SAT Instances, NP Completeness of the SAT Problem, A Restricted Satisfiability Problem: Normal Forms for Boolean Expressions, Converting Expressions to CNF, The Problem of Independent Sets, The Node-Cover Problem.

Books:

Text:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, –Introduction to Automata Theory Languages and Computation”, Addison-Wesley, ISBN 0-201-44124-1.
2. H.L. Lewis, Christos H. Papadimitriou, –Elements of the Theory of Computation”, Prentice Hall, ISBN-10: 0132624788; ISBN-13: 978-0132624787

References:

1. John Martin, –Introduction to Languages of The Theory of Computation”, 2nd Edition, Mc Graw Hill Education, ISBN-13: 978-1-25-900558-9, ISBN-10: 1-25-900558-5
2. Sanjeev Arora and Boaz Barak, –Computational Complexity: A Modern Approach”, Cambridge University Press, ISBN:0521424267 9780521424264
3. Daniel Cohen, –Introduction to Computer Theory”, Wiley & Sons, ISBN 9788126513345
4. J. Carroll & D Long, –Theory of Finite Automata”, Prentice Hall, ISBN 0-13-913708-4
5. Kavi Mahesh, –Theory of Computation : A Problem-Solving Approach”, Wiley India, ISBN10 8126533110
6. Michael Sipser, –Introduction to the Theory of Computation”, Cengage Learning, ISBN-13: 9781133187813
7. Vivek Kulkarni –Theory of Computation”, Oxford University Press, ISBN 0-19-808458

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks
Prerequisites Courses : Discrete Mathematics (210241), Data Structures (210243 & 210252)		
Companion Course: Database Management System Lab (310247)		
Course Objectives : - To understand the fundamental concepts of database management. These concepts include aspects of database design, database languages, and database-system implementation - To provide a strong formal foundation in database concepts, technology and practice - To give systematic database design approaches covering conceptual design, logical design and an overview of physical design - Be familiar with the basic issues of transaction processing and concurrency control - To learn and understand various Database Architectures and Applications - To learn a powerful, flexible and scalable general purpose database to handle big data		
Course Outcomes : On completion of the course, student will be able to– - Design E-R Model for given requirements and convert the same into database tables. - Use database techniques such as SQL & PL/SQL. - Use modern database techniques such as NOSQL. - Explain transaction Management in relational database System. - Describe different database architecture and analyses the use of appropriate architecture in real time environment. - Students will be able to use advanced database Programming concepts Big Data – HADOOP		
Course Contents		
Unit I	Introduction	07 Hours
Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications, View of Data, Database Languages, Database System Structure, Data Models, Database Design and ER Model: Entity, Attributes, Relationships, Constraints, Keys, Design Process, Entity Relationship Model, ER Diagram, Design Issues, Extended E-R Features, converting E-R & EER diagram into tables.		
Unit II	SQL AND PL/SQL	07 Hours
SQL: Characteristics and advantages, SQL Data Types and Literals, DDL, DML, DCL, TCL, SQL Operators, Tables: Creating, Modifying, Deleting, Views: Creating, Dropping, Updating using Views, Indexes, SQL DML Queries: SELECT Query and clauses, Set Operations, Predicates and Joins, Set membership, Tuple Variables, Set comparison, Ordering of Tuples, Aggregate Functions, Nested Queries, Database Modification using SQL Insert, Update and Delete Queries. PL/SQL: concept of Stored Procedures & Functions, Cursors, Triggers, Assertions, roles and privileges, Embedded SQL, Dynamic SQL.		
Unit III	Relational Database Design	08 Hours

Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, BCNF, Modeling Temporal Data.

Unit IV	Database Transactions and Query Processing	08 Hours
Basic concept of a Transaction, Transaction Management, Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability: Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules, Concurrency Control: Need, Locking Methods, Deadlocks, Time-stamping Methods, Recovery methods : Shadow-Paging and Log-Based Recovery, Checkpoints, Query Processing, Query Optimization, Performance Tuning.		
Unit V	Parallel and Distributed Databases	07 Hours
Introduction to Database Architectures: Multi-user DBMS Architectures, Case study- Oracle Architecture. Parallel Databases: Speedup and Scale up, Architectures of Parallel Databases. Distributed Databases: Architecture of Distributed Databases, Distributed Database Design, Distributed Data Storage, Distributed Transaction: Basics, Failure modes, Commit Protocols, Concurrency Control in Distributed Database.		
Unit VI	NoSQL Database	08 Hours
Introduction to NoSQL Database, Types and examples of NoSQL Database- Key value store, document store, graph, Performance, Structured verses unstructured data, Distributed Database Model, CAP theorem and BASE Properties, Comparative study of SQL and NoSQL, NoSQL Data Models, Case Study-unstructured data from social media. Introduction to Big Data, HADOOP: HDFS, MapReduce.		
Books:		
Text:		
1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition 2. Connally T, Begg C., "Database Systems", Pearson Education, ISBN 81-7808-861-4 3. Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled", Addison Wesley, ISBN-10: 0321826620, ISBN-13: 978-0321826626		
References:		
1. C J Date, "An Introduction to Database Systems", Addison-Wesley, ISBN: 0201144719 2. S.K.Singh, "Database Systems : Concepts, Design and Application", Pearson, Education, ISBN 978-81-317-6092-5 3. Kristina Chodorow, Michael Dirolf, "MongoDB: The Definitive Guide", O'Reilly Publications, ISBN: 978-1-449-34468-9. 4. Adam Fowler, "NoSQL For Dummies", John Wiley & Sons, ISBN-1118905628 5. Kevin Roebuck, "Storing and Managing Big Data - NoSQL, HADOOP and More", Emereopt Limited, ISBN: 1743045743, 9781743045749 6. Joy A. Kreibich, "Using Sqlite", O'REILLY, ISBN: 13:978-93-5110-934-1 7. Garrett Grolemond, "Hands-on Programming with R", O'REILLY, ISBN : 13:978-93-5110-728-6		

Third Year of Computer Engineering (2015 Course)

310243: Software Engineering and Project Management

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: Fundamentals of Programming Languages (110003, 110011)

Course Objectives:

- To learn and understand the principles of Software Engineering
- To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements.
- To apply Design and Testing principles to S/W project development.
- To understand project management through life cycle of the project.
- To understand software quality attributes.

Course Outcomes:

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

- Decide on a process model for a developing a software project
- Classify software applications and Identify unique features of various domains
- Design test cases of a software system.
- Understand basics of IT Project management.
- Plan, schedule and execute a project considering the risk management.
- Apply quality attributes in software development life cycle.

Course Contents

Unit I	Introduction to Software Engineering, Software Process Models	07 Hours
Software Engineering Fundamentals: Nature of Software, Software Engineering Principles, The Software Process, Software Myths. Process Models : A Generic Process Model, Prescriptive Process Models: The Waterfall, Incremental Process(RAD), Evolutionary Process, Unified Process, Concurrent. Advanced Process Models & Tools: Agile software development: Agile methods, Plan-driven and agile development, Extreme programming Practices, Testing in XP, Pair programming. Introduction to agile tools: JIRA, Kanban, Case Studies: An information system (mental health-care system), wilderness weather system		
Unit II	Software Requirements Engineering& Analysis	08 Hours
Requirements Engineering: User and system requirements, Functional and non-functional requirements, Types & Metrics, A spiral view of the requirements engineering process. Software Requirements Specification (SRS): The software requirements Specification document, The structure of SRS, Ways of writing a SRS, structured & tabular SRS for an insulin pump case study, Requirements elicitation & Analysis: Process, Requirements validation, Requirements management. Case Studies: The information system. Case study - Mental health care patient management system (MHC-PMS).		
Unit III	Design Engineering	08 Hours
Design Process & quality, Design Concepts, The design Model, Pattern-based Software Design. Architectural Design : Design Decisions, Views, Patterns, Application Architectures, Modeling Component level Design: component, Designing class based components, conducting component-level design, User Interface Design: The golden rules, Interface Design steps & Analysis, Design Evaluation, Case Study: Web App Interface Design		

The W5HH Principle, Metrics in the Process and Project Domains, Software Measurement : size & function oriented metrics(FP & LOC), Metrics for Project and Software Quality, **Project Estimation** :Observations on Estimation, Project Planning Process, Software Scope and feasibility, Resources: Human Resources, Reusable software, Environmental Resources. Software Project Estimation, Decomposition Techniques, Empirical Estimation Models: Structure, COCOMO II, Estimation of Object-oriented Projects, Specialized Estimation **Case Study**: Software Tools for Estimation, **Project Scheduling**: Basic Concepts, Defining a Task Set for the Software Project, Defining Task Network, Scheduling with time-line charts, **Schedule tracking Tools:- Microsoft Project, Daily Activity Reporting & Tracking (DART)**

Unit V	Project Management: Risk Management, Configuration Management, Maintenance & Reengineering	07 Hours
Project Risk Management : Risk Analysis & Management: Reactive versus Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Risks Monitoring and Management, The RMMM plan for case study project Software Configuration Management: The SCM repository, SCM process, Configuration management for WebApps, Case study: CVS and Subversion Tools, Visual Source Safe from Microsoft & Clear Case. Maintenance & Reengineering: Software Maintenance, Software Supportability, Reengineering, Business Process Reengineering, Software Reengineering, Reverse Engineering, Restructuring, Forward Engineering		
Unit VI	Software Testing	07 Hours
Introduction to Software Testing, Principles of Testing, Testing Life Cycle, Phases of Testing, Types of Testing, Verification & Validation, Defect Management, Defect Life Cycle, Bug Reporting, GUI Testing, Test Management and Automation. Books: Text: 1. Roger Pressman, –Software Engineering: A Practitioner’s Approach”, McGraw Hill, ISBN 0–07–337597–7 2. Ian Sommerville, –Software Engineering”, Addison and Wesley, ISBN 0-13-703515-2 References: 1. Carlo Ghezzi, –Fundamentals of Software Engineering", Prentice Hall India, ISBN-10: 0133056996 2. Rajib Mall, –Fundamentals of Software Engineering”, Prentice Hall India, ISBN-13: 978-8120348981 3. Pankaj Jalote, –An Integrated Approach to Software Engineering”, Springer, ISBN 13: 9788173192715. 4. S K Chang, –Handbook of Software Engineering and Knowledge Engineering”, World Scientific, Vol I, II, ISBN: 978-981-02-4973-1 5. Tom Halt, –Handbook of Software Engineering”, Clanye International, ISBN-10: 1632402939		

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Course Objectives: - To prepare the students to various forms of the Information Systems and its application in organizations. - To expose the students to the managerial issues relating to information systems and help them identify and evaluate various options in Information Systems. - To Prepare engineering students to analyze cost / revenue data and should able to do economic analyses in the decision making process to justify or reject alternatives / projects on an economic basis for an organization.		
Course Outcomes: On completion of the course, student will be able to– - Understand the need, usage and importance of an Information System to an organization. - Understand the activities that are undertaken while managing, designing, planning, implementation, and deployment of computerized information system in an organization. - Further the student would be aware of various Information System solutions like ERP, CRM, Data warehouses and the issues in successful implementation of these technology solutions in any organizations - Outline the past history, present position and expected performance of a company engaged in engineering practice or in the computer industry. - Perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives. - Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.		
Course Contents		
Unit I	Basic of Management Theory & Practices	07 Hours
Role of Information Systems in Organizations, The Information System Manager and his challenges, Concepts of Information Systems, Information Systems and Management Strategy Case Studies - Information Systems in the Indian Railways, Information Systems in an e-Commerce Organization.		
Unit II	Management Information System (MIS)	08 Hours
Managing Information Systems, Ethical and Social Issues, Information Technology Infrastructure and Choices, Information Systems Security and Control, Case Studies -Information Technology Infrastructure in a Bank, Information Technology Infrastructure in a manufacturing / process industry.		

Business Process Integration and Enterprise Systems, ICT for Development and E-Governance, Case Studies - in-house or cloud based ERP implementation, UIDAI Unique Identification Authority of India.

Unit IV	Money and Economic Value	08 Hours
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Engineering Economic Decisions, Time Value of Money, Understanding Money Management, Case Studies- Economic decisions done in Multi-national companies.

Unit V	Economics and Management	07 Hours
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Equivalence Calculations under Inflation, Present-Worth Analysis, Annual-Equivalence Analysis. Case Studies -comparative analysis of software enterprises from similar domains.

Unit VI	Understanding Cash Flow and Taxes	08 Hours
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Accounting for Depreciation and Income Taxes, Project Cash-Flow Analysis, Understanding Financial Statements, Case Studies - cash flow analysis done in start-up companies.

Books:

Text:

1. Rahul De, –MIS: Management Information Systems in Business, Government and Society”, Wiley India, ISBN: 13: 978-81-265-2019-0.
2. Chan S. Park , "Fundamentals of Engineering Economics”, 3rd Edition, Pearson Education, ISBN 13: 978-02-737-7291-0

References:

1. Turban and Wali, –Information Technology on Management”, Willey India, ISBN:9788126558711
2. William G. Sullivan, Elin M. Wicks, C. Patrick Koelling, Engineering Economy, Pearson Education, ISBN13: 978-01-334-3927-4

Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: Computer Organization and Architecture (210244)		
Companion Course: Computer Network Lab (310248)		
Course Objectives: - To understand the fundamental concepts of networking standards, protocols and technologies. - To learn different techniques for framing, error control, flow control and routing. - To learn role of protocols at various layers in the protocol stacks. - To learn network programming. - To develop an understanding of modern network architectures from a design and performance perspective		
Course Outcomes: On completion of the course, student will be able to– - Analyze the requirements for a given organizational structure to select the most appropriate networking architecture, topologies, transmission mediums, and technologies - Demonstrate design issues, flow control and error control - Analyze data flow between TCP/IP model using Application, Transport and Network Layer Protocols. - Illustrate applications of Computer Network capabilities, selection and usage for various sectors of user community. - Illustrate Client-Server architectures and prototypes by the means of correct standards and technology. - Demonstrate different routing and switching algorithms		
Course Contents		
Unit I	Physical Layer	09 Hours
Introduction of LAN; MAN; WAN; PAN, Ad-hoc Network, Network Architectures: Client-Server; Peer To Peer; Distributed and SDN, OSI Model, TCP/IP Model, Topologies: Star and Hierarchical; Design issues for Layers, Transmission Mediums: CAT5, 5e, 6, OFC and Radio Spectrum, Network Devices: Bridge, Switch, Router, Brouter and Access Point, Manchester and Differential Manchester Encodings; IEEE802.11: Frequency Hopping (FHSS) and Direct Sequence (DSSS)		
Unit II	Logical Link Control	09 Hours
Design Issues: Services to Network Layer, Framing, Error Control and Flow Control. Error Control: Parity Bits, Hamming Codes (11/12-bits) and CRC. Flow Control Protocols: Unrestricted Simplex, Stop and Wait, Sliding Window Protocol, WAN Connectivity : PPP and HDLC		
Unit III	Medium Access Control	09 Hours

-On algorithm, Fast Ethernet, Gigabit Ethernet, IEEE 802.11a/b/g/n and IEEE 802.15 and IEEE 802.16 Standards, Frame formats, CSMA/CA.

Unit IV	Network Layer	09 Hours
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Switching techniques, IP Protocol, IPv4 and IPv6 addressing schemes, Subnetting, NAT, CIDR, ICMP, Routing Protocols: Distance Vector, Link State, Path Vector, Routing in Internet: RIP, OSPF, BGP, Congestion control and QoS, MPLS, Mobile IP, Routing in MANET : AODV, DSR

Unit V	Transport Layer	09 Hours
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Services, Berkley Sockets, Addressing, Connection establishment, Connection release, Flow control and buffering, Multiplexing, TCP, TCP Timer management, TCP Congestion Control, Real Time Transport protocol(RTP), Stream Control Transmission Protocol (SCTP), Quality of Service (QoS), Differentiated services, TCP and UDP for Wireless.

Unit VI	Application Layer	09 Hours
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Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), Email: SMTP, MIME, POP3, Webmail, FTP, TELNET, Dynamic Host Control Protocol (DHCP), Simple Network Management Protocol (SNMP).

Books:

Text:

1. Andrew S. Tenenbaum, –Computer Networks”, PHI, ISBN 81-203-2175-8.
2. Fourauzan B., "Data Communications and Networking", 5th Edition, Tata McGraw- Hill, Publications, ISBN: 0 – 07 – 058408 – 7

References:

1. Kurose, Ross –Computer Networking a Top Down Approach Featuring the Internet”, Pearson, ISBN-10: 0132856204
2. Matthew S. G, –802.11 Wireless Networks”, O’Reilly publications, ISBN: 81-7656-992-5
3. C. Siva Ram Murthy and B. S. Manoj, –Ad Hoc Wireless Networks: Architectures and Protocols” Prentice Hall, ISBN-10: 8131706885; ISBN-13: 978-8131706886
4. Holger Karl and Andreas Willing, –Protocols and Architectures for Wireless Sensor Networks”, Wiley India, ISBN: 9788126533695
5. Eldad Perahia, Robert Stacey, –Next Generation Wireless LANs”, Cambridge, ISBN-10: 1107016762; ISBN-13: 978-1107016767
6. Efraim Turban, Linda Volonino, Gregory R. Wood –Computer Networking a Top Down Approach Featuring the Internet”, 10th Edition, Wiley; ISBN13: 978-1-118-96126-1

Teaching Scheme:	Credit (04)	Examination Scheme:
TUT: 02 Hour/Week	Tutorial PR	TW: 50 Marks
PR: 04 Hours/Week	02 02	OR: 50 Marks

Prerequisite Courses: Fundamentals of Programming Languages (110003 and 110011), Principles of Programming Languages (210254), Data Structures and Algorithms (210243)

Course Objectives:

- To adapt the usage of modern tools and recent software.
- To evaluate problems and analyze data using current technologies
- To learn the process of creation of data-driven web applications using current technologies
- To understand how to incorporate best practices for building enterprise applications
- To learn how to employ Integrated Development Environment(IDE) for implementing and testing of software solution
- To construct software solutions by evaluating alternate architectural patterns.

Course Outcomes:

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

- Evaluate problems and analyze data using current technologies in a wide variety of business and organizational contexts.
- Create data-driven web applications
- Incorporate best practices for building applications
- Employ Integrated Development Environment(IDE) for implementing and testing of software solution
- Construct software solutions by evaluating alternate architectural patterns.

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, features of tool/framework/language used, Design, test cases, conclusion. **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.

skill learned. Team of 3 to 4 students may work on mini-project. During the assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation and software engineering approach followed. The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding, effective and efficient implementation and demonstration skills. 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.

For this laboratory total five Skill Development Modules plus one Aptitude Development Module are provided as below:

SD Module-I: Advanced JAVA and Mobile Application Development

SD Module-II: PYTHON and DATA Science with R

SD Module-III: Advanced JAVA and GROOVY on GRAILS

SD Module-IV: SCHEME and SCALA and GROOVY on GRAILS

SD Module-V: Advanced JAVA and Data Science with R

SD Module VI: Aptitude Development (To be EXCLUDED for Practical Exam)

Instructions:

Each college has to select at least one module out of five modules provided. College can select more than one module too! Set of suggested assignments is provided. Each student must perform 7 to 8 assignments and at least one mini-project provided in each module excluding Module VI. Instructor should frame set of mini projects or guide students to frame the problem statement of mini-project by sticking to technologies in respected module.

Term Work will be based on assignments be carried out by students and **Oral Examination will be based on Mini-Project demonstration and related skill learned ONLY.**

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

Programming tools recommended: - Open Source C,C++, JAVA, PYTHON, G++/GCC, R, Grails, Groovy, Android Studio for Linux.

Course Contents

SD Module-I	Advanced JAVA and Mobile Application Development	
	Theory Content for Lab	

Generics and Collection Framework: Generic Methods and Generic Classes. Interfaces (Set, List, Queue, and Dequeue) and classes (ArrayList, Vector, LinkedList, PriorityQueue, HashSet, LinkedHashSet, and TreeSet). **Serialization and Networking:** Serializing an Object and Deserializing an Object, Socket Programming. **Database Connectivity and Multithreading:** SQL, JDBC, Thread life cycle, Thread methods, Thread Pools, Executor Service. **GUI in JAVA:** AWT, Applet, Swing.

MOBILE APPLICATION DEVELOPMENT

Introduction to Android: Android Platform Architecture, Basic components of android, Features of ART and Dalvik Virtual Machine, Activity Life Cycle, Intents and Intent Filters, Resources, System Permissions, Android Application Structure, Device screen size compatibility, Android Emulator

User Interface components: Layouts, RecyclerView, ListView, GridView and WebView, Input Controls: Buttons, Checkboxes, Radio Buttons, Toggle Buttons, Spinners, Input Events, Menus, Toast, Dialogs, Styles and Themes, **Multimedia, Animation and Graphics:** Playing Audio, Playing Video, Rotate Animation, FadeIn/FadeOut Animation, Zoom Animation, Scale Animation, 2D and 3D Graphics. **Data Storage:** Shared Preferences, Internal Storage, External Storage, SQLite Databases, Content provider. and Remote Databases, **Advanced Components of Android:** Web App, JSON Parsing, Google Map, GPS, Sensors, Bluetooth/Wi-Fi Connectivity

Books:

Text:

1. Herbert Schildt, –Java: The Complete Reference”, TMG Publication, ISBN 9780070636774
2. Thomas Powell, –Java generics and collections”, O'Reilly Media, ISBN: 0596527756
3. Neil Smyth, –Android Studio 2 Development Essentials”, Payload Media, ISBN: 1532853319
4. John Horton, –Android Programming for Beginners”, ISBN 10: 1785883267 ISBN 13: 9781785883262

Reference:

1. Sharanam Shah and Vaishali Shah , –JAVA EE 7 for Beginners”, SPD, ISBN: 13:978-93-5110-349-3
2. Reto Meier, –Professional Android 4 Application Development”, Wrox, ISBN-10: 1118102274; ISBN-13: 978-1118102275
3. Greg Nudelman, –Android Design Patterns :Interaction Design Solutions for Developers”, ISBN-10: 1118394151; ISBN-13: 978-1118394151
4. Sharanam Shah, Vaishali Shah,” Core Java 8 for beginners”, THE TEAM, ISBN: 13:978-93-5213-080-1

Suggested List of Laboratory Assignments for Advanced JAVA

1.	Design a system with the help of advance data structures in Java and enhance the system using collections and generics.
2.	Enhance the above system with the help of socket programming use client server architecture.
3.	Enhance above system by using JDBC, Multithreading, concurrency, synchronous and asynchronous callbacks, ThreadPools using ExecutorService.
4.	Transform the above system from command line system to GUI based application

Suggested List of Laboratory Assignments for Mobile Application Development

1.	Download Install and Configure Android Studio on Linux/windows platform.
2.	Design a mobile app for media player.
3.	Design a mobile app to store data using internal or external storage.
4.	Design a mobile app using Google Map and GPS to trace the location.

Suggested Mini Project on Advanced JAVA and Mobile Application Development

SD Module-II	PYTHON and DATA Science with R	
	Theory Content for Lab	
PYTHON		
Python Basics: Data types, Statements and Expressions, Operators and Math's, Conditionals, Loops, Strings, List , Tuples , Set Operation, Dictionary (Dict), Date and Times. Functions, Packages and Classes: Lambda function, Regular expression, Packages, Files, Exception Handling, Classes ,Objects, Method ,class and instance variable, constructor, destructor, inheritance. Numpy and Matplotlib :Array operations, Numpy Side Effects, 2D Numpy Arrays , Numpy Basic Statistics, Universal Function, Matplotlib: Introduction, Simple plots, Line API, Legend API, Figures, Subplots, Axes and Ticks. Pandas: Look Ups, Selections and Indexing, Filling Methods, Series operation, Handling NaN values, Mapping, Data Frames, Reading Files, Plotting, Joins, Correlation, Histograms, Rolling calculation, Date Time indexing, Grouping, Aggregate Functions, pandas.IO. Data, Panel.		
DATA SCIENCE WITH R		
Introduction to Data Science- What is Data Science? Current landscape of perspectives, Skill sets needed, The Data Science Process life cycle, Role of Data Scientist. Data pre-processing. ETL – extract, transform, and load. Introduction to R-What is R? Installation of R. Basic features of R. R Objects. Creating Vectors and Matrices. Getting Data in and out of R. Using different packages related to data science. Managing Data frames and Functions. Descriptive Statistics using R - Discrete and continuous random variables, densities and distributions .Data Summarization: Measures of Central Tendency, Measures of Dispersion (quartiles, five number summary, variance, standard deviation), Measures of shape (skewness, kurtosis), Measures of association (covariance, correlation), Outliers. Using R for descriptive statistics and data visualization using ggplot2 package. Predictive Analysis using Machine Learning Techniques using R: Machine learning - what, how, where. Supervised, unsupervised and semi-supervised learning. Training, validation, testing, generalization, over fitting. Building a Regression model using R. Features and feature engineering. Using Decision trees, Linear classifiers, Naïve Bayes, Nearest neighbor methods in R packages.		
Books:		
Text: 1. Zed A. Shaw, –Learn PYTHON The Hard Way”, Pearson, ISBN: 978-93-325-8210-1 2. Kenneth A Lambert and B L Juneja, –Fundamentals of PYTHON”, CENGAGE Learning, ISBN:978-81-315-2903-4 3. Peng, Roger D and Elizabeth Matsui, –The Art of Data Science." A Guide for Anyone Who Works with Data. Skybrude Consulting 200 (2015): 162. 4. Evans, James R., and Carl H. Lindner, "Business analytics: the next frontier for decision sciences." Decision Line 43.2 (2012): 4-6.		
Reference: 1. Allen B Downey, —Think PYTHON”, O’Rielly, ISBN: 13:978-93-5023-863-9, 4th Indian Reprint 2015 2. Jiawei Han and Micheline Kamber, Morgan Kaufman, –Learning R, Richard Cotton”, O’Reilly, ISBN: 13:978-93-5110-286-1, First Edition, Fourth Indian Reprint 2015		
Suggested List of Laboratory Assignments on PYTHON		
1.	Getting Started with Python (Example Word count exercise)	
2.	Build the Hangman Game using Python.	

	cleaning. Add component on data set.
Suggested List of Laboratory Assignments on DATA Science with R	
1.	Getting Started with R installation, R objects and basic statistics.
2.	Using R for data preprocessing, exploratory analysis, visualization.
3.	Using R for correlation and regression analysis.
4.	Data analysis case study using R for readily available data set using any one machine learning algorithm
Suggested Mini Project on PYTHON and DATA Science with R	
1. Implementing a simple Recommender System based on user buying pattern. 2. Twitter Sentiment Analysis in Python 3. Applying linear regression model to a real world problem.	
SD Module-III Advanced JAVA and GROOVY on GRAILS	
	Theory Content for Lab
ADVANCED JAVA	
Data Structures in Java: Enumeration, BitSet, Vector, Stack, Dictionary, Hash table, Properties. Generics and Collection Framework: Generic Methods and Generic Classes. Interfaces (Set, List, Queue, and Dequeue) and classes (ArrayList, Vector, LinkedList, PriorityQueue, HashSet, LinkedHashSet, and TreeSet). Serialization and Networking: Serializing an Object and Deserializing an Object, Socket Programming. Database Connectivity and Multithreading: SQL, JDBC, Thread life cycle, Thread methods, Thread Pools, Executor Service. GUI in JAVA: AWT, Applet, Swing.	
GROOVY on GRAIL	
Introduction to Grails: Object Relational Mapping (GORM), Basic CRUD, Scaffolding JSON, REST API, DataSources and Environments. Web Layer: Model, View, Controllers (MVC), Redirects and Chaining, Data Binding, Groovy Server Pages, URL Mappings, Plug-in, Grails and Hibernate.	
Books:	
Text:	
1. Herbert Schildt, –Java: The Complete Reference”, TMG Publication, ISBN 9780070636774 2. Thomas Powell, –Java Generics and collections”, O'Reilly Media, ISBN: 0596527756. 3. Christopher M. Judd, Joseph Faisal Nusairat, and James Shingler, –Beginning Groovy and Grails From Novice to Professional”, Apress, ISBN-13: 978-1-4302-1045-0	
Reference:	
1. Sharanam Shah and Vaishali Shah, –JAVA EE 7 for Beginners”, SPD, ISBN: 13:978-93-5110-349-3 2. Official Website http://docs.grails.org/latest/	
Suggested List of Laboratory Assignments for Advanced JAVA	
1.	Design a system with the help of advance data structures in Java and enhance the system using collections and generics.
2.	Enhance the above system with the help of socket programming use client server architecture.
3.	Enhance above system by using JDBC, Multithreading, concurrency, synchronous and asynchronous callbacks, Thread Pools using Executor Service.
4.	Transform the above system from command line system to GUI based application

2.	Design a simple web application using Scaffolding data source for CRUD operations
3.	Design a simple web application using MySQL for CRUD operations
Suggested Mini Project on Advanced JAVA and GROOVY on GRAILS	
Design a dynamic web application system(Ex, Employee Payroll System, Student Result System)	
SD Module-IV	SCHEME and SCALA and GROOVY on GRAILS
	Theory Content for Lab
SCHEME and SCALA	
SCHEME: lambda calculus, Atoms, Lists, lambda expressions. Functions as first class objects. Control structures, Recursion and continuations, operations on objects, basic input output, Exceptions and conditions, lazy evaluation and streams. SCALA: Classes and Objects, Data Types, Control structures, composition and inheritance. Packages. Pattern matching. Collections API. Working with XML. Actors and concurrency. GUI programming in SCALA.	
GROOVY on GRAILS	
Introduction to Grails: Object Relational Mapping (GORM), Basic CRUD, Scaffolding JSON, REST API, DataSources and Environments Web Layer: Model ,View ,Controllers (MVC), Redirects and Chaining, Data Binding, Groovy Server Pages, URL Mappings, Plug-in, Grails and Hibernate	
Books:	
Text: 1. R Kent Dybvig, –the Scheme Programming Language”, MIT Press, ISBN 978-0-262-51298-5. 2. Martin Odersky, Lex Spoon, and Bill Venners, –Programming in SCALA”, Artima. ISBN :-13: 978-0-9815316-1-8. 3. Beginning Groovy and Grails From Novice to Professional, Christopher M. Judd, Joseph Faisal Nusairat, and James Shingler, Apress, ISBN-13: 978-1-4302-1045-0	
Reference: 1. Cay S Horstmann, –Scala for the Impatient”, Pearson, ISBN: 978-81-317-9605-4, 2. Scala Cookbook, Alvin Alexander, O’Reilly, SPD,ISBN: 978-93-5110-263-2 3. Jason Swartz, –Learning Scala”, O’REILLY, ISBN: 13:978-93-5213-256-0 4. Official Website http://www.groovy-lang.org/download.html 5. Official Website https://en.wikipedia.org/wiki/Scheme_(programming_language) 6. Official Website https://www.scala-lang.org/ 7. Official Website https://grails.org/	
Suggested List of Laboratory Assignments on SCHEME and SCALA	
1.	Create a recursive function in Scheme that displays the sum of n odd numbers starting from 1.
2.	Write a program to find sum and product of all the elements of a list in scheme without using built in functions.
3.	Write a SCALA Program to perform following operations on Strings: 1. Create a String Object. 2. Check String is palindrome or not. 3. Check length of String 4. Replace all <u>a</u>‘ in a string with <u>A</u>‘
4.	Develop a SCALA pattern matching programming which matches a given Person object and displays whether he is Eligible for Election or not. Use name, age and eligibility as class members.

2.	Design a simple web application using Scaffolding data source for CRUD operations
3.	Design a simple web application using MySQL for CRUD operations
Suggested Mini Project on SCHEME and SCALA and GROOVY on GRAILS	
Design a dynamic web application system Use Front End: Groovy on Grails, Back End: Scheme and Scala (Ex, Employee Payroll System, Student Result System)	
SD Module-V	Advanced JAVA and Data Science with R
	Theory Content for Lab
ADVANCED JAVA	
Data Structures in Java: Enumeration, BitSet, Vector, Stack, Dictionary, Hash table, Properties. Generics and Collection Framework: Generic Methods and Generic Classes. Interfaces (Set, List, Queue, and Dequeue) and classes (ArrayList, Vector, LinkedList, PriorityQueue, HashSet, LinkedHashSet, and TreeSet). Serialization and Networking: Serializing an Object and Deserializing an Object, Socket Programming. Database Connectivity and Multithreading: SQL, JDBC, Thread life cycle, Thread methods, Thread Pools, Executor Service. GUI in JAVA: AWT, Applet, Swing.	
DATA SCIENCE WITH R	
Introduction to Data Science- What is Data Science? Current landscape of perspectives, Skill sets needed, The Data Science Process life cycle, Role of Data Scientist. Data pre-processing. ETL – extract, transform, and load. Introduction to R- What is R? Installation of R. Basic features of R. R Objects. Creating Vectors and Matrices. Getting Data in and out of R. Using different packages related to data science. Managing Data frames and Functions. Descriptive Statistics using R - Discrete and continuous random variables, densities and distributions .Data Summarization: Measures of Central Tendency, Measures of Dispersion (quartiles, five number summary, variance, standard deviation), Measures of shape (skewness, kurtosis), Measures of association (covariance, correlation), Outliers. Using R for descriptive statistics and data visualization using ggplot2 package. Predictive Analysis using Machine Learning Techniques using R: Machine learning - what, how, where. Supervised, unsupervised and semi-supervised learning. Training, validation, testing, generalization, over fitting. Building a Regression model using R. Features and feature engineering. Using Decision trees, Linear classifiers, Naïve Bayes, Nearest neighbor methods in R packages.	
Books:	
Text:	
1. Herbert Schildt, —Java: The Complete Reference”, TMG Publication, ISBN 9780070636774 2. Thomas Powell, —Java generics and collections”, O'Reilly Media, ISBN: 0596527756, 2006. 3. Peng, Roger D., and Elizabeth Matsui. "The Art of Data Science." A Guide for Anyone Who Works with Data. Skybrude Consulting 200 (2015): 162. 4. Evans, James R., and Carl H. Lindner. "Business analytics: the next frontier for decision sciences." Decision Line 43.2 (2012): 4-6.	
Reference:	
1. JAVA EE 7 for Beginners, Sharanam Shah and Vaishali Shah, SPD, ISBN: 13:978-93-5110-349-3 2. Data Mining: Concepts and Techniques, Jiawei Han and Micheline Kamber, Morgan Kaufman, ISBN 978-81-312-0535-8 3. Learning R, Richard Cotton, O'Reilly, ISBN: 13:978-93-5110-286-1	
Suggested List of Laboratory Assignments for Advanced JAVA	
1.	Design a system with the help of advance data structures in Java and enhance the system using

3.	Enhance above system by using JDBC, Multithreading, concurrency, synchronous and asynchronous callbacks, Thread Pools using Executor Service.
4.	Transform the above system from command line system to GUI based application
Suggested List of Laboratory Assignments on Data Science with R	
1.	Getting Started with R installation, R objects and basic statistics.
2.	Using R for data preprocessing, exploratory analysis, visualization.
3.	Using R for correlation and regression analysis.
4.	Data analysis case study using R for readily available data set using any one machine learning algorithm
Suggested Mini Project on Advanced JAVA and Data Science with R	
1. Implementing a simple Recommender System based on user buying pattern. 2. Applying linear regression model to a real world problem.	
SD Module-VI	Aptitude Development
Quantitative Aptitude, Logical Reasoning and Verbal Ability	
An aptitude is a component of a competence to do a certain kind of work at a certain level. Outstanding aptitude can be considered "talent". An aptitude may be physical or mental. Aptitude is inborn potential to do certain kinds of work whether developed or undeveloped. Ability is developed knowledge, understanding, learned or acquired abilities (skills) or attitude. The innate nature of aptitude is in contrast to skills and achievement, which represent knowledge or ability that is gained through learning. (Ref: https://en.wikipedia.org/wiki/Aptitude). Aptitude and ability tests are designed to assess your logical reasoning or thinking performance. The statistics reveal that 70 percent of world's recruitment companies use aptitude test as a part of their recruitment procedure. These types of tests often permit potential companies to learn more about candidate's personality and abilities. It is well said that aptitude isn't really something one can easily improve, but surely practice can help to improve. Solving number of high level of questions will surely help to succeed while subsequent practices of solving same. Each attempt should aim to attain a level of efficiency. Practice of solving hundreds of similar questions helps to choose right approach to solve. It is recommended to conduct few expert talks and conduct practice tests for students for minimum 15 minutes per week in current semester and continue in semester VI, VII and VIII.	
Text: 1. R.S Aggarwal, –Quantitative Aptitude”, S Chand Publisher, ISBN- 9788121924986 2. Aptipedia- Aptitude Encyclopedia, Wiley, ISBN:978-81-265-6223-7 3. Shakuntala Devi, –Puzzles to Puzzle You” and –More Puzzles to Puzzle You”, Orient Paperbacks, 2005. ISBN, 8122200141, 9788122200140	

Teaching Scheme:	Credit 02	Examination Scheme: Practical: 50 Marks Term Work: 25 Marks
Companion Course: Database Management System (310242)		
Course Objectives: • To develop basic, intermediate and advanced Database programming skills • To develop basic Database administration skills • To perceive transaction processing		
Course Outcomes: On completion of the course, student will be able to– • Develop the ability to handle databases of varying complexities • Use advanced database Programming concepts		
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 <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>		
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. <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 the student's academics.		
Guidelines for Laboratory Conduction		
The instructor is expected to frame the assignments by understanding the prerequisites,		

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 assignment list is provided in groups- A and B. Each student must perform at least 13 assignments (8-Mandatory plus 4 from remaining 8 assignments) from group A , 5 from group B and 2 mini projects from Group C

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

Programming tools recommended: SQL, PL/SQL, Front End: Java/Perl/PHP/Python/Ruby/.net, Backend : Monod/MYSQL/Oracle, Database Connectivity : ODBC/JDBC

Books:

References:

1. Ivan Bayross, –SQL, PL/SQL: The Programming Language of Oracle”, BPB Publication, ISBN-10: 8176560723; ISBN-13: 978-8176560726
2. Kristina Chodorow, Michael Dirolf, –MongoDB: The Definitive Guide”, O’Reilly Publications, ISBN: 9781449381561
3. Import, Tidy, Transform,” R for Data Science”, O'REILLY, ISBN: 13:978-93-5213-497-7
4. <http://www.tutorialspoint.com/json/> & <http://docs.mongodb.org/manual/>

Suggested List of Laboratory Assignments

Group A- Database Programming Languages – SQL, PL/SQL

1.	Study of Open Source Relational Databases : MySQL
2.	Design and Develop SQL DDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence, Synonym
3.	Design at least 10 SQL queries for suitable database application using SQL DML statements: Insert, Select, Update, Delete with operators, functions, and set operator.
4.	Design at least 10 SQL queries for suitable database application using SQL DML statements: all types of Join, Sub-Query and View.
5.	Unnamed PL/SQL code block: Use of Control structure and Exception handling is mandatory. Write a PL/SQL block of code for the following requirements:- Schema: 1. Borrower(Rollin, Name, DateofIssue, NameofBook, Status) 2. Fine(Roll_no,Date,Amt) • Accept roll_no & name of book from user. • Check the number of days (from date of issue), if days are between 15 to 30 then fine amount will be Rs 5per day. • If no. of days>30, per day fine will be Rs 50 per day & for days less than 30, Rs. 5 per day. • After submitting the book, status will change from I to R. • If condition of fine is true, then details will be stored into fine table. Frame the problem statement for writing PL/SQL block inline with above statement.
6.	Cursors: (All types: Implicit, Explicit, Cursor FOR Loop, Parameterized Cursor) Write a PL/SQL block of code using parameterized Cursor, that will merge the data available in the newly created table N_RollCall with the data available in the table O_RollCall. If the data in the first table already exist in the second table then that data should be skipped. Frame the separate problem statement for writing PL/SQL block to implement all types

	Write a Stored Procedure namely proc_Grade for the categorization of student. If marks scored by students in examination is ≤ 1500 and marks ≥ 990 then student will be placed in distinction category if marks scored are between 989 and 900 category is first class, if marks 899 and 825 category is Higher Second Class Write a PL/SQL block for using procedure created with above requirement. Stud_Marks(name, total_marks) Result(Roll, Name, Class) Frame the separate problem statement for writing PL/SQL Stored Procedure and function, inline with above statement. The problem statement should clearly state the requirements.
8.	Database Trigger (All Types: Row level and Statement level triggers, Before and After Triggers). Write a database trigger on Library table. The System should keep track of the records that are being updated or deleted. The old value of updated or deleted records should be added in Library_Audit table. Frame the problem statement for writing Database Triggers of all types, in-line with above statement. The problem statement should clearly state the requirements.
Group B Large Scale Databases	
1.	Study of Open Source NOSQL Database: MongoDB (Installation, Basic CRUD operations, Execution)
2.	Design and Develop MongoDB Queries using CRUD operations. (Use CRUD operations, SAVE method, logical operators)
3.	Implement aggregation and indexing with suitable example using MongoDB.
4.	Implement Map reduces operation with suitable example using MongoDB.
5.	Design and Implement any 5 query using MongoDB
6.	Create simple objects and array objects using JSON
7.	Encode and Decode JSON Objects using Java/Perl/PHP/Python/Ruby
Group C Mini Project : Database Project Life Cycle	
1.	Write a program to implement MogoDB database connectivity with PHP/ python/Java Implement Database navigation operations (add, delete, edit etc.) using ODBC/JDBC.
2.	Implement MYSQL/Oracle database connectivity with PHP/ python/Java Implement Database navigation operations (add, delete, edit,) using ODBC/JDBC.
3.	Using the database concepts covered in Part-I & Part-II & connectivity concepts covered in Part C, students in group are expected to design and develop database application with following details: Requirement Gathering and Scope finalization Database Analysis and Design: - Design Entity Relationship Model, Relational Model, Database Normalization Implementation : - Front End : Java/Perl/PHP/Python/Ruby/.net - Backend : MongoDB/MYSQL/Oracle - Database Connectivity : ODBC/JDBC Testing : Data Validation Group of students should submit the Project Report which will be consist of documentation related to different phases of Software Development Life Cycle: Title of the Project, Abstract, Introduction, scope, Requirements, Data Modeling features, Data Dictionary, Relational Database Design, Database Normalization, Graphical User Interface, Source Code, Testing document, Conclusion. Instructor should maintain progress report of mini project throughout the semester from project group and assign marks as a part of the term work

Teaching Scheme: PR: 02 Hours/Week	Credit 01	Examination Scheme: TW: 25 Marks PR: 50 Marks
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Companion Course: 310245 Computer Networks (CN)
Course Objectives:

- To establish communication among the computing nodes in P2P and Client-Server architecture
- Configure the computing nodes with understanding of protocols and technologies.
- Use different communicating modes and standards for communication
- Use modern tools for network traffic analysis
- To learn network programming.

Course Outcomes:

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

- Demonstrate LAN and WAN protocol behavior using Modern Tools.
- Analyze data flow between peer to peer in an IP network using Application, Transport and Network Layer Protocols.
- Demonstrate basic configuration of switches and routers.
- Develop Client-Server architectures and prototypes by the means of correct standards and technology.

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, algorithm, flowchart, 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.

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 assignment list is provided in groups- A and B. Each student must perform at least 8 assignments (4-Mandatory plus 4 from remaining 8 assignments) from group A and 4 from group B (2-Mandatory plus 2 from remaining 5 assignments).

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

Programming tools recommended:- Open Source C,C++, JAVA, PYTHON,
Programming tool like G++/GCC, Wireshark, Ethereal and Packet Tracer

Books:

References:

1. Thomas D. Nadean and Ken Gray, –Software Defined Networks”, O'REILLY, ISBN: 13:978-93-5110-264-9
2. Robert Faludi, –Building Wireless Sensor Networks”, O'REILLY, ISBN: 13:978-93-5023-289-7

Suggested List of Laboratory Assignments

Group A

All assignments should be implemented using Open Source Linux flavors, Open Source Tools: Wireshark and Packet Tracer and C/C++, JAVA, PYTHON.

- | | | | | | |
|----------------------------------|--|----------------------------------|--------------------------|---------------------------|---------|
| 1. | <p>Lab Assignment on Unit I: (Mandatory Assignment)</p> <p>Part A: Setup a wired LAN using Layer 2 Switch and then IP switch of minimum four computers. It includes preparation of cable, testing of cable using line tester, configuration machine using IP addresses, testing using PING utility and demonstrate the PING packets captured traces using Wireshark Packet Analyzer Tool.</p> <p>Part B: Extend the same Assignment for Wireless using Access Point</p> | | | | |
| 2. | <p>Lab Assignment on Unit II: (Use C/C++)</p> <p>Write a Program with following four options to transfer-</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">a. Characters separated by space</td> <td style="width: 50%;">b. One Strings at a time</td> </tr> <tr> <td>c. One Sentence at a time</td> <td>d. file</td> </tr> </table> <p>between two RS 232D or USB ports using C/C++. (To demonstrate Framing, Flow control, Error control).</p> | a. Characters separated by space | b. One Strings at a time | c. One Sentence at a time | d. file |
| a. Characters separated by space | b. One Strings at a time | | | | |
| c. One Sentence at a time | d. file | | | | |

	Tool for peer to peer mode.(50% students will perform Hamming Code and others will perform CRC)
4.	Lab Assignment on Unit II: (Use JAVA/PYTHON) Write a program to simulate Go back N and Selective Repeat Modes of Sliding Window Protocol in peer to peer mode and demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
5.	Lab Assignment on Unit IV: (Use JAVA/PYTHON) Write a program to demonstrate subletting and find the subnet masks.
6.	Lab Assignment on Unit IV: (Use JAVA/PYTHON) Write a program to simulate the behavior of link state routing protocol to find suitable path for transmission.
7.	Lab Assignment on Unit V: (Mandatory Assignment) (Use C/C++) Write a program using TCP socket for wired network for following a. Say Hello to Each other (For all students) b. File transfer (For all students) c. Calculator (Arithmetic) (50% students) d. Calculator (Trigonometry) (50% students) Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
8.	Lab Assignment on Unit V: (Mandatory Assignment) (Use C/C++) Write a program using UDP Sockets to enable file transfer (Script, Text, Audio and Video one file each) between two machines. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
9.	Lab Assignment on Unit V: (Mandatory Assignment) (Use C/C++) Write a program to analyze following packet formats captured through Wireshark for wired network. 1. Ethernet 2. IP 3.TCP 4. UDP
10.	Write a program to simulate the behavior of Slow Start and AIMD (Additive Increase and Multiplicative Decrease) congestion control protocols. (Use JAVA/PYTHON)
11.	Lab Assignment on Unit VI: (Use JAVA/PYTHON) Write a program for DNS lookup. Given an IP address input, it should return URL and vice-versa.
12.	Lab Assignment on Unit VI: Installing and configure DHCP server and write a program to install the software on remote machine.
Group B	
1.	Lab Assignment on Unit II: (Use JAVA/PYTHON) Write a Program to transfer- By using Bluetooth a. Characters separated by space b. One Strings at a time c. One Sentence at a time d. File
2.	Lab Assignment on Unit IV: (Use JAVA/PYTHON) Study of any network simulation tools - To create a network with three nodes and establish a TCP connection between node 0 and node 1 such that node 0 will send TCP packet to node 2 via node 1
3.	Lab Assignment on Unit V: (Use JAVA/PYTHON) Write a program using TCP sockets for wired network to implement a. Peer to Peer Chat b. Multiuser Chat

	Write a program using UDP sockets for wired network to implement - Peer to Peer Chat - Multiuser Chat Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
5.	Lab Assignment on Unit V: (Use JAVA/PYTHON) Write a program to prepare TCP and UDP packets using header files and send the packets to destination machine in peer to peer mode. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.
6.	Lab Assignment on Unit IV and Unit V: (Mandatory Assignment) Use network simulator NS2 to implement: - Monitoring traffic for the given topology - Analysis of CSMA and Ethernet protocols - Network Routing: Shortest path routing, AODV. - Analysis of congestion control (TCP and UDP).
7.	Lab Assignment on Unit IV: (Mandatory Assignment) Configure RIP/OSPF/BGP using packet Tracer.

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

AC3- I	Cyber Security
AC3-II	Professional Ethics and Etiquettes
AC3-III	Emotional Intelligence
AC3-IV	MOOC-Learn New Skills
AC3-V	Foreign Language (one of Japanese/ Spanish/French/German). Course contents for Japanese (Module 3) are provided. For other languages institute may design suitably.

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>

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:

- To assess the current security landscape, including the nature of the threat, the general status of common vulnerabilities, and the likely consequences of security failures;
- To critique and assess the strengths and weaknesses of general cyber security models, including the CIA triad
- To appraise the interrelationships among elements that comprise a modern security system, including hardware, software, policies, and people;
- To assess how all domains of security interact to achieve effective system-wide security at the enterprise level.

Course Outcome:

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

- Compare the interrelationships among security roles and responsibilities in a modern information-driven enterprise—to include interrelationships across security domains (IT, physical, classification, personnel, and so on)
- Assess the role of strategy and policy in determining the success of information security;
- Estimate the possible consequences of misaligning enterprise strategy, security policy, and security plans;

Course Contents:

- 1. Cyber Security Basics:** Introduction, Elements of Information security, Security Policy, Techniques, Operational Model of Network Security, Terminologies in Network Security
- 2. Introduction to Cryptography:** Introduction, Encryption Methods: Symmetric, Asymmetric, Public Key and Management, Authentication methods, Digital Signatures
- 3. Security requirements:** Electronic Mail Security: Pretty Good Privacy, MIME, S/MIME, And Comparison. WEB Security, Secure Electronic Transaction(SET).
- 4. Intrusion and Firewall:** Introduction to threats, Intrusion detection, IDS: Need, Methods, Types of IDS, Password Management, Limitations and Challenges, Firewall Introduction, Characteristics and types, Benefits and limitations. Firewall architecture, Trusted Systems, Access Control
- 5. Security perspective of Hacking and its counter majors :** Introduction to Hacking, Counter majors: General Strategies

Books:

1. William Stallings, —Cryptography and Network Security”, Pearson, ISBN:978-93-325-1877-3
2. Oded Goldreich, —Foundations of Cryptography: Basic Tools”, Cambridge University Press, ISBN-10: 0521035368; ISBN-13: 978-0521035361
3. Jonathan Katz and Yehuda Lindell, —Introduction to Modern Cryptography”, CRC Book

AC3 – II: Professional Ethics and Etiquettes

Professional ethics is the underlying concept behind the successful accomplishment of any act of a professional towards achieving the individual and societal goals. These goals should ultimately result in morally, legally, ethically and even culturally acceptable good things for all. Engineers being special group of professionals need to be more conscious of their acts since their duties, rights and responsibilities permeate into the society and the surroundings. To practice professional ethics, understanding of values and concepts are essential.

Course Objectives:

- To create awareness on professional ethics and Human Values.
- To provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards.
- To inculcate knowledge and exposure on Safety and Risk.
- To expose students to right attitudinal and behavioral aspects

Course Outcome:

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

- understand the basic perception of profession, professional ethics, various moral issues & uses of ethical theories
- Understand various social issues, industrial standards, code of ethics and role of professional ethics in engineering field.
- Follow Ethics as an engineering professional and adopt good standards & norms of engineering practice.
- apply ethical principles to resolve situations that arise in their professional lives

Course Contents:

- 1. Human Values And Engineering Ethics:** Morals, values and Ethics, Integrity, Work ethic, Civic virtue , Valuing time, Cooperation, Commitment, Empathy, Self-confidence , stress management, Senses of Engineering Ethics, Kohlberg's theory, Gilligan's theory, Models of professional roles, Uses of Ethical Theories.
- 2. Research Ethics and Codes of Ethics:** Industrial standardization, ethical code and its importance, ethical accountability, law in engineering, engineering as social experimentation.
- 3. Safety, Responsibilities And Rights:** Safety and Risk, Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk collegiality, Collective Bargaining , Confidentiality , Conflicts of Interest, Professional Rights, Employee Rights, Intellectual Property Rights (IPR), Discrimination, Utilitarianism
- 4. Professional Etiquette:** Etiquette at Meetings, Public Relations Office(PRO)'s Etiquettes, Technology Etiquette Phone Etiquette, Email Etiquette, Social Media Etiquette, Video Conferencing Etiquette, Interview Etiquette, Dressing Etiquettes : for Interview, offices and social functions, Ethical Values: Importance of Work Ethics.

Books:

1. Caroline Whitbeck, –Ethics in Engineering Practice and Research”, Cambridge Press, ISBN:978-1-107-66847-8
2. Prabhuddha Ganguli: —Intellectual Property Rights| Tata Mc-Graw –Hill, New Delhi, ISBN-10:0070077177
3. Professional Ethics and Etiquette (Mastering Career Skills), Checkmark, ISBN-10: 0816071179
4. A Alavudeen, ”Professional Ethics And Human Values” Firewall, ISBN13 : 8131803066

AC3 – III: Emotional Intelligence

Prerequisite Audit Courses: Audit Course AC1-V(210250), AC2-V(210258)

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

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>

AC3 – V: Foreign Language(Japanese Module 3)**Prerequisite Courses: Audit Course AC1-V(210250), AC2-V(210258)****About Course:**

With changing times, the competitiveness has gotten into the nerves and Being the Best at all times is only the proof of it. Nonetheless, being the best differs significantly from Communicating the best. The best can merely be communicated whilst using the best suited Language!

Japanese is the new trend of 21st century. Not only youngsters but even the professionals seek value in it. It is the engineer's companion in current times with an assertion of a thriving future. Pune has indisputably grown to become a major center of Japanese Education in India while increasing the precedence for Japanese connoisseurs.

Japanese certainly serves a great platform to unlock a notoriously tough market & find a booming career. While the companies prefer candidates having the knowledge of the language, it can additionally help connect better with the native people thus prospering in their professional journey. Learning Japanese gives an extra edge to the resume since the recruiters consciously make note of the fact it requires real perseverance and self-discipline to tackle one of the most complex languages.

It would be easy for all time to quit the impossible; however it takes immense courage to reiterate the desired outcomes, recognize that improvement is an ongoing process and ultimately soldier on it. The need of an hour is to introduce Japanese language with utmost professionalism to create awareness about the bright prospects and to enhance the proficiency and commitment. It will then prove to be the ultimate path to the quest for professional excellence!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcome:

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

- Have ability of basic communication.
- Have the knowledge of Japanese script.
- Get introduced to reading, writing and listening skills for language Japanese.
- Develop interest to pursue professional Japanese Language course

Course Contents:

1. Introduction to Kanji Script, Describing one's daily routine. To ask what someone does. Expressions of Giving & Receiving.
2. Adjectives (Types of adjectives), Asking impression or an opinion about a thing / person / place that the listener, has experienced, visited, or met, Describing things / person / places with the help of the adjectives.
3. Expressions of Like & Dislikes. Expressing one's ability, hobby, Comparison between objects, persons & cities, which resulted from a certain action in the past.

References:

1. Minna No Nihongo, —Japanese for EveryoneI, Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.
2. <http://www.tcs.com> (http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx)

SEMESTER II

Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: Discrete Mathematics (210241), Data Structures (210243, 210252), Theory of Computation (310241)		
Course Objectives: - To develop problem solving abilities using mathematical theories - To analyze the performance of algorithms - To study algorithmic design strategies		
Course Outcomes: On completion of the course, student will be able to– - Formulate the problem - Analyze the asymptotic performance of algorithms - Decide and apply algorithmic strategies to solve given problem - Find optimal solution by applying various methods		
Course Contents		
Unit I	Fundamentals	09 Hours
The Role of Algorithms in Computing - What are algorithms, Algorithms as technology, Evolution of Algorithms, Design of Algorithm, Need of Correctness of Algorithm, Confirming correctness of Algorithm – sample examples, Iterative algorithm design issues.		
Unit II	Models and Design	09 Hours
Functional Model – Features, Recursive processes, Scope rules, Tail recursion, Checking correctness of Iterative process. Imperative Model – Basics, Specifications and Prototyping, Stepwise Refinement, Proof Rules – Basics, For loops, Goto and Exit loops, Functions and Procedures, Problem Solving using Greedy strategy - Knapsack problem, Huffman code generation algorithm.		
Unit III	Abstract Algorithms	09 Hours
Dynamic Programming, Divide and Conquer, Greedy strategy, Branch-n-Bound, Natural Algorithms –Evolutionary Algorithms and Evolutionary Computing, Introduction to Genetic Algorithm, Simulated Annealing, Artificial Neural Network and Tabu Search.		
Unit IV	Complexity Theory	09 Hours
Complexity theory – Counting Dominant operators, Growth rate, upper bounds, asymptotic growth, O , Ω , Θ , o and ω notations, polynomial and non-polynomial problems, deterministic and non-deterministic algorithms, P-class problems, NP-class of problems, Polynomial problem reduction NP complete problems- vertex cover and 3-SAT and NP hard problem - Hamiltonian cycle.		
Unit V	Amortized Analysis	09 Hours

Introduction to Randomized and Approximate algorithms, Embedded Algorithms. Embedded system scheduling (power optimized scheduling algorithm), sorting algorithm for embedded systems.

Unit VI	Multithreaded and Distributed Algorithms	09 Hours
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Multithreaded Algorithms - Introduction, Performance measures, Analyzing multithreaded algorithms, Parallel loops, Race conditions.

Problem Solving using Multithreaded Algorithms - Multithreaded matrix multiplication, Multithreaded merge sort.

Distributed Algorithms - Introduction, Distributed breadth first search, Distributed Minimum Spanning Tree.

String Matching- Introduction, The Naive string matching algorithm, The Rabin-Karp algorithm

Books:

Text:

1. Parag Himanshu Dave, Himanshu Bhalchandra Dave, –Design And Analysis of Algorithms”, Pearson Education, ISBN 81-7758-595-9
2. Gilles Brassard, Paul Bratley, –Fundamentals of Algorithmics”, PHI, ISBN 978-81-203-1131-2

References:

1. Michael T. Goodrich, Roberto Tamassia , –Algorithm Design: Foundations, Analysis and Internet Examples”, Wiley, ISBN 978-81-265-0986-7
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, –Introduction to Algorithms”, MIT Press; ISBN 978-0-262-03384-8
3. Horowitz and Sahani, "Fundamentals of Computer Algorithms", University Press, ISBN: 978 81 7371 6126, 81 7371 61262
4. Rajeev Motwani and Prabhakar Raghavan, –Randomized Algorithms”, Cambridge University Press, ISBN: 978-0-521-61390-3
5. Dan Gusfield, –Algorithms on Strings, Trees and Sequences”, Cambridge University Press, ISBN: 0-521-67035-7

Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: Fundamentals of Programming Languages(110011,110003), Data Structures (210243,210252)		
Companion Course: Systems Programming and Operating System Lab (310257)		
Course Objectives: • To understand basics of System Programming. • To learn and understand data structures used in design of system software. • To learn and understand basics of compilers and tools. • To understand functions of operating system. • To learn and understand process, resource and memory management.		
Course Outcomes: On completion of the course, student will be able to– • Analyze and synthesize system software • Use tools like LEX & YACC. • Implement operating system functions.		
Course Contents		
Unit I	Introduction	09 Hours
Introduction: Components of System Software: Text editors, Loaders, Assemblers, Macro processors, Compilers, Debuggers. Machine Structure, Machine language and Assembly Language. Assemblers: General design procedure, design of two pass assembler		
Unit II	Macro Processor, Linker and Loader	09 Hours
Macro Processor: Macro instructions, Features of macro facility, Design of two-pass, single pass and nested macro processor. Loaders: Loader schemes: Compile and go, General Loader Scheme, Absolute loaders, subroutine linkages, relocating loaders, direct linking loaders, overlay structure. Design of an absolute loader, Design of direct linking loader. Linkers: Relocation and linking concepts, Design of linker, self relocating programs, Static and dynamic link libraries, use of call back functions. Case Study: Loading phases using Java.		
Unit III	Language Translator	09 Hours
Role of lexical analysis -parsing & Token, patterns and Lexemes & Lexical Errors, regular definitions for the language constructs & strings, sequences, Comments & Transition diagram for recognition of tokens, reserved words and identifiers, examples Introduction to Compilers and Interpreters: General Model of Compiler, Program interpretation, Comparison of compiler and Interpreter, Use of Interpreter and components of Interpreter. Case Study: Overview of LEX and YACC specification and features.		
Unit IV	Operating Systems	09 Hours

Process Management: Process Concept- Process states, Process control block, Threads, Process Scheduling: Types of process schedulers, Types of scheduling: Preemptive, Non preemptive. Scheduling algorithms: FCFS, SJF, RR, Priority, Deadlocks: Methods of handling deadlocks, Deadlock prevention, avoidance and detection, Recovery from deadlocks. Case Study: Process Management in multi-cores OS.

Unit V	Memory Management	09 Hours
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Memory management: Review of Programming Model of Intel 80386, Contiguous and non-contiguous, Swapping, Paging, Segmentation, Segmentation with Paging. Virtual Memory: Background, Demand paging, Page replacement scheme- FIFO, LRU, Optimal, Thrashing. Case Study: Memory Management in multi-cores OS.

Unit VI	I/O Management	09 Hours
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I/O Management: I/O Devices, Organization of I/O function, I/O Buffering, Disk Scheduling- Disk Scheduling policies like FIFO, LIFO, STTF, SCAN, C-SCAN. File Management: Concept, Access methods, Directory Structure, Protection, File System implementation, Directory Implementation, Allocation methods, Free Space management. Case Study: I/O and File Management in multi-cores OS Case Study: Light weight and heavy weight OS: Linux, Tizen

Books:

- Text:**
1. John Donovan, –System Programming”, McGraw Hill, ISBN 978-0--07-460482-3.
 2. Silberschatz, Galvin, Gagne, "Operating System Principles", 9th Edition, Wiley, ISBN 978-1-118-06333-0

- References:**
1. Dhamdhare D., "Systems Programming and Operating Systems", McGraw Hill, ISBN 0 - 07 - 463579 – 4
 2. Randal Bryant and David O'Hallaron, –Computer Systems: A Programmer's Perspective” , Pearson, ISBN 10: 0-13-610804-0
 3. Stallings W., "Operating Systems", 6th Edition, Prentice Hall, ISBN-978-81-317-2528-3.
 4. John. R. Levine, Tony Mason and Doug Brown, –Lex and Yacc”, O'Reilly, 1998, ISBN: 1-56592-000-7

Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (paper): 70 Marks
Prerequisite Course: Computer Networks (310245)		
Companion Course: Embedded Systems and IoT Lab (310258)		
Course Objectives: - To understand fundamentals of IoT and embedded system including essence, basic design strategy and process modeling. - To introduce students a set of advanced topics in embedded IoT and lead them to understand research in network. - To develop comprehensive approach towards building small low cost embedded IoT system. - To understand fundamentals of security in IoT, - To learn to implement secure infrastructure for IoT - To learn real world application scenarios of IoT along with its societal and economic impact using case studies		
Course Outcomes: On completion of the course, student will be able to– - Implement an architectural design for IoT for specified requirement - Solve the given societal challenge using IoT - Choose between available technologies and devices for stated IoT challenge		
Course Contents		
Unit I	Introduction to Embedded System and Internet of Things	09 Hours
Embedded Systems: Application Domain and Characteristic of Embedded System, Real time systems and Real time scheduling, Processor basics and System-On-Chip, Introduction to ARM processor and its architecture. IoT: Definition and characteristics of IoT, Internet of Things: Vision, Emerging Trends, Economic Significance, Technical Building Blocks, Physical design of IoT, Things of IoT, IoT Protocols, Logical design of IoT, IoT functional blocks, IoT communication models, IoT Communication APIs, IoT enabling technologies, IoT levels and deployment templates, IoT Issues and Challenges, Applications		
Unit II	Embedded IoT Platform Design Methodology	09 Hours
Purpose and requirement specification, Process specification, Domain model specification, information model specification, Service specifications, IoT level specification, Functional view specification, Operational view specification, Device and component integration, Application development		
Unit III	Pillars of Embedded IoT and Physical Devices	09 Hours
Horizontal, verticals and four pillars of IoT, M2M: The internet of devices, RFID: The internet of objects, WSN: The internet of transducer, SCADA: The internet of controllers, DCM: Device, Connect and Manage, Device: Things that talk, Connect: Pervasive Network, Mangae: To create business values. IoT Physical Devices and Endpoints: Basic building blocks of and IoT device, Exemplary device: Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python, Other IoT Devices.		

Protocols, Issues with IoT Standardization, Unified Data Standards, Protocols – IEEE 802.15.4, BACNet Protocol, Modbus, KNX, Zigbee Architecture, Network layer, APS layer.
IoT Security: Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling, Key elements of IoT Security: Identity establishment, Access control, Data and message security, Non-repudiation and availability, Security model for IoT.

Unit V	Web of Things and Cloud of Things	09 Hours
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Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Unified Multitier WoT Architecture, WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing, Cloud Middleware, Cloud Standards – Cloud Providers and Systems, Mobile Cloud Computing, The Cloud of Things Architecture.

Unit VI	IoT Physical Servers, Cloud Offerings and IoT Case Studies	09 Hours
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Introduction to Cloud Storage Models, Communication API, WAMP: AutoBahn for IoT, Xively Cloud for IoT, Python Web Application Framework: Django, Amazon Web Services for IoT, SkyNet IoT Messaging Platform. Case Studies: Home Intrusion Detection, Weather Monitoring System, Air Pollution Monitoring, Smart Irrigation.

Books:

Text:

1. Arshdeep Bahga, Vijay Madisetti, –Internet of Things – A hands-on approach”, Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515
2. Honbo Zhou, –The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012. ISBN : 9781439892992
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, –Architecting the Internet of Things”, Springer, 2011. ISBN: 978-3-642-19156-5
4. Lyla B. Das, –Embedded Systems: An Integrated Approach” Pearson , ISBN: 9332511675, 9789332511675.

References:

1. David Easley and Jon Kleinberg, –Networks, Crowds, and Markets: Reasoning About a Highly Connected World”, Cambridge University Press, 2010, ISBN:10: 0521195330
2. Olivier Hersent, Omar Elloumi and David Boswarthick, –The Internet of Things: Applications to the Smart Grid and Building Automation”, Wiley, 2012, 9781119958345
3. Olivier Hersent, David Boswarthick, Omar Elloumi , –The Internet of Things – Key applications and Protocols”, Wiley, 2012, ISBN:978-1-119-99435-0
4. Barrie Sosinsky, –Cloud Computing Bible”, Wiley-India, 2010. ISBN : 978-0-470-90356-8
5. Adrian McEwen, Hakim Cassimally, –Designing the Internet of Things”, Wiley, 2014, ISBN: 978-1-118-43063-7
6. Christopher Hallinan, –Embedded Linux Primer”, Prentice Hall, ISBN:13: 978-0-13-167984-9

Third Year of Computer Engineering (2018 Course)

310253: Software Modeling and Design

Teaching Scheme: TH: 03 Hours/Week	Credits 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Course: Software Engineering and Project Management (310243)		
Course Objectives: • To understand and apply Object Oriented(OO) concept for designing OO based model/application • To transform Requirement document to Appropriate design • To understand different architectural designs and to transform them into proper model • To choose and use modern design tools for project development and implementation. • To choose and use appropriate test tool for testing web-based/desktop application		
Course Outcomes: On completion of the course, student will be able to– • Analyze the problem statement (SRS) and choose proper design technique for designing web-based/ desktop application • Design and analyze an application using UML modeling as fundamental tool • Apply design patterns to understand reusability in OO design • Decide and apply appropriate modern tool for designing and modeling • Decide and apply appropriate modern testing tool for testing web-based/desktop application		
Course Contents		
Unit I	Introduction	07 Hours
Introduction to software design, design methods- procedural / structural and object oriented, Requirement Vs Analysis Vs Architecture Vs Design Vs Development 4+1 Architecture, case study of transferring requirement to design, UP, COMET use case based software life cycle, Introduction to UML -Basic building blocks, Reusability, Use case modeling, Use case template Case study – Transferring requirements into design using advanced tool		
Unit II	Static Modelling	08 Hours
Analysis Vs Design, Class diagram- Analysis - Object & classes finding analysis & Design- design classes, refining analysis relationships, Inheritance & polymorphism, Object diagram, Component diagram- Interfaces & components, deployment diagram, Package diagram		
Unit III	Dynamic Modelling	07 Hours
Interaction & Interaction overview diagram, sequence diagram, Timing diagram, Communication diagram, Advanced state machine diagram, Activity diagram		
Unit IV	Architecture Design	08 Hours
Introduction to Architectural design, overview of software architecture, Object oriented software architecture, Client server Architecture, Service oriented Architecture, Component based Architecture, Real time software Architecture		
Unit V	Design patterns	07 Hours

Unit VI	Testing	08 Hours
Introduction to testing, Error, Faults, Failures, verification and validation, Whit Box Testing, Black Box Testing, Unit testing, Integration testing, GUI testing, User acceptance Validation testing, integration testing, scenario testing, performance testing. Test cases and test plan. Case studies expected for developing usability test plans and test cases.		
Note: Instructor should frame appropriate case studies/ mini-project (different case study for a group of 6-8 students) on unit-I to unit-V. The case study framed for unit-I may be continued/carry forward for next units if necessary. The same case studies/mini-projects should be tested using appropriate testing tool (preferably open source like Selenium).		
Books:		
Text Books:		
1. Jim Arlow, Ila Neustadt, –UML 2 and the unified process –practical object-oriented analysis and design” Addison Wesley, Second edition, ISBN 978-0201770605 2. Hassan Gomaa, –Software Modeling and Design- UML, Use cases, Patterns and Software Architectures” Cambridge University Press, 2011, ISBN 978-0-521-76414-8 3. Srinivasan Desikan, Gopalaswamy Ramesh, –Software testing- Principles and practices” Prentice Hall, 2007, ISBN 9788177581218		
References Books:		
1. Eric J. Braude, –Software Design: from Programming to Architecture”, J. Wiley, 2004, ISBN 978-0-471-20459-6 2. Gardy Booch, James Rumbaugh, Ivar Jacobson, –The unified modeling language user guide” , Pearson Education, Second edition, 2008, ISBN 0-321-24562-8		

Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: Computer Network (310245) , Database Management Systems (310242)		
Companion Course: Web Technology Lab (310256)		
Course Objectives: - To understand the principles and methodologies of web based applications development process - To understand current client side and server side web technologies - To understand current client side and server side frameworks - To understand web services and content management		
Course Outcomes: On completion of the course, student will be able to– - analyze given assignment to select sustainable web development design methodology - develop web based application using suitable client side and server side web technologies - develop solution to complex problems using appropriate method, technologies, frameworks, web services and content management		
Course Contents		
Unit I	Web Development Process, Front End Tools	07 Hours
Introduction to web technology, internet and www, Web site planning and design issues, HTML: structure of html document , HTML elements: headings, paragraphs, line break, colors & fonts, links, frames, lists, tables, images and forms, Difference between HTML and HTML5. CSS: Introduction to Style Sheet, Inserting CSS in an HTML page, CSS selectors, XML: Introduction to XML, XML key component, Transforming XML into XSLT, DTD: Schema, elements, attributes, Introduction to JSON.		
Unit II	Client Side Technologies	08 Hours
JavaScript: Overview of JavaScript, using JS in an HTML (Embedded, External), Data types, Control Structures, Arrays, Functions and Scopes, Objects in JS, DOM: DOM levels, DOM Objects and their properties and methods, Manipulating DOM, JQuery: Introduction to JQuery, Loading JQuery, Selecting elements, changing styles, creating elements, appending elements, removing elements, handling events.		
Unit III	Server Side Technologies	08 Hours
Introduction to Server Side technology and TOMCAT, Servlet: Introduction to Servlet, need and advantages, Servlet Lifecycle, Creating and testing of sample Servlet, session management. JSP: Introduction to JSP, advantages of JSP over Servlet , elements of JSP page: directives, comments, scripting elements, actions and templates, JDBC Connectivity with JSP.		
Unit IV	Server Side Technologies	07 Hours
PHP: Introduction to PHP, Features, sample code, PHP script working, PHP syntax, conditions & Loops, Functions, String manipulation, Arrays & Functions, Form handling, Cookies & Sessions, using MySQL with PHP, WAP & WML, AJAX: Introduction, Working of AJAX, AJAX processing steps, coding AJAX script.		

forms, includes, views, scopes, services, dependency injection, custom directives, Internationalization, Introduction to NodeJS. Struts: Overview, architecture, configuration, actions, interceptors, result types, validations, localization, exception handling, annotations.

Unit VI	Web Services	08 Hours
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Web Services: Overview, types of WS, difference between SOAP and REST, EJB: types of EJB, benefits, Architecture, EJB technology, JNDI lookup, Introduction to Content Management System(CMS) , Wordpress / Joomla, Advanced Technology: Bootstrap, JSF, Spring.

Books:

Text:

1. Achyut Godbole & Atul Kahate, "Web Technologies: TCP/IP to Internet Application Architectures", McGraw Hill Education publications, ISBN, 007047298X, 9780070472983
2. Ralph Moseley & M. T. Savaliya, "Developing Web Applications", Wiley publications, ISBN 13 : 9788126538676

References:

1. Adam Bretz & Colin J Ihrig, "Full Stack Javascript Development with MEAN", SPD, ISBN-13: 978-0992461256
2. Giulio Zambon, "Beginning JSP, JSF and Tomcat", Apress Publication, ISBN-10: 1430246235; ISBN-13: 978-1430246237
3. Jeremy McPeak & Paul Wilton, "Beginning JavaScript", Wrox Publication, ISBN-13: 978-0470525937
4. Black Book, "Struts 2", Dreamtech Press, ISBN 13, : 9788177228700
5. Black Book, "JDBC 4.2, Servlet 3.1 & JSP 2.3", Dreamtech Press, ISBN-13: 978-8177228700
6. Sandeep Panda, "Angular JS: Novice To Ninja", SPD, First Edition 2014, ISBN-13: 978-0992279455
7. B. V. Kumar, S. Sangeetha, S. V. Subrahmanya, "J2EE Architecture, an illustrative gateway to enterprise solutions", Tata McGraw Hill Publishing Company. ISBN: 9780070621633
8. Brian Fling, "Mobile Design and Development", O'REILLY, ISBN: 13:978-81-8404-817-9
9. Robin Nixon, "Learning PHP, Mysql and Javascript with JQuery, CSS & HTML5", O'REILLY, ISBN: 13:978-93-5213-015-3
10. Allan Cole, Raeiva Jackson Armitage Brandon R. Jones Jeffrey Way, "Build Your Own Wicked Wordpress Themes", SPD, ISBN: 978-93-5213-154-9
11. Ed Burnette, "Hello , Android Introducing Google' Mobile Development Platform", SPD, ISBN: 13:978-93-5213-085-6

Teaching Scheme: TUT: 01 Hour/Week	Credit 01	Examination Scheme: TW: 50 Marks
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Course Objectives:

- To explore the basic principles of communication (verbal and non-verbal) and active, empathetic listening, speaking and writing techniques.
- To expose the student to new technologies, researches, products, algorithms, services

Course Outcomes:

On completion of the course, student will–

- be able to be familiar with basic technical writing concepts and terms, such as audience analysis, jargon, format, visuals, and presentation.
- be able to improve skills to read, understand, and interpret material on technology.
- improve communication and writing skills

Guidelines:

- Each student will select a topic in the area of Computer Engineering and Technology preferably keeping track with recent technological trends and development beyond scope of syllabus avoiding repetition in consecutive years.
- The topic must be selected in consultation with the institute guide.
- Each student will make a seminar presentation using audio/visual aids for a duration of 20-25 minutes and submit the seminar report prepared in Latex only.
- Active participation at classmate seminars is essential.
- BoS has circulated the Seminar Log book and it is recommended to use it.

Guidelines for Assessment:

Panel of staff members along with a guide would be assessing the seminar work based on these parameters-Topic, Contents and Presentation, regularity, Punctuality and Timely Completion, Question and Answers, Report, Paper presentation/Publication, Attendance and Active Participation.

Recommended Format of the Seminar Report:

- Title Page with Title of the topic, Name of the candidate with Exam Seat Number / Roll Number, Name of the Guide, Name of the Department, Institution and Year & University
- Seminar Approval Sheet/Certificate
- Abstract and Keywords
- Acknowledgements
- Table of Contents, List of Figures, List of Tables and Nomenclature
- Chapters Covering topic of discussion- Introduction with section including organization of the report, Literature Survey/Details of design/technology/Analytical and/or experimental work, if any/,Discussions and Conclusions ,Bibliography/References
- Plagiarism Check report
- Report Documentation page

References:

1. Rebecca Stott, Cordelia Bryan, Tory Young, –Speaking Your Mind: Oral Presentation and Seminar Skills (Speak-Write Series)”, Longman, ISBN-13: 978-0582382435
2. Johnson-Sheehan, Richard, –Technical Communication”, Longman. ISBN 0-321-11764-6
3. Vikas Shirodka, –Fundamental skills for building Professionals”, SPD, ISBN 978-93-5213-146-5

Teaching Scheme:
PR: 02 Hours/Week

Credit
01

Examination Scheme:
TW: 25 Marks
PR: 50 Marks

Companion Course: Web Technology (310254)

Course Objectives:

- To use current client side and server side web technologies
- To implement communication among the computing nodes using current client side and server side technologies
- To design and implement web services with content management

Course Outcomes:

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

- develop web based application using suitable client side and server side web technologies
- develop solution to complex problems using appropriate method, technologies, frameworks, web services and content management

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/technology/tool in brief, design, test cases, conclusion/analysis. **Program codes with sample output of all performed assignments are to be submitted as softcopy.**

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

Continuous assessment of laboratory work is done based on overall performance and 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.

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.

Suggested List of Laboratory Assignments

1.	Lab Assignment on Unit I: Assignment 1a: Installation and Configuration of Web Application Servers Tomcat, Apache, WebSphere, JBoss, GlassFish. Assignment 1b: Design and develop any suitable web application using HTML, CSS and XML in consultation of course instructor.
2.	Lab Assignment on Unit II: Assignment 2: Perform validation of all fields in assignment no.1 by using Java script/JQuery.
3.	Lab Assignment on Unit III: Assignment 3: Add dynamic web application essence in assignment no. 2 using Servlet, JSP and backend.
4.	Lab Assignment on Unit IV: Assignment 4: Add dynamic web application essence in assignment no. 2 using PHP, MySQL database connectivity and AJAX controls.
5.	Lab Assignment on Unit V: Assignment 5: Re-Design, develop and deploy assignment no. 3 of unit –III using Strut Re-Design, develop and deploy assignment no. 4 of unit –IV using Angular JS
6.	Lab Assignment on Unit VI: Assignment 6: Design, Develop and Deploy separate web application using EJB/CMS/JSF/Spring/Bootstrap.

Reference Books:

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

Third Year of Computer Engineering (2015 Course)

310257: System Programming & Operating System Lab

Teaching Scheme:

PR: 04 Hours/Week

Credit

02

Examination Scheme:

TW: 25 Marks

PR: 50 Marks

Companion Course: Systems Programming and Operating System (310251)

Course Objectives:

- To implement basic language translator by using various needed data structures
- To implement basic Macroprocessor
- To design and implement Dynamic Link Libraries
- To implement scheduling schemes

Course Outcomes:

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

- Understand the internals of language translators
- Handle tools like LEX & YACC.
- Understand the Operating System internals and functionalities with implementation point of view

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, algorithm, flowchart, 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.

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.

Set of suggested assignment list is provided in groups- A, B, C, D (All Compulsory)

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

Programming tools recommended: - Eclipse IDE

References:

1. Paul Gries Jennifer Campbell, Jason Montojo, –Practical Programming Second Edition”, SPD, ISBN: 978-93-5110-469-8

Suggested List of Laboratory Assignments

Group A

1. Design suitable data structures and implement pass-I of a two-pass assembler for pseudo-machine in Java using object oriented feature. Implementation should consist of a few instructions from each category and few assembler directives.
2. Implement Pass-II of two pass assembler for pseudo-machine in Java using object oriented features. The output of assignment-1 (intermediate file and symbol table) should be input for this assignment.
3. Design suitable data structures and implement pass-I of a two-pass macro-processor using OOP features in Java
4. Write a Java program for pass-II of a two-pass macro-processor. The output of assignment-3 (MNT, MDT and file without any macro definitions) should be input for this assignment.

Group B

1. Write a program to create Dynamic Link Library for any mathematical operation and write an application program to test it. (Java Native Interface / Use VB or VC++).
2. Write a program using Lex specifications to implement lexical analysis phase of compiler to generate tokens of subset of ‘Java’ program.
3. Write a program using Lex specifications to implement lexical analysis phase of compiler to count no. of words, lines and characters of given input file.
4. Write a program using YACC specifications to implement syntax analysis phase of compiler to validate type and syntax of variable declaration in Java.
5. Write a program using YACC specifications to implement syntax analysis phase of compiler to recognize simple and compound sentences given in input file.

Group C

1. Write a Java program (using OOP features) to implement following scheduling algorithms: FCFS, SJF (Preemptive), Priority (Non-Preemptive) and Round Robin (Preemptive)
2. Write a Java program to implement Banker’s Algorithm
3. Implement UNIX system calls like ps, fork, join, exec family, and wait for process management (use shell script/ Java/ C programming).
4. Study assignment on process scheduling algorithms in Android and Tizen.

Group D

- Write a Java Program (using OOP features) to implement paging simulation using
 1. Least Recently Used (LRU)
 2. Optimal algorithm

Teaching Scheme: PR: 02 Hours/Week	Credit 01	Examination Scheme: TW: 25 Marks PR: 50 Marks
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Companion Course-Embedded Systems & Internet of Things (310252)

Course Objectives:

- To understand functionalities of various single board embedded platforms fundamentals
- To develop comprehensive approach towards building small low cost embedded IoT system.
- To implement the assignments based on sensory inputs

Course Outcomes:

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

- Design the minimum system for sensor based application
- Solve the problems related to the primitive needs using IoT
- Develop full fledged IoT application for distributed environment

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, algorithm, flowchart, 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.

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.

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 assignment list is provided in groups- A, B, C, D, and E. Each student must perform at least 13 assignments as at least 3 from group A, 3 from group B, 2 from group C, 2 from group D and 1 from group E.

References:

1. Nitesh Dhanjani, –Abusing the Internet of Things”, O'REILLY, ISBN: 13:978-93-5313-217-1
2. Cuno Pfister, –Getting Started with the Internet of Things”, O'REILLY, ISBN: 13:978-93-53023-413-6
3. Massimo Banzi and Michael Shiloh, –Getting Started with Arduino”, MAKER MEDIA, ISBN: 13:978-93-5110-907-5
4. Don Wilcher, –BASIC Arduino Projects”, MAKER MEDIA, ISBN: 13:978-93-5110-503-9
5. Cefn Hoile, Clare Bowman, Sjoerd Dirk Meijer, Brian Corteil, Lauren Orsini, –Raspberry Pi and AVR Projects”, MAKER MEDIA, ISBN: 13:978-93-5110-914-3
6. Wolfram Donot, –A Raspberry Pi Controlled Robot”, MAKER MEDIA, ISBN: 13:978-93-5110-913-6
7. Kimmo Karvinen and Tero Karvinen, –Arduino Bots and Gadgets”, O'REILLY, ISBN: 13:978-93-5023-374-0
8. Derek Molley, –Exploring Beaglebone”, Willey, ISBN: 978-1-118-935125
9. Matt Richardson and Shawn Wallace, –Getting with Raspberry Pi”, MAKER MEDIA, ISBN: 978-93-5213-450-2
10. Dr. Simon Monk, –Raspberry PiCook-Book”, O'REILLY, ISBN: 978-93-5213-389-5

Suggested List of Laboratory Assignments

Group A

1.	Study of Raspberry-Pi, Beagle board, Arduino and other micro controller (History & Evolution)
2.	Study of different operating systems for Raspberry-Pi /Beagle board. Understanding the process of OS installation on Raspberry-Pi /Beagle board
3.	Study of Connectivity and configuration of Raspberry-Pi /Beagle board circuit with basic peripherals, LEDs. Understanding GPIO and its use in program.
4.	Understanding the connectivity of Raspberry-Pi /Beagle board circuit with temperature sensor. Write an application to read the environment temperature. If temperature crosses a threshold value, the application indicated user using LEDs

Group B

5.	Understanding the connectivity of Raspberry-Pi /Beagle board circuit with IR sensor. Write an application to detect obstacle and notify user using LEDs.
6.	Understanding and connectivity of Raspberry-Pi /Beagle board with camera. Write an application to capture and store the image.
7.	Understanding and connectivity of Raspberry-Pi /Beagle board with a Zigbee module. Write a network application for communication between two devices using Zigbee.
8.	Study of different CPU frequency governors. Write an application to change CPU frequency of Raspberry-Pi /Beagle board

	simulated traffic signal.
11.	Write an application using Raspberry-Pi /Beagle board to control the operation of a hardware simulated lift elevator
Group D	
12.	Write a server application to be deployed on Raspberry-Pi /Beagle board. Write client applications to get services from the server application.
13.	Create a small dashboard application to be deployed on cloud. Different publisher devices can publish their information and interested application can subscribe.
14.	Create a simple web interface for Raspberry-pi/Beagle board to control the connected LEDs remotely through the interface.
Group D	
15.	Develop a Real time application like smart home with following requirements: When user enters into house the required appliances like fan, light should be switched ON. Appliances should also get controlled remotely by a suitable web interface. The objective of this application is student should construct complete Smart application in group.
16.	Develop a Real time application like a smart home with following requirements: If anyone comes at door the camera module automatically captures his image send it to the email account of user or send notification to the user. Door will open only after user's approval.

Third Year of Computer Engineering (2015 Course)

310259: Audit Course 4

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

AC4- I	Digital and Social Media Marketing
AC4-II	Green Computing
AC4-III	Sustainable Energy Systems
AC4-IV	Leadership and Personality Development
AC4-V	Foreign Language (one of Japanese/ Spanish/French/German). Course contents for Japanese (Module 4) are provided. For other languages institute may design suitably.

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>

AC4 – I: Digital & Social Media Marketing

The importance of social media's role in modern marketing efforts can no longer be ignored. It's an integral component in almost all successful marketing strategies. With this increasing emphasis on integrated social media strategies, there is an Irrefutable need for marketing professionals and organizations to have end- to- end social media expertise. Through case studies, interactive sessions, and class exercises, students will learn best practices and develop the skills to connect business objectives with social media strategy, platforms and tactics. Topics will include choosing appropriate platforms, creating effective and engaging social media content, content management, social listening and creating a social media policy

Course Objectives:

- Identify best practices for Social Media Marketing, including platform level best practices.
- Connect business objectives to appropriate Social Media tactics.
- Create strong content that engages their target audience with their marketing message.

Course Outcome:

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

- Create editorial calendars to manage content distribution.
- Use Social Listening tools to create timely, relevant content.
- Create Social Media policies that combine business objectives with appropriate use of social media channels and content.

Course Contents:

1. Introductions and review class objectives, Discuss class goals and individual goals, Fill out questionnaire, Introduction to Blogging, Create a blog post for your project. Include headline, imagery, links and post.
2. Introduction to Facebook and channel advertising and campaigns, Introduction to Twitter and channel advertising and campaigns, Creative Campaign examples across social channels
3. Introduction to both Google+ and LinkedIn. Provide an overview on LinkedIn advertising, Create Google+ and LinkedIn outlines for your project and include: types of posts and an example post for each platform.
4. Introduction to both Instagram and Pinterest as well as channel advertising and campaigns, Create Instagram and Pinterest outlines for your project and include: types of posts and an example post for each platform, review a content calendar, Lay out your own content calendar.

References:

1. Vandana Ahuja, Digital Marketing, Oxford Press, ISBN: 9780199455447,
2. Wiley, Jeanniey Mullen, David Daniels, David Gilmour –Email Marketing: An Hour a Day”, ISBN: 978-0-470-38673-6
3. David Scott, –The New Rules of Marketing and PR”, Wiley India, ISBN: 978-1-119-07048-1

AC4 – II: Green Computing

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

Course Objectives:

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

Course Outcome:

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

- Understand the concept of green IT and relate it to sustainable development.
- Apply the green computing practices to save energy.
- Discuss how the choice of hardware and software can facilitate a more sustainable operation,
- Use methods and tools to measure energy consumption

Course Contents:

- 1. Fundamentals of Green IT:** Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot Print - Measuring, Details, reasons to bother, Plan for the Future, Cost Savings: Hardware, Power.
- 2. Green Assets and Power Problems:** Green Assets: Buildings, Data Centers, Networks, and Devices, Green Information Systems : Design and Development Models, Monitoring Power Usage, Servers, Low-Cost Options, Reducing Power Use, Data De-Duplication, Low-Power Computers and peripheral devices
- 3. Greening Information Systems:** Initial Improvement Calculations, Selecting Metrics, Tracking Progress, Change Business Processes, Customer Interaction, Paper Reduction, Green Supply Chain, Improve Technology Infrastructure, Reduce PCs and Servers, Shared Services, Hardware Costs, Cooling
- 4. Green Grid Framework:** Virtualization of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center Case Studies – Applying Green IT Strategies and Applications to a Home Hospital, Packaging Industry and Telecom Sector

References:

1. Woody Leonhard, Katherrine Murray, –Green Home Computing for Dummies”, August2009, ISBN: 978-0-470-46745-9
2. Alvin Galea, Michael Schaefer, Mike Ebberts, –Green Data Center: steps for the Journey”, Shoff/IBM rebook, 2011. ISBN: 10: 1-933742-05-4; 13: 978-1-933742-05-2
3. John Lamb, –The Greening of IT”, Pearson Education, 2009, ISBN 10: 0137150830
4. Jason Harris, –Green Computing and Green IT- Best Practices on regulations & industry”,Lulu.com, 2008, ISBN: 1558604898
5. Bud E. Smith, –Green Computing Tools and Techniques for Saving Energy, Money and Resources”, CRC Press, 2014, 9781466503403

AC4 – III: Sustainable Energy Systems

Course Objectives:

- To understand the impact of engineering solutions on a global, economic, environmental, and societal context.
- To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

Course Outcome:

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

- To demonstrate an overview of the main sources of renewable energy.
- To understand benefits of renewable and sustainable energy systems.

Course Contents:

1. Introduction and Energy Fundamentals, Sustainable Energy Systems: Issues for the 21st century, the critical challenges for a sustainable energy future, Sustainable energy systems: definitions, indicators, Physics of Energy: Laws of Thermodynamics Energy Forms and Conversion, First and Second Laws and Efficiencies Devices: Heat Engines, Refrigerators and Heat Pumps Instantaneous and Average Power.
2. Introduction to Renewable Energy, Wind Energy Wind Turbine Technologies Wind Resources and Modeling Energy Performance and Environmental Impacts Economics and Economic Development Impacts, Photovoltaic: PV and BIPV Technologies Solar Resources and Modeling Energy Performance and Environmental Impacts, Economics and Net Metering
3. Biomass: Electricity Biomass Technologies Introduction Biomass Productivity and Modeling Biopower: MSW, willows/switch grass/ poplar, wood waste, Biomass: Transport Fuels Biofuels, Bioethanol, Biodiesel, Algal, Jatropha Biofuels and Water Land Use Impacts, Food vs Fuel, Renewable Fuels Standards
4. Building Energy Technologies and Policy, Smart buildings, Lighting and LEDs, Heating/cooling, technologies.

References:

1. İbrahim Dinçer, Calin Zamfirescu, –Sustainable Energy Systems and Applications”, Springer; 2012 edition, ISBN-10: 0387958606
2. D. Mukherjee, –Fundamentals of Renewable Energy Systems”, Atlantic, ISBN: 10: 8122415407
3. John R. Barker and Marc H. Ross Am. J. Phys ,–An introduction to global warming”, ISBN: 0-632-03779-2

AC4 – IV: Leadership and Personality Development

Personality is considered as one of the integral part of an individual's existence. Where a student is concerned paying close attention to **Personality** which is extremely important. To enhance holistic development of students and improve their employability skills

Course Objectives:

- To develop inter personal skills and be an effective goal oriented team player.
- To develop professionals with idealistic, practical and moral values.
- To develop communication and problem solving skills.
- To re-engineer attitude and understand its influence on behavior

Course Outcome:

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

- Enhanced holistic development of students and improve their employability skills

Course Contents:

1. **Introduction to Personality and working towards developing it:** Definition & Basics of personality, Analyzing strength & weaknesses, Corporate theories on personality Development, Increasing Vocabulary, Body Language, Preparation of Self Introduction
2. **Communication skill and handling attitude:** Communication Skills, Listening, Communication Barriers, Overcoming these Barriers Building Self Esteem and Self Confidence, Working on attitudes .i.e. aggressive, assertive, and submissive
3. **Leadership Techniques in Personality development:** Introduction to Leadership, Leadership Styles, Group Dynamics, Team Building
4. **Stress and time management skills:** Interpersonal Relationships, Analysis of Ego States, transactions, & Life positions, Stress Management, Causes, Impact & Managing Stress, Introduction to conflict management, Time Management, Concept of time management, Steps towards better time management

References:

1. SOFT SKILLS, –Career Development Centre”, Green Pearl Publications
2. Covey Sean,” Seven Habits of Highly Effective Teens”, New York, Fireside Publishers, 1998, ISBN: 978-1476764665
3. Carnegie Dale, –How to win Friends and Influence People”, New York: Simon & Schuster, 1998, ISBN: 1-4391-6734-6
4. Thomas A Harris, I am ok, You are ok , New YorkHarper and Row, 1972, ISBN 13: 978-0060724276ISBN:
5. Daniel Coleman, Emotional Intelligence, Bantam Book, 2006, ISBN: 055380491X, 9780553804911
6. Shiv Khera, –You Can Win”, A&C Black, ISBN: 9780230331198.

AC4 – V: Foreign Language(Japanese Module 4)**Prerequisite Courses: Audit Course AC1-V(210250), AC2-V(210258), AC3-V(310249)****About Course:**

With changing times, the competitiveness has gotten into the nerves and ‘Being the Best’ at all times is only the proof of it. Nonetheless, ‘being the best’ differs significantly from ‘Communicating the best’. The best can merely be communicated whilst using the best suited Language!

Japanese is the new trend of 21st century. Not only youngsters but even the professionals seek value in it. It is the engineer’s companion in current times with an assertion of a thriving future. Pune has indisputably grown to become a major center of Japanese Education in India while increasing the precedence for Japanese connoisseurs.

Japanese certainly serves a great platform to unlock a notoriously tough market & find a booming career. While the companies prefer candidates having the knowledge of the language, it can additionally help connect better with the native people thus prospering in their professional journey. Learning Japanese gives an extra edge to the ‘resume’ since the recruiters consciously make note of the fact it requires real perseverance and self-discipline to tackle one of the most complex languages.

It would be easy for all time to quit the impossible; however it takes immense courage to reiterate the desired outcomes, recognize that improvement is an ongoing process and ultimately soldier on it. The need of an hour is to introduce Japanese language with utmost professionalism to create awareness about the bright prospects and to enhance the proficiency and commitment. It will then prove to be the ultimate path to the quest for professional excellence!

Course Objectives:

- To meet the needs of ever growing industry with respect to language support.
- To get introduced to Japanese society and culture through language.

Course Outcome:

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

- Have ability of basic communication.
- Have the knowledge of Japanese script.
- Get introduced to reading, writing and listening skills for language Japanese.
- Develop interest to pursue professional Japanese Language course

Course Contents:

1. Stating existence or a presence of thing (s), person (s), Relative positions, Counters
2. Expressing one’s Desire & wants, Verb groups, Asking, Instructing a person to do something
3. Indicating an action or motion is in progress, Describing habitual action, describing a certain continuing state which resulted from a certain action in the past. Express permission & prohibition

References:

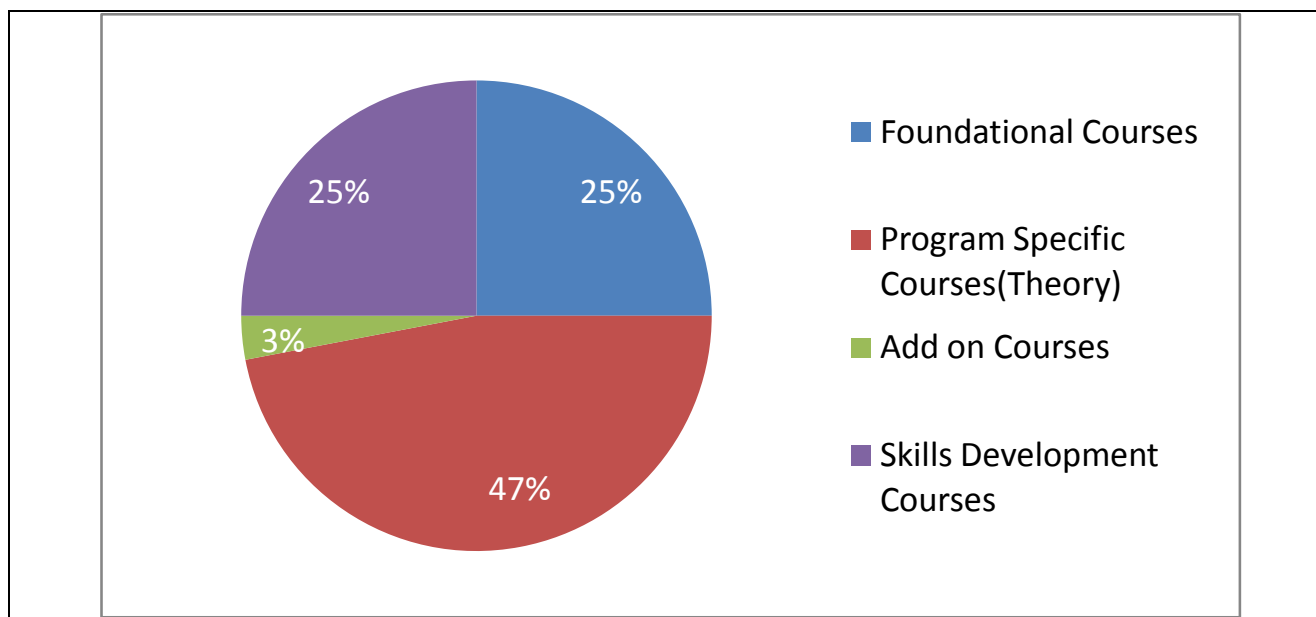
1. Minna No Nihongo, —Japanese for Everyone, Elementary Main Text book 1-1 (Indian Edition), Goyal Publishers & Distributors Pvt. Ltd.
2. <http://www.tcs.com> (http://www.tcs.com/news_events/press_releases/Pages/TCS-Inaugurates-Japan-centric-Delivery-Center-Pune.aspx)

First Year	Second Year	Third Year	Fourth Year (Proposed)
50 Credit	50 Credit	46 Credit	44 Credit
Semester I			
FPL I	Discrete Mathematics	Theory of Computation	Parallel Architectures and Concurrent Computing
Engineering Maths I	Digital Electronics and Logic Design	Database Management Systems (DBMS)	Big data Analytics
Engineering Physics	Data Structures and Algorithms	Software Engineering & Project Management	Software Testing & Quality Assurance
Basic Electrical Engineering	Computer Organization and Architecture	Information Systems & Engineering Economics	Elective I – - Digital Signal Processing - Advanced Databases, - Artificial Intelligence, - Wireless Sensor Networks
Engineering Graphics I	Object Oriented Programming+ OOP Lab	Computer Networks (CN)	Elective II- - Cloud Computing, - Soft Computing - Software Architecture & Design - Operation Research
Basic Civil and Environmental Engineering	Digital Electronics Lab	Skill Development Lab	Lab I
Workshop Practice	Data Structures Lab	DBMS Lab	Lab II
Engineering Physics Lab	Soft Skills Lab	CN Lab	Project Stage I
	Audit Course 1	Audit Course 3	Audit Course 5
Semester II			
FPL II	Engineering Mathematics III	Design & Analysis of Algorithms	Distributed Systems
Engineering Maths II	Computer Graphics	Systems Programming & Operating System (SP& OS)	Information Security
Engineering Chemistry	Advanced Data Structures	Embedded Systems & Internet of Things (ES & IoT) AND ES & IoT Lab	Elective-III : - Data Mining & Data Warehouse - Mobile Communication, - Image Processing - Human Computer Interface
Basic Electronics Engineering	Microprocessor	Software Modeling and Design	Elective-IV : - Principles of Compiler Design - Embedded & Real Time OS, - Pervasive and Ubiquitous Computing - Open Elective
Basic Mechanical Engineering	Principles of Programming Languages	Web Technology (WT)	Lab III
Engineering Mechanics	Computer Graphics Lab	Seminar & Technical Communication	Lab IV
Engg Graphics II	Advanced Data Structures Lab	Web Technology Lab	Project Work
Engg Chemistry Lab	Microprocessor Lab	SP & OS Lab	Audit Course 6
	Audit Course 2	Audit Course 4	

Courses-Credit Share

Sr. No	Category	Comprised of (Total Credit)	% of Credit Share
1	Foundational Courses (47 Credit)	- Mathematics (18) - Engineering Sciences (10) - Fundamentals of Core Engineering Domain (19)	25%
2	Program Specific Courses (Theory) (90 Credit)	Core (40)	47%
		Advanced (38)	
		Elective + Open Elective (12)	
3	Add on Courses (Audit +Credit Courses) (05 Credit)	- Social Awareness - Environmental - Personal Development - Economics (04) - Soft Skills (01)	3%
4	Skills Development Courses (48 Credit)	- Project (major) (08) - Seminar (01) - Labs + Mini-Project (39)	25%

Courses Credit Share



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 (BoS), Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design at both UG and PG programs.

It is always the strenuous task to balance the syllabus with the blend of core subjects, current developments and exotic subjects. By considering all the aspects with adequate prudence the contents are designed to make the graduate competent enough as far as employability is concerned. It is absolutely necessary and justified to add sufficient flexibility in the given constraints leading the curriculum design near to perfection.

It may be highly subjective to include or exclude the courses, but benefit of the learner is always the nucleus the process. Many thoughts, suggestions, recommendations and directions help us to come up with the final contents. For the final year finishing touch is absolutely necessary which is provided with project based learning at the most.

I sincerely thank all the minds and hands who work adroitly to materialize these tasks. I really appreciate everyone's contribution and suggestions in finalizing the contents.

Dr. Varsha H. Patil

Coordinator, Board of Studies (Computer Engineering), SPPU, Pune

[This document contents Program Educational Objectives - Program Outcomes - Program Specific Outcomes(page 3),Courses (teaching scheme, examination, marks and credit)(page 4-5), Courses syllabi(page 7-85) and FE to BE courses at a glance(Page 86-87)].

Other related Syllabus Links:

[Syllabus for First Year Engineering \(2015 Course\)](#)

[Syllabus for Second Year Computer Engineering \(2015 Course\)](#)

[Syllabus for Third Year Computer Engineering \(2015 Course\)](#)

Savitribai Phule Pune University, Pune

Bachelor of 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 Pune University
Fourth Year of 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	50	--	100	--	02
410247	Laboratory Practice II	--	04	--	--	50	--	*50	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				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: Project/ Mini-Project Presentation

Savitribai Phule Pune University
Fourth Year of 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	50	--	100	--	02
410255	Laboratory Practice IV	--	04	--	--	50	--	*50	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) Compilers						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-IV: [Usability Engineering](#)AC6-II: [Gamification](#)AC6-V: [Conversational Interfaces](#)AC6-III: [Quantum Computing](#)AC6-VI: [MOOC- Learn New Skills](#)

Abbreviations:

TW: Term Work**TH:** Theory**OR:** Oral**PR:** Practical**Sem:** Semester**PRE:** Project/ Mini-Project Presentation

SEMESTER I



Savitribai Phule Pune University
Fourth 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
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Prerequisite Courses: 210253-Microprocessor, 210244- Computer Organization and Architecture, 210254-Principles of Programming Languages, 310251- Systems Programming and Operating System

Companion Course: 410246-Laboratory Practice I

Course Objectives:

- To study parallel computing hardware and programming models
- To be conversant with performance analysis and modeling of parallel programs
- To understand the options available to parallelize the programs
- To know the operating system requirements to qualify in handling the parallelization

Course Outcomes:

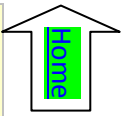
On completion of the course, student will be able to–

- Describe different parallel architectures, inter-connect networks, programming models
- Develop an efficient parallel algorithm to solve given problem
- Analyze and measure performance of modern parallel computing systems
- Build the logic to parallelize the programming task

Course Contents

Unit I	Introduction	09 Hours
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 architecture.		
Unit II	Parallel Programming	09 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	09 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 Models of Parallel Programs	09 Hours
Analytical Models: Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, and 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	Parallel Algorithms- Sorting and Graph	09 Hours
Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Parallelizing Quick sort, All-Pairs Shortest Paths, Algorithm for sparse graph, Parallel Depth-First Search, Parallel Best-First Search.		
Unit VI	CUDA Architecture	09 Hours
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:		
1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2 2. Jason sanders, Edward Kandrot, "CUDA by Example", Addison-Wesley, ISBN-13: 978-0-13-138768-3		
References:		
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 4. Rod Stephens, "Essential Algorithms", Wiley, ISBN: ISBN: 978-1-118-61210-1		



Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410242: Artificial Intelligence and Robotics

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: 210254-Principles of Programming Languages

Companion Course: 410246-Laboratory Practice I

Course Objectives:

- To understand the concept of Artificial Intelligence (AI)
- 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–

- 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	08 Hours
Artificial Intelligence: 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	08 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 Look ahead Strategies.		

Unit III	Logic and Reasoning	08 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	08 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, Boltzmann Machine.		
Unit V	Robotics	08 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	08 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:		
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:		
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 3. Andries P. Engelbrecht-Computational Intelligence: An Introduction, 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0		

Savitribai Phule Pune University

Fourth Year of Computer Engineering (2015 Course)

410243: **Data Analytics**

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

Prerequisite Courses: 310242-Database Management Systems

Companion Course: 410246-Laboratory Practice I

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 Outcomes:

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

- Write case studies in Business Analytic and Intelligence using mathematical models
- Present a survey on applications for Business Analytic and Intelligence
- Provide problem solutions for multi-core or distributed, concurrent/Parallel environments

Course Contents

Unit I	Introduction and Life Cycle	08 Hours
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	08 Hours
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	08 Hours
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	08 Hours
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	08 Hours
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	08 Hours
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:		
1. David Dietrich, Barry Hiller, “Data Science and Big Data Analytics”, EMC education services, Wiley publications, 2012, ISBN0-07-120413-X 2. Ashutosh Nandeshwar , “Tableau Data Visualization Codebook”, Packt Publishing, ISBN 978-1-84968-978-6		
References:		
1. Maheshwari Anil, Rakshit, Acharya, “Data Analytics”, McGraw Hill, ISBN: 789353160258. 2. Mark Gardner, “Beginning R: The Statistical Programming Language”, Wrox Publication, ISBN: 978-1-118-16430-3 3. Luís Torgo, “Data Mining with R, Learning with Case Studies”, CRC Press, Talay and Francis Group, ISBN9781482234893 4. Carlo Vercellis, “Business Intelligence - Data Mining and Optimization for Decision Making”, Wiley Publications, ISBN: 9780470753866.		



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
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Prerequisite Courses: 207003- Engineering Mathematics III

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To Study and understand representation and properties of signals and systems.
- To learn methodology to analyze signals and systems
- To study transformed domain representation of signals and systems
- To explore Design and analysis of Discrete Time (DT) signals and systems
- To Understand 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–

- Understand the mathematical models and representations of DT Signals and Systems
- Apply different transforms like Fourier and Z-Transform from applications point of view.
- Understand the design and implementation of DT systems as DT filters with filter structures and different transforms.
- Demonstrate the knowledge of signals and systems for design and analysis of systems
- Apply knowledge and use the signal transforms for digital processing applications

Course Contents

Unit I	Signals and Systems	08 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	08 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)	08 Hours

Effective computation of DFT, Radix-2 FFT algorithms: DIT FFT, DIF FFT, Inverse DFT using FFT, Z-transform (ZT), ZT and FT, ZT and DFT, ROC and its properties, ZT Properties, convolution, initial value theorem, Rational ZT, Pole Zero Plot, Behavior of causal DT signals, Inverse Z Transform (IZT): power series method, partial fraction expansion (PFE), Residue method.

Unit IV	Analysis of DT - LTI Systems	08 Hours
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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.

Unit V	Digital Filter Design	08 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, Pre-warping, Design examples, Comparison of IIR and FIR Filters.

Unit VI	Filter Structures and DSP Processors	08 Hours
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Filter Structures for FIR Systems: direct form, cascade form, structures for linear phase FIR Systems, Examples, Filter structures for IIR Systems: direct form, cascade form, parallel form, Examples DSP Processors: ADSP 21XX Features, comparison with conventional processor, Basic Functional Block diagram, SHARC DSP Processor Introduction to OMAP (Open Multimedia Application Platform).

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. Mitra S., "Digital Signal Processing: A Computer Based Approach", Tata McGraw-Hill, 1998, ISBN 0-07-044705-5
2. Iflechor E. C., Jervis B. W., "Digital Signal Processing: A Practical Approach", Pearson Education, 2002, ISBN-13: 978-0201596199, ISBN-10: 0201596199
3. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, "Digital Signal Processing", McGraw-Hill, ISBN 0-07-463996-X
4. S. Poornachandra, B. Sasikala, "Digital Signal Processing", 3rd Edition, McGraw-Hill, ISBN-13:978-07- 067279-6



Savitribai Phule Pune University

Fourth Year of Computer Engineering (2015 Course)

Elective I

410244(B): Software Architecture and Design

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: 310243- Software Engineering and Project Management

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To introduce basic concepts and principles about software design and software architecture
- To learn practical approaches and methods for creating and analyzing software architecture
- To acquaint with the interaction between quality attributes and software architecture
- To experience with examples in design pattern application and case studies in software architecture

Course Outcomes:

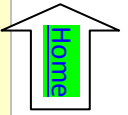
On completion of the course, student will be able to—

- Express the analysis and design of an application
- Specify functional semantics of an application
- Evaluate software architectures
- Select and use appropriate architectural styles and software design patterns

Course Contents

Unit I	Introduction	08 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	08 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	08 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	08 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	08 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", ISBN-10: 1590593413, ISBN-13: 978-1590593417 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:	Credit	Examination Scheme:
TH: 03 Hours/Week	03	In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks

Prerequisite Courses: 310245- Computer Networks

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- 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

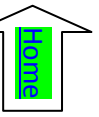
Course Outcomes:

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

- 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	08 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, Pinch Watch: A Wearable Device for One-Handed Micro interactions., Interfaces - Enabling mobile micro-interactions with physiological computing.		
Unit V	User Interface	08 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 and Application Development	08 Hours
Location as context, Location Tracking, Co-ordinate models, Location Data Sources, sorting and 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 and 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 and 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 5. Adelstein, “Fundamental of Mobile and Pervasive Computing”, McGrawHill, ISBN: 0-07-141237-9		

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective I
410244(D): Data Mining and Warehousing

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, 310244- Information Systems and Engineering Economics

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To understand the fundamentals of Data Mining
- To identify the appropriateness and need of mining the data
- To learn the preprocessing, mining and post processing of the data
- To understand various methods, techniques and algorithms in data mining

Course Outcomes:

On completion of the course the student should be able to-

- Apply basic, intermediate and advanced techniques to mine the data
- Analyze the output generated by the process of data mining
- Explore the hidden patterns in the data
- Optimize the mining process by choosing best data mining technique

Course Contents

Unit I

Introduction

08 Hours

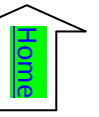
Data Mining, Data Mining Task Primitives, Data: Data, Information and Knowledge; Attribute Types: Nominal, Binary, Ordinal and Numeric attributes, Discrete versus Continuous Attributes; Introduction to Data Preprocessing, Data Cleaning: Missing values, Noisy data; Data integration: Correlation analysis; transformation: Min-max normalization, z-score normalization and decimal scaling; data reduction: Data Cube Aggregation, Attribute Subset Selection, sampling; and Data Discretization: Binning, Histogram Analysis

Unit II

Data Warehouse

08 Hours

Data Warehouse, Operational Database Systems and Data Warehouses(OLTP Vs OLAP), A Multidimensional Data Model: Data Cubes, Stars, Snowflakes, and Fact Constellations Schemas; OLAP Operations in the Multidimensional Data Model, Concept Hierarchies, Data Warehouse Architecture, The Process of Data Warehouse Design, A three-tier data warehousing architecture, Types of OLAP Servers: ROLAP versus MOLAP versus HOLAP.



Unit III	Measuring Data Similarity and Dissimilarity	08 Hours
Measuring Data Similarity and Dissimilarity, Proximity Measures for Nominal Attributes and Binary Attributes, interval scaled; Dissimilarity of Numeric Data: Minkowski Distance, Euclidean distance and Manhattan distance; Proximity Measures for Categorical, Ordinal Attributes, Ratio scaled variables; Dissimilarity for Attributes of Mixed Types, Cosine Similarity.		
Unit IV	Association Rules Mining	08 Hours
Market basket Analysis, Frequent item set, Closed item set, Association Rules, a-priori Algorithm, Generating Association Rules from Frequent Item sets, Improving the Efficiency of a-priori, Mining Frequent Item sets without Candidate Generation: FP Growth Algorithm; Mining Various Kinds of Association Rules: Mining multilevel association rules, constraint based association rule mining, Meta rule-Guided Mining of Association Rules.		
Unit V	Classification	08 Hours
Introduction to: Classification and Regression for Predictive Analysis, Decision Tree Induction, Rule-Based Classification: using IF-THEN Rules for Classification, Rule Induction Using a Sequential Covering Algorithm. Bayesian Belief Networks, Training Bayesian Belief Networks, Classification Using Frequent Patterns, Associative Classification, Lazy Learners-k-Nearest-Neighbor Classifiers, Case-Based Reasoning.		
Unit VI	Multiclass Classification	08 Hours
Multiclass Classification, Semi-Supervised Classification, Reinforcement learning, Systematic Learning, Wholistic learning and multi-perspective learning. Metrics for Evaluating Classifier Performance: Accuracy, Error Rate, precision, Recall, Sensitivity, Specificity; Evaluating the Accuracy of a Classifier: Holdout Method, Random Sub sampling and Cross-Validation.		
Books:		
Text:		
1. Han, Jiawei Kamber, Micheline Pei and Jian, "Data Mining: Concepts and Techniques", Elsevier Publishers, ISBN:9780123814791, 9780123814807. 2. Parag Kulkarni, "Reinforcement and Systemic Machine Learning for Decision Making" by Wiley-IEEE Press, ISBN: 978-0-470-91999-6		
References:		
1. Matthew A. Russell, "Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More", Shroff Publishers, 2nd Edition, ISBN: 9780596006068 2. Maksim Tsvetovat, Alexander Kouznetsov, "Social Network Analysis for Startups: Finding connections on the social web", Shroff Publishers , ISBN: 10: 1449306462		



Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective II
410245(A): Distributed Systems

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: 310254-Web Technology, 210254-Principles of Programming Languages

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To understand the concept of Distributed system ,remote method invocation and Remote Procedure Calls
- To learn communication methodology in distributed systems
- To acquaint with the Distributed File Systems
- To know the concepts of shared memory and security aspects in distributed system

Course Outcomes:

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

- Able to learn and apply the concept of remote method invocation and Remote Procedure Calls
- Able to analyze the mechanism of peer to peer systems and Distributed File Systems
- Demonstrate an understanding of the challenges faced by current and future distributed systems

Course Contents

Unit I	Introduction	08 Hours
Characteristics of Distributed Systems(DS): Introduction, Examples of DS, Trends in DS, Sharing Resources, Challenges in DS. System Models: Physical, Architectural and Fundamental Models Remote Invocation : Request Reply protocols, RPC, RMI, Case Study- JAVA RMI.		
Unit II	Inter-process Communication and Remote Invocation	08 Hours
Representing Distributed Algorithms: Representation Guarded Actions, Non-determinism, Atomic actions, Fairness, Central vs Distributed Scheduler. Time in Distributed Systems: Logical clocks, Vector clocks, Physical Clock Synchronization, Algorithms for Internal and External Clock Synchronization. Mutual Exclusion: Solution to Message passing systems, Token-Passing algorithms, Solutions on shared memory models, Mutual exclusion using special instructions, Group mutual exclusion.		
Unit III	Indirect Communication	08 Hours
Distributed Snapshot: Properties of Consistent snapshot, Chandy-Lamport algorithm, Lai-Yang algorithm, Distributed debugging. Global state collection : Elementary algorithm for All-to- All broadcasting, Termination Detection algorithm, Wave algorithm, Distributed deadlock detection Coordination Algorithms: Leader Elections, Algorithms like Bully, Maxima finding on the ring, election in arbitrary networks, Election in anonymous networks. Synchronizers: ABD synchronizer, Awerbuch's synchronizers.		

Unit IV	Distributed File Systems	08 Hours
Distributed consensus: Consensus in asynchronous systems, Consensus in synchronous systems, Paxo's algorithm, Failure detectors. Distributed Transactions: Classification of transactions, Implementing Transactions, Concurrency control and serializability, Atomic Commit protocols, Recovery from Failures.		
Unit V	Time, Global state and coordination	08 Hours
Group Communication: Atomic multicast, IP Multicast, Application layer multicast, Ordered multicast, Reliable multicast, Open groups. Replicated Data Management : Architecture of replicated Data Management, Data-Centric Consistency models, Client centric consistency protocols, Implementation of Data-Centric Consistency models, Quorum based protocols, Replica Placement, Brewer's CAP algorithm.		
Unit VI	Distributed Transaction and Replication	08 Hours
Distributed Discrete-Event Simulation: Distributed simulation, Conservative Simulation, Optimistic simulation and Time warp. Security in DS: Security Mechanisms to thwart various attacks in DS. Social and Peer-to-Peer network: Metrics of Social networks, Modeling Social Networks, Centrality measure in Social network, Community detection, Koorde and De Bruijn Graphs, Skip graph, Replication management, Bit-torrent and free riding, Censorship resistance and anonymity.		
Books:		
Text:		
1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems, Concepts and Design", Fifth Edition, Addison Wesley, ISBN 0-13-214301-1. 2. Sukumar Ghosh, "Distribute Systems : An Algorithmic Approach", Chapman and Hall/ CRC Press, Second Edition, 2015, ISBN 10: 1584885645 ISBN 13: 9781584885641 3. Andrew S. Tanenbaum and Maarten van Steen, "Distributed Systems –Principles and Paradigms" , PHI Publication, ISBN 0-13-239227-5		
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. Sape Mullender, "Distributed Systems", (Editor),Addison-Wesley Publication, ISBN 10: 0201624273 - ISBN13: 9780201624274 3. Kenneth, P. Birman, "Reliable Distributed Systems: Technologies, Web Services, and Applications", Springer; 1 edition, ISBN-10: 0387215093; ISBN-13: 978-0387215099 4. Galli D.L., "Distributed Operating Systems: Concepts and Practice", Prentice-Hall 2000, ISBN0-13-079843-6		



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
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Prerequisite Courses: 310243- Software Engineering and Project Management, 310263- Software Modeling and Design

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- 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–

- 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
- Apply recent automation tool for various software testing for testing software
- Apply different approaches of quality management, assurance, and quality standard to software system
- Apply and analyze effectiveness Software Quality Tools

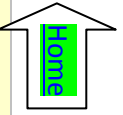
Course Contents

Unit I	Introduction	08 Hours
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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	08 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	08 Hours
What is Test Automation, Terms used in automation, Skills needed for automation, What to automate, scope of automation, Design and 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	08 Hours
Introducing Selenium, Brief History of The Selenium Project, Selenium's Tool Suite, Selenium-IDE, Selenium RC, Selenium Webdriver, Selenium Grid, Test Design Considerations		
Unit V	Quality Management	08 Hours
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	08 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 and 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
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Prerequisite Courses: 210241- Discrete Mathematics, 310243- Software Engineering and Project Management

Companion Course: 410247-Laboratory Practice II

Course Objectives:

- To introduce the learners the 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 the 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:

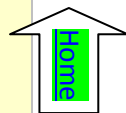
On completion of the course, student will be able to–

- 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	08 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	08 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	08 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, Minimax, Maximin principle, Principle of Dominance, Solution for mixed strategy problems, Graphical method for 2 x n and m x 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	08 Hours
Integer Programming Algorithms – BandB 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 and Materials Management		
Unit VI	Decision Theory and Sensitivity Analysis	08 Hours
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 and Co, "Operations Research", 2009, ISBN:978-81-224-2288-7 2. Hrvey 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 know GSM architecture and support services
- To learn current technologies being used on field

Course Outcomes:

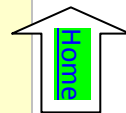
On completion of the course, student will be able to–

- 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.
- Use the 3G/4G technology based network with bandwidth capacity planning.
- Percept to the requirements of next generation mobile network and mobile applications.

Course Contents

Unit I	Introduction to Cellular Networks	08 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	08 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	08 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	08 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	08 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, Wiley Publication, ISBN: 978812651560 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. Lee and Kappal, “Mobile Communication Engineering”, Mc Graw Hill, ISBN: 3. William Stallings, “Wireless Communication and Networks”, Prentice Hall, Second Edition, 2014, ISBN: 978-0131918351		



Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
410246: Laboratory Practice I

Teaching Scheme: Practical : 04 Hours/Week	Credit 02	Examination Scheme: Term Work: 50 Marks Practical: 50 Marks
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Companion Courses: 410241, 410242 and 410243

Course Objectives and Outcomes: Practical hands on is the absolute necessity as far as employability of the learner is concerned. The presented course is solely intended to enhance the competency by undertaking the laboratory assignments of the core courses.

About

Laboratory Practice I is for practical hands on for core courses High Performance Computing, AI & Robotics, and Data Analytics.

Guidelines for Laboratory Conduction

- List of recommended programming assignments and sample mini-projects is provided for reference.
- Referring these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related to the respective courses.
- Preferably there should be multiple sets of assignments/mini-project and distribute among batches of students.
- Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects.
- Mini-project can be completed in group of 2 to 3 students.
- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.
- Instructor may also set one assignment or mini-project that is suitable to respective course **beyond the scope of syllabus.**

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

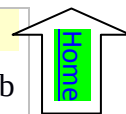
Programming Languages: C++/JAVA/PYTHON/R

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

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal may consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/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 digital storage media/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 to be 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 **reserving weightage for successful mini-project completion and related documentation.**

Guidelines for Practical Examination

- Both internal and external examiners should jointly frame suitable problem statements for practical examination based on the term work completed.
- 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.
- 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 boost to the student's academics.

Guidelines for Instructor's Manual

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

Suggested List of Laboratory Assignments

(any 04 assignments per High Performance Computing, AI, and Data Analytics and Mini-project per course)

410241:: High Performance Computing

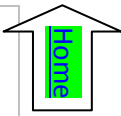
Note: for all programming assignments of HPC-

- Select the suitable model of a parallel computation (Data parallel model, Task graph model, Work pool model, Master slave model , Producer consumer or pipeline model, Hybrid model or other) for algorithm to be developed by considering a strategy for dividing the data, processing method and suitable strategy to reduce interactions.
- Assume suitable processor model, topology, load distribution strategy and Communication.
- Utilize all available resources.
- Test on data set of sufficiently large size
- Compute Total cost and Efficiency as

$$\text{Total Cost} = \text{Time complexity} \times \text{Number of processors used}$$

$$\text{Efficiency} = \text{WCSA} / \text{WCPA}$$
 (WCSA--Worst case execution time of sequential algorithm and WCPA--Worst case execution time of the parallel algorithm)
- Compare performance by varying number of processors used and also with sequential algorithm.

1. a) Implement Parallel Reduction using Min, Max, Sum and Average operations.
 b) Write a CUDA program that, given an N-element vector, find-

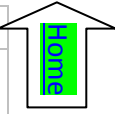


	•The maximum element in the vector •The minimum element in the vector •The arithmetic mean of the vector •The standard deviation of the values in the vector Test for input N and generate a randomized vector V of length N (N should be large). The program should generate output as the two computed maximum values as well as the time taken to find each value.
2.	Vector and Matrix Operations- Design parallel algorithm to 1. Add two large vectors 2. Multiply Vector and Matrix 3. Multiply two $N \times N$ arrays using n^2 processors
3.	Parallel Sorting Algorithms- For Bubble Sort and Merger Sort, based on existing sequential algorithms, design and implement parallel algorithm utilizing all resources available.
4.	Parallel Search Algorithm- Design and implement parallel algorithm utilizing all resources available. for • Binary Search for Sorted Array • Depth-First Search (tree or an undirected graph) OR • Breadth-First Search (tree or an undirected graph) OR • Best-First Search that (traversal of graph to reach a target in the shortest possible path)
5.	Parallel Implementation of the K Nearest Neighbors Classifier
Sample Mini Projects	
6.	Compression Module (Image /Video) Large amount of bandwidth is required for transmission or storage of images. This has driven the research area of image compression to develop parallel algorithms that compress images. OR For video: RGB To YUV Transform concurrently on many core GPU
7.	Generic Compression Run length encoding concurrently on many core GPU
8.	Encoding Huffman encoding concurrently on many core GPU
9.	Database Query Optimization Long running database Query processing in parallel
410242: Artificial Intelligence and Robotics	
1.	Implement Tic-Tac-Toe using A* algorithm
2.	Implement 3 missionaries and 3 cannibals problem depicting appropriate graph. Use A* algorithm.
3.	Solve 8-puzzle problem using A* algorithm. Assume any initial configuration and define goal configuration clearly.
4.	Define the operators for controlling domestic robot; use these operators to plan an activity to be executed by the robot. For example, transferring two/three objects one over the other from

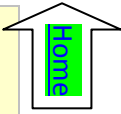
	one place to another. Use Means-Ends analysis with all the steps revealed.														
5.	Implement any one of the following Expert System , - Medical Diagnosis of 10 diseases based on adequate symptoms - Identifying birds of India based on characteristics														
6.	Implement alpha-beta pruning graphically with proper example and justify the pruning.														
7.	Develop elementary chatbot for suggesting investment as per the customers need.														
8.	Solve following 6-tiles problem stepwise using A* algorithm, Initial Configuration <table><tr><td>B</td><td>W</td><td>B</td><td>W</td><td>B</td><td>W</td><td></td></tr></table> Final Configuration <table><tr><td>B</td><td>B</td><td>B</td><td>W</td><td>W</td><td>W</td><td></td></tr></table> Constraint: Tiles can be shifted left or right 1 or 2 positions with cost 1 and 2 respectively.	B	W	B	W	B	W		B	B	B	W	W	W	
B	W	B	W	B	W										
B	B	B	W	W	W										
9.	Implement goal stack planning for the following configurations from the blocks world, B A C D C A B D Start Goal														
10.	Use Heuristic Search Techniques to Implement Hill-Climbing Algorithm.														
11.	Use Heuristic Search Techniques to Implement Best first search (Best-Solution but not always optimal) and A* algorithm (Always gives optimal solution).														
12.	Constraint Satisfaction Problem: Implement crypt-arithmetic problem or n-queens or graph coloring problem (Branch and Bound and Backtracking)														
13.	Implement syntax analysis for the assertive English statements. The stages to be executed are, - Sentence segmentation - Word tokenization - Part-of-speech/morpho syntactic tagging - Syntactic parsing (Use any of the parser like Stanford)														

410243:: Data Analytics

1.	Download the Iris flower dataset or any other dataset into a DataFrame. (eg https://archive.ics.uci.edu/ml/datasets/Iris) Use Python/R and Perform following – - How many features are there and what are their types (e.g., numeric, nominal)? - Compute and display summary statistics for each feature available in the dataset. (eg. minimum value, maximum value, mean, range, standard deviation, variance and percentiles - Data Visualization-Create a histogram for each feature in the dataset to illustrate the feature distributions. Plot each histogram. - Create a boxplot for each feature in the dataset. All of the boxplots should be combined into a single plot. Compare distributions and identify outliers.
2.	Download Pima Indians Diabetes dataset. Use Naive Bayes' Algorithm for classification - Load the data from CSV file and split it into training and test datasets. - summarize the properties in the training dataset so that we can calculate probabilities and make predictions. - Classify samples from a test dataset and a summarized training dataset.



3.	Write a Hadoop program that counts the number of occurrences of each word in a text file.
4.	Write a program that interacts with the weather database. Find the day and the station with the maximum snowfall in 2013
5.	Use Movies Dataset. Write the map and reduce methods to determine the average ratings of movies. The input consists of a series of lines, each containing a movie number, user number, rating, and a timestamp: The map should emit movie number and list of rating, and reduce should return for each movie number a list of average rating.
6.	Trip History Analysis: Use trip history dataset that is from a bike sharing service in the United States. The data is provided quarter-wise from 2010 (Q4) onwards. Each file has 7 columns. Predict the class of user. Sample Test data set available here https://www.capitalbikeshare.com/trip-history-data
7.	Bigmart Sales Analysis: For data comprising of transaction records of a sales store. The data has 8523 rows of 12 variables. Predict the sales of a store. Sample Test data set available here https://datahack.analyticsvidhya.com/contest/practice-problem-big-mart-sales-iii/
8.	Twitter Data Analysis: Use Twitter data for sentiment analysis. The dataset is 3MB in size and has 31,962 tweets. Identify the tweets which are hate tweets and which are not. Sample Test data set available here https://datahack.analyticsvidhya.com/contest/practice-problem-twitter-sentiment-analysis/
9.	Time Series Analysis: Use time series and forecast traffic on a mode of transportation. Sample Test data set available here https://datahack.analyticsvidhya.com/contest/practice-problem-time-series-2/



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 Presentation: 50 Marks
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Companion Courses: 410244 and 410245

Course Objectives and Outcomes: Practical hands on is the absolute necessity as far as employability of the learner is concerned. The presented course is solely intended to enhance the competency by undertaking the laboratory assignments of the core courses. Enough choice is provided to the learner to choose an elective of one's interest.

Laboratory Practice II is companion lab for elective course I and elective course II.

Guidelines for Laboratory Conduction

- List of recommended programming assignments and sample mini-projects is provided for reference.
- Referring these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related to the respective courses.
- Preferably there should be multiple sets of assignments/mini-project and distribute among batches of students.
- Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects.
- Mini-project can be completed in group of 2 to 3 students.
- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.
- Instructor may also set one assignment or mini-project that is suitable to respective course **beyond the scope of syllabus.**

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

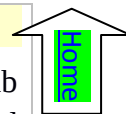
Programming Languages: C++/JAVA/PYTHON/R

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

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal may consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/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 digital storage media/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 to be 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 **reserving weightage for successful mini-project completion and related documentation.**

Guidelines for Practical Examination

- **It is recommended to conduct examination based on Mini-Project demonstration and related skill learned.** Team of 2 to 3 students may work on mini-project. During the assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation and software engineering approach followed.
- The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding, effective and efficient implementation and demonstration skills.
- 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 Instructor's Manual

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

Suggested List of Laboratory Assignments

Recommended / Sample set of assignments and mini projects for reference for all four courses offered for Elective I and for all four courses offered for Elective II. Respective Student have to complete laboratory work for elective I and II that he/she has opted.

410244: Elective I

410244(A) : Digital Signal Processing

- | | |
|----|--|
| 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. Program 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, Henning, Kaiser. 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

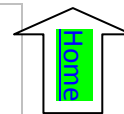
1.	Mini-Project 1: Narrate concise System Requirements Specification and organize the problem domain area into broad subject areas and identify the boundaries of problem/system. Identify and categorize the target system services with detailed service specifications modeled with component diagram incorporating 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

Mini-Projects are to be designed so as to use,

- No / minimal extra hardware,
- uses open source software's,
- need hardly any subscription / telephony / data charges.

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 a mobile application with context awareness to determine the remaining battery level depending on the users current usage patterns.
3.	Design and build a music streaming system and a smart mobile application to use the speakers or headphones of the smart phone 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



	phone automatically. -OR- Smart Mobile Application with ambient light sensing to adjust the screen brightness automatically.
5.	Mini-Project 1: Smart Mobile Application for Location-Based Messaging Design and build a 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.
6.	Mini-Project 2: Smart Mobile Application as a Museum Guide Build a Mobile Application as a museum guide, the device scans the QR codes on the artifacts and gives an interactive detailed explanation using Audio / Text / Video about the museum artifact. using location of the user and the list of previously seen artifacts, the mobile application can suggest / recommend which next artifacts to be seen by the user
7.	Mini-Project 3: Smart Mobile Application as a Travel / Route Guide, Scenario - You are visiting an ancient monument. There is no local guide available. The previous users have commented on various locations where artifacts 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.
8.	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. These include such characteristics as, • Location awareness and GPS systems • Accelerometers • Messaging • Sensor detection capability • Microphone and Camera • Media Player • Touch screen • Mapping Technology • Mobile Web Services
410244(D): Data Mining and Warehousing	
1.	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. For Example: Business Origination: Sales, Order, Marketing Process.
2.	Consider a suitable dataset. For clustering of data instances in different groups, apply different clustering techniques (minimum 2). Visualize the clusters using suitable tool.
3.	Apply a-priori algorithm to find frequently occurring items from given data and generate strong association rules using support and confidence thresholds. 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.	Mini project on classification: 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.

For Example: Health Care Domain for predicting disease

410245: Elective II

410245(A): Distributed Systems

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

Mini-Projects

Important properties your system should have:

- The system must support multiple, autonomous agents (either human or automated) contending for shared resources and performing real-time updates to some form of shared state.
- The state of the system should be distributed across multiple client or server nodes.

The only centralized service should be one that supports users logging on, adding or removing clients or servers, and other housekeeping tasks.

- The system should be robust

The system should be able to continue operation even if one of the participant nodes crashes.

It should be possible to recover the state of a node following a crash, so that it can resume operation.

We will let you choose your own application, and we will give you wide latitude in the overall and the detailed design of your implementation.

Design, implement, and thoroughly test a distributed system, implementing - Shared document editing, in the style of Google docs. The system should support real-time editing and viewing by multiple participants. Multiple replicas would be maintained for fault tolerance. Caching and/or copy migration would be useful to minimize application response time.

Design, implement, and thoroughly test a distributed system, implementing - A low-latency notification system. E.g., watch a whole bunch of RSS feeds and send all subscribers an email when one is updated. Interface with both the raw RSS feeds and Google's update notification service. Replicate and partition the state of the monitoring system so that it can scale and survive node failures.

Design, implement, and thoroughly test a distributed system, implementing - An airline reservation system. Each airline would maintain its own collection of servers, with enough state replication to enable automatic fail-over. It would be possible to book travel that involves multiple airlines.

Design, implement, and thoroughly test a distributed system, implementing - Implement a distributed file system that does something interesting. Maybe you want one for storing your MP3s or movies. Or perhaps for something entirely different.

410245(B): Software Testing and Quality Assurance

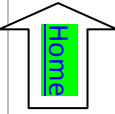
1. **Mini-Project 1:** Create a small application by selecting relevant system environment / platform and programming languages. Narrate concise Test Plan consisting features to be tested and bug taxonomy. Prepare Test Cases inclusive of Test Procedures for identified Test Scenarios. Perform selective 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

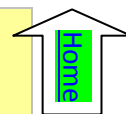
1. **The Transportation Problem:**
 Milk in a milk shed area is collected on three routes A, B and C. There are four chilling centers P, Q, R and S where milk is kept before transporting it to a milk plant. Each route is able to supply on an average one thousand liters of milk per day. The supply of 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 Centers			
	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										
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.	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: • Zoom and View change • Navigation to specific locations • Marker and getting location with touch • Monitoring of location									
7.	Mini-Project 2: Create an app to add of a product to SQLite database and make sure to add following features • SMS messaging and email provision • Bluetooth options • Accessing Web services • Asynchronous remote method call • Use Alert box for user notification									
8.	Mini-Project 3: Create the module for collecting cellular mobile network performance parameters using telephony API Manager • Nearest Base Station • Signal Strengths • SIM Module Details • Mobility Management Information									
9.	Mini-Project 4: Create an application for Bank using spinner, intent • 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 second form. Provide different menu options									
10.	Mini-Project 5: Create the module for payment of fees for College by demonstrating the following methods. • 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 : 02 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 at least 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 (2015 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:

- To introduce the aspects of Entrepreneurship
- To acquaint with legalities in product development
- To understand IPR, Trademarks, Copyright and patenting
- To know the facets of functional plans, Entrepreneurial Finance and Enterprise Management

Course Outcome:

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

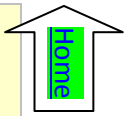
- Understand the legalities in product development
- Undertake the process of IPR, Trademarks, Copyright and patenting
- Understand and apply functional plans
- Manage Entrepreneurial Finance
- Inculcate managerial skill as an entrepreneur

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; 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.
- 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, 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 and acquisitions

Books:

1. Kumar, Arya, ``Entrepreneurship: Creating and Leading an Entrepreneurial Organization'', Pearson ISBN-10: 8131765784; ISBN-13: 978-8131765784 ...
2. Hishrich., Peters, ``Entrepreneurship: Starting, Developing and Managing a New Enterprise'', ISBN 0-256-14147- 9
3. Irwin Taneja, ``Entrepreneurship,`` Galgotia Publishers. ISBN: 978-93-84044-82-4
4. Charantimath, Poornima, ``Entrepreneurship Development and Small Business Enterprises,`` Pearson Education, ISBN, 8177582607, 9788177582604.



Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 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
- To learn the concept of Botnet

Course Outcome:

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

- Implement security as a culture and show mistakes that make applications vulnerable to attacks.
- Understand various attacks like DoS, buffer overflow, web specific, database specific, web - spoofing attacks.
- 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 Sensors and 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 and Botnet
- 5. Service Layer Protocols and 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 and 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 and 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 (2015 Course)
410249: Audit Course 5
AC5 – III: 3D Printing

**Course Objectives:**

- To understand the principle of 3D printing
- To understand resource requirements of 3D printing
- To know the basic artwork needed for 3D printing

Course Outcomes:

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

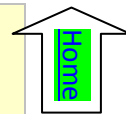
- Apply models for 3D printing
- Plan the resources for 3D printing
- Apply principles in 3D printing in real world

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 (2015 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 it's designing and their meticulous implementation.

Course Objectives:

- To understand Industrial hazards and Safety requirements with norms
- To learn the basics of Safety performance planning
- To know the means of accident prevention
- To understand the impact of industrialization on environment
- To know the diversified industrial requirements of safety and security

Course Outcomes:

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

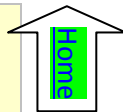
- Formulate the plan for Safety performance
- Formulate the action plan for accidents and hazards
- Follow the safety and security norms in the industry
- Consider critically the environmental issues of Industrialization

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,
- 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.

Books:

1. Basudev Panda ,“Industrial Safety, Health Environment and Security”,Laxmi Publications, ISBN-10: 9381159432, 13: 978-9381159439
2. L.M. Deshmukh, “Industrial Safety Management”, TMH , ISBN: 9780070617681



Savitribai Phule Pune University, Pune
Fourth Year of Computer Engineering (2015 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 the leadership effectiveness by creating an atmosphere that engages others

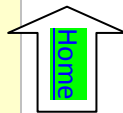
Course Contents:

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 (2015 Course)
410249: Audit Course 5
AC5 – VI & AC6-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 (not opted earlier) 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:

- To understand human learning aspects 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–

- Distinguish different learning based applications
- Apply different preprocessing methods to prepare training data set for machine learning.
- Design and implement supervised and unsupervised machine learning algorithm.
- Implement different 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
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
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
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Prerequisite Courses: 310245-Computer Networks

Companion Course: 410254: Laboratory Practice III

Course Objectives:

- To offer an understanding of principle concepts, central topics and basic approaches in information and cyber security.
- To know the basics of cryptography.
- To acquire knowledge of standard algorithms and protocols employed to provide confidentiality, integrity and authenticity.
- To enhance awareness about Personally Identifiable Information (PII), Information Management, cyber forensics.

Course Outcomes:

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

- 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	08 Hours
Introduction, Elements of Information Security, Security Policy, Techniques, Steps, Categories, Operational Model of Network Security, Basic Terminologies in Network Security. Threats and Vulnerability, Difference between Security and Privacy.		
Unit II	Data Encryption Techniques And Standards	08 Hours
Introduction, Encryption Methods: Symmetric, Asymmetric, Cryptography, Substitution Ciphers. Transposition Ciphers, Stenography applications and limitations, Block Ciphers and methods of operations, Feistel Cipher, Data Encryption Standard (DES), Triple DES, DES Design Criteria, Weak Keys in DES Algorithms, Advance Encryption Standard (AES).		
Unit III	Public Key And Management	08 Hours
Public Key Cryptography, RSA Algorithm: Working, Key length, Security, Key Distribution, Diffie-Hellman Key Exchange, Elliptic Curve: Arithmetic, Cryptography, Security, Authentication methods, Message Digest, Kerberos, X.509 Authentication service. Digital Signatures: Implementation, Algorithms, Standards (DSS), Authentication Protocol.		
Unit IV	Security Requirements	08 Hours

IP Security: Introduction, Architecture, IPV6, IPv4, IPSec protocols, and Operations, AH Protocol, ESP Protocol, ISAKMP Protocol, Oakkey determination Protocol, VPN. WEB Security: Introduction, Secure Socket Layer (SSL), SSL Session and Connection, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol, Handshake Protocol. Electronic Mail Security: Introduction, Pretty Good Privacy, MIME, S/MIME, Comparison. Secure Electronic Transaction (SET).

Unit V**Firewall And Intrusion****08 Hours**

Introduction, Computer Intrusions. Firewall Introduction, Characteristics and types, Benefits and limitations. Firewall architecture, Trusted Systems, Access Control. Intrusion detection, IDS: Need, Methods, Types of IDS, Password Management, Limitations and Challenges.

Unit VI**Confidentiality And Cyber Forensic****08 Hours**

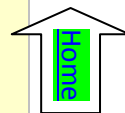
Introduction to Personally Identifiable Information (PII), Cyber Stalking, PII impact levels with examples Cyber Stalking, Cybercrime, PII Confidentiality Safeguards, Information Protection Law: Indian Perspective.

Books:**Text:**

1. Bernard Menezes, "Network Security and Cryptography", Cengage Learning India, 2014, ISBN No.: 8131513491
2. Nina Godbole, Sunit Belapure, "Cyber Security", Wiley India, 2014, ISBN No.: 978-81-345-2179-1

References:

1. Eoghan Casey, "Digital Evidence and Computer Crime Forensic Science, Computers and the Internet", ELSEVIER, 2011, ISBN 978-0-12-374268-1
2. Atul Kahate, "Cryptography and Network Security", Mc Graw Hill Publication, 2nd Edition, 2008, ISBN : 978-0-07-064823-4
3. William Stallings, "Cryptography and network security principles and practices", Pearson, 6th Edition, ISBN : 978-93-325-1877-3
4. Forouzan, "Cryptography and Network Security (SIE)", Mc Graw Hill, ISBN, 007070208X, 9780070702080
5. Dr. Nilakshi Jain-Digital Forensic: The Fascinating World of Digital Evidences-Wiley India-ISBN: 9788126565740



Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective III
410252(A): Advanced Digital Signal Processing

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: 410244(A) Digital Signal Processing

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To study the parametric methods for power spectrum estimation.
- To study adaptive filtering techniques and applications of adaptive filtering.
- To learn and understand Multi-rate DSP and applications
- To explore appropriate transforms
- Understand basic concepts of speech production, speech analysis, speech coding and parametric representation of speech
- Acquire knowledge about different methods used for speech coding and understand various applications of speech processing
- Learn and understand basics of Image Processing and various image filters with its applications

Course Outcomes:

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

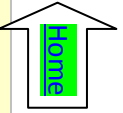
- Understand and apply different transforms for the design of DT/Digital systems
- Explore the knowledge of adaptive filtering and Multi-rate DSP
- Design DT systems in the field/area of adaptive filtering, spectral estimation and multi-rate DSP
- Explore use of DCT and WT in speech and image processing
- Develop algorithms in the field of speech , image processing and other DSP applications

Course Contents

Unit I	DFT and Applications	08 Hours
DFT and Applications – Linear filtering, spectral leakage, Spectral resolution and selection of Window Length, Frequency analysis, 2-D DFT, applications in Image and Speech Processing		
Unit II	Adaptive FIR and IIR filter Design	08 Hours
Adaptive FIR and IIR filter Design – DT Filters, FIR and IIR filters, Adaptive FIR Filter design: Steepest descent and Newton method, LMS method, Applications, Adaptive IIR Filter design: Pade Approximation, Least square design, Applications		
Unit III	Multi-rate DSP and applications	08 Hours
Adaptive FIR and IIR filter Design – DT Filters, FIR and IIR filters, Adaptive FIR Filter design: Steepest descent and Newton method, LMS method, Applications, Adaptive IIR Filter design: Pade Approximation, Least square design, Applications		



Unit IV	Spectral Estimation	08 Hours
Spectral Estimation – Estimation of density spectrum, Nonparametric method, Parametric method, Evaluation ,DCT and WT – DCT and KL transform, STFT, WT, Harr Wavelet and Dubecheis Wavelet, Applications of DCT and WT.		
Unit V	Speech processing	08 Hours
Speech processing - Speech coding: Phase Vocoder, LPC, Sub-band coding, Adaptive Transform Coding, Harmonic Coding, Vector Quantization based Coders. Fundamentals of Speech recognition, Speech segmentation, Text-to-speech conversion, speech enhancement, Speaker Verification, Applications.		
Unit VI	Image Processing	08 Hours
Image Processing – Image as 2D signal and image enhancement techniques, filter design: low pass, highpass and bandpass for image smoothing and edge detection, Optimum linear filter and order statistic filter, Examples – Wiener and Median filters, Applications		
Books:		
Text:		
1. J. G. Proakis, D. G. Manolakis, “ Digital Signal Processing: Principles, Algorithms, and Applications,” Prentice Hall, 2007, 4th edition, ISBN: 10: 0131873741 2. Dr. Shaila D. Apate , “ Advanced Digital Signal Processing,” Wiley Publ., 2013, ISBN-10: 8126541245 3. S. K. Mitra, “Digital Signal Processing : A Computer Based Approach”, McGraw Hill Higher Education, 2006, 3rd edition, ISBN-10: 0070429537 4. Rabiner and Juang, “Fundamentals of Speech Recognition”, Prentice Hall, 1994, ISBN:0-13-015157-2 . 5. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing and Analysis”, Pearson Education, 3d Ed., 2007, ISBN: 81-7808-629-8		
References:		
1. Chanda, Muzumdar, “Digital Image Processing and Analysis,” Estern Economy Edition, PHI, 2nd Ed., ISBN: 978-81-203-4096-1 2. TarunRawat, “Digital Signal Processing”, Oxford University Press, 2015, ISBN-10: 0198062281 3. Roberto Crist, “Modern Digital Signal Processing,” Thomson Brooks/Cole 2004, ISBN:978-93-80026-55-8. 4. Nelson Morgan and Ben Gold, “ Speech and Audio Signal Processing: Processing and Perception Speech and Music”, 1999, John Wiley and Sons, ISBN: 0387951547 5. Raghuveer. M. Rao, AjitS.Bopardikar, “Wavelet Transforms: Introduction to Theory and applications,” Pearson Education, Asia, 2000.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): Compilers

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: Theory of Computation(310241), 310251-Systems Programming and Operating System

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- 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–

- 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	08 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	08 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	08 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	08 Hours
Storage Management – Static, Stack and 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	08 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	08 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:		
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:		
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		

Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)
Elective III

410252(C): Embedded and Real Time Operating System

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: 310251-Systems Programming and Operating System

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- 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 learn software development process and tools for RTOS applications

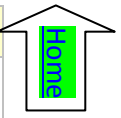
Course Outcomes:

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

- 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)	08 Hours
Embedded SOC, ASIC, IP core, ASIP, ASSP, examples of embedded systems. Advanced architectures/processors for embedded systems- ARM, SHARC, DSP, Superscalar Units. Processor organization, Memory organization, Performance metrics for a processor, memory map and addresses, Processor selection and memory selection for real-time applications. Networked embedded systems- I2C, CAN, USB, Fire wire. Internet enabled systems- TCP, IP, UDP. Wireless and mobile system Protocols- IrDA, Bluetooth, 802.11, ZigBee.		
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 a-periodic and sporadic real-time tasks.		
Unit V	Inter-process communication	08 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	08Hours
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
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Prerequisite Courses: 310250-Design and Analysis of Algorithm

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To know the basics behind the Design and development intelligent systems in the framework of soft computing
- To acquire knowledge of Artificial Neural Networks Fuzzy sets, Fuzzy Logic, Evolutionary computing and swarm intelligence
- To explore the applications of soft computing
- To understand the need of optimization

Course Outcomes:

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

- Apply 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	Introduction	08 Hours
Introduction, soft computing vs. hard computing, various types of soft computing techniques, and 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	08 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, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications and Defuzzifications.		
Unit III	Fuzzy Systems	08 Hours
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 IV	Evolutionary Computing	08 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 V	Genetic Algorithm	08 Hours
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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 and advances in GA, Differences and similarities between GA and other traditional method, applications.

Unit VI	Swarm Intelligence	08 Hours
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Swarm intelligence , Particle Swarm Optimization (PSO) Algorithm- Formulations, Pseudo-code, parameters, premature convergence, topology, biases, Real valued and binary PSO, Ant colony optimization (ACO)- Formulations, Pseudo-code. Applications of PSO and ACO.

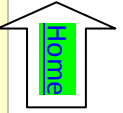
Books:

Text:

1. S.N. Sivanandam- “Principles of Soft Computing”, Wiley India- ISBN- 9788126527410
2. S. Rajsekaran and G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications” , Prentice Hall of India, ISBN: 0451211243
3. J S R Jang, CT Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing” , 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

References:

1. Andries P. Engelbrecht, “Computational Intelligence: An Introduction”, 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0
2. N.P.Padhy, “Artificial Intelligence and Intelligent Systems” Oxford University Press, ISBN 10: 0195671546
3. Siman Haykin, “Neural Networks”, Prentice Hall of India, ISBN: 0-7923-9475-5
4. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” , Wiley India, ISBN: 978-0-470-74376-8
5. 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
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Prerequisite Courses: 310245-Computer Networks

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- To understand the challenges of the traditional networks and evolution of next generation networks.
- To gain conceptual understanding of Software Defined Networking (SDN) and its role in Data Center.
- To understand role of Open Flow protocol and SDN Controllers.
- To study industrial deployment use-cases of SDN
- To Understand the Network Functions Virtualization and SDN.

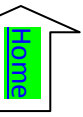
Course Outcomes:

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

- 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)	08 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 and 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	08 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	08 Hours
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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 Centre	08 Hours
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Data Center Definition, Data Center Demands (Adding, Moving, Deleting Resources, Failure Recovery, Multitenancy, Traffic Engineering and 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)	08 Hours
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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	08 Hours
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Wide Area Networks, Service Provider and Carrier Networks, Campus Networks, Hospitality Networks, Mobile Networks, Optical Networks, SDN vs P2P/Overlay Networks.

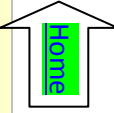
Books:

Text:

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:

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
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Prerequisite Courses: 210251-Computer Graphics

Companion Course: 410255-Laboratory Practice IV

Course Objectives:

- 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.
- Learn a variety of methods for evaluating the quality of a user interface
- To implement simple graphical user interfaces based on principles of HCI.

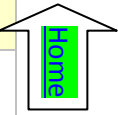
Course Outcomes:

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

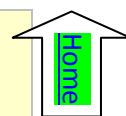
- Evaluate the basics of human and computational abilities and limitations.
- Inculcate basic theory, tools and techniques in HCI.
- Apply the fundamental aspects of designing and evaluating interfaces.
- Apply appropriate HCI techniques to design systems that are usable by people

Course Contents

Unit I	Foundations of Human–Computer Interaction	08 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	08 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	08 Hours
Implementation Tools, Technology and change designing for the Web, designing for portable devices. Handling errors and Designing Help. Prototyping and UI Software.		
Unit IV	Evaluation and User Support	08 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	08 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	08 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:		
1. Alan J, Dix. Janet Finlay, Rusell 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:		
3. Jonathan Lazar, Jinjuan Feng, Harry Hochheiser, "Research Methods in Human-Computer Interaction", Third Edition, Morgan Kaufmann, 2017, ISBN: 9780128053904. 4. 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:

- To understand cloud computing concepts;
- To study various platforms for cloud computing
- To explore the applications based on cloud computing

Course Outcomes:

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

- To install cloud computing environments.
- To develop any one type of cloud
- To explore future trends of cloud computing

Course Contents

Unit I	Basics of Cloud Computing	08 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	08 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	08 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 and Content Delivery Identify key AWS storage options Describe Amazon EBS Creating an Elastic Block Store Volume Adding an EBS Volume to an Instance Snap shooting 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	08 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	08 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.

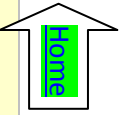
Books:

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, ISBN10: 8126536039
2. Buyya, "Mastering Cloud Computing", Tata McGraw Hill, ISBN-13: 978-1-25-902995-0,
3. Barrie Sosinsky,"Cloud Computing", Wiley India, ISBN: 978-0-470-90356-8
4. Kailash Jayaswal, "Cloud computing", Black Book, Dreamtech Press
5. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, "Cloud Computing: Concepts, Technology and Architecture", Pearson, 1st Edition, ISBN :978 9332535923, 9332535922
4. 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)
Elective IV
410253(D): Open Elective

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

Companion Course: 410255-Laboratory Practice IV

The open elective included, so as to give the student a wide choice of subjects from other Engineering Programs. To inculcate the out of box thinking and to feed the inquisitive minds of the learners the idea of open elective is need of the time.

Flexibility is extended with the choice of open elective allows the learner to choose interdisciplinary/exotic/future technology related courses to expand the knowledge horizons.

With this idea learner opts for the course without any boundaries to choose the approved by academic council and Board of Studies.

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: 50 Marks

Companion Courses: 410250 and 410251

Course Objectives and Outcomes: Practical hands on is the absolute necessity as far as employability of the learner is concerned. The presented course is solely intended to enhance the competency by undertaking the laboratory assignments of the core courses.

About

Laboratory Practice III is for practical hands on for core courses Machine Learning and Information & Cyber Security.

Guidelines for Laboratory Conduction

- List of recommended programming assignments and sample mini-projects is provided for reference.
- Referring these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related to the respective courses.
- Preferably there should be multiple sets of assignments/mini-project and distribute among batches of students.
- Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects.
- Mini-project can be completed in group of 2 to 3 students.
- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.
- Instructor may also set one assignment or mini-project that is suitable to respective course **beyond the scope of syllabus.**

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

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal may consists of prologue, Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/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 digital storage media/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 to be 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 **reserving weightage for successful mini-project completion and related documentation.**

Guidelines for Practical Examination

- Both internal and external examiners should jointly frame suitable problem statements for practical examination based on the term work completed.
- 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.
- 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 boost to the student's academics.

Guidelines for Instructor's Manual

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

Suggested List of Laboratory Assignments

(any 04 assignments Machine Learning and Information & Cyber Security AND Mini-project per course)

410250: Machine Learning

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

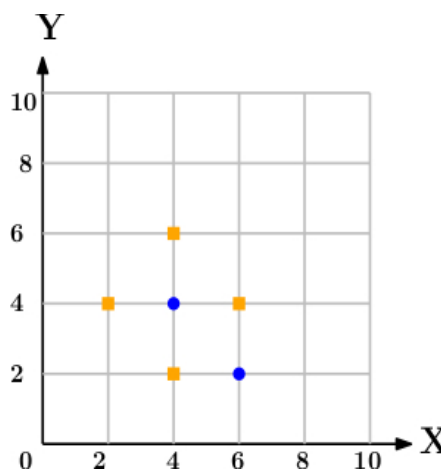
2. Assignment on Decision Tree Classifier:

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

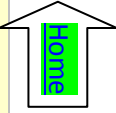


4. Assignment on K-Means Clustering:

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	
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 Presentation: 50 Marks

Companion Courses: 410252 and 410253

Course Objectives and Outcomes: Practical hands on is the absolute necessity as far as employability of the learner is concerned. The presented course is solely intended to enhance the competency by undertaking the laboratory assignments of the elective courses. Enough choice is provided to the learner to choose an elective of one's interest.

Laboratory Practice II is companion lab for elective course III and elective course IV.

Guidelines for Laboratory Conduction

- List of recommended programming assignments and sample mini-projects is provided for reference.
- Referring these, Course Teacher or Lab Instructor may frame the assignments/mini-project by understanding the prerequisites, technological aspects, utility and recent trends related to the respective courses.
- Preferably there should be multiple sets of assignments/mini-project and distribute among batches of students.
- Real world problems/application based assignments/mini-projects create interest among learners serving as foundation for future research or startup of business projects.
- Mini-project can be completed in group of 2 to 3 students.
- Software Engineering approach with proper documentation is to be strictly followed.
- Use of open source software is to be encouraged.
- Instructor may also set one assignment or mini-project that is suitable to respective course beyond the scope of syllabus.

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

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal may consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software and Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory- Concept in brief, Algorithm/Database design, test cases, conclusion/analysis). Program codes with sample output of all performed assignments are to be submitted as softcopy.

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Guidelines for Assessment

Continuous assessment of laboratory work is to be 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 **reserving weightage for successful mini-project completion and related documentation.**

Guidelines for Practical Examination

- **It is recommended to conduct examination based on Mini-Project demonstration and related skill learned.** Team of 2 to 3 students may work on mini-project. During the assessment, the expert evaluator should give the maximum weightage to the satisfactory implementation and software engineering approach followed.
- The supplementary and relevant questions may be asked at the time of evaluation to test the student's for advanced learning, understanding, effective and efficient implementation and demonstration skills.
- 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 Instructor's Manual

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

Suggested List of Laboratory Assignments

Recommended / Sample set of assignments and mini projects for reference for all four courses offered for Elective I and for all four courses offered for Elective II. Respective Student have to complete laboratory work for elective I and II that he/she has opted.

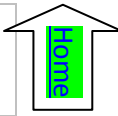
410252: Elective III

410252 (A) Advanced Digital Signal Processing

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) 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	
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

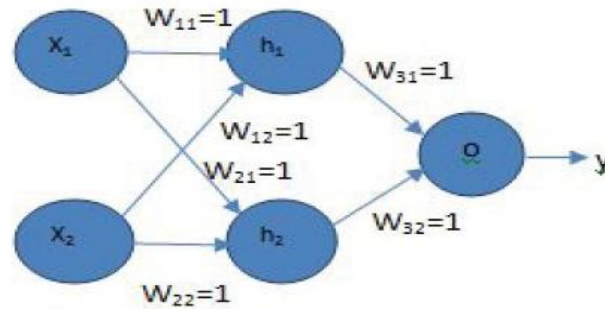
- Autonomous car
- Smart home (sound system, temperature, light)
- Control of an autonomous quadrocopter (e.g. for surveillance tasks)
- Control of a rail station
- Video conference system

Washing machine

Course: 410252 (D) Soft Computing and Optimization Algorithms

1. 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.
2. Implement genetic algorithm for benchmark function (eg. Square, Rosenbrock function etc) Initialize the population from the Standard Normal Distribution. Evaluate the fitness of all its individuals. Then you will do multiple generation of a genetic algorithm. A generation consists of applying selection, crossover, mutation, and replacement.
Use:
 - Tournament selection without replacement with tournament size s
 - One point crossover with probability P_c
 - bit-flip mutation with probability P_m
 - use full replacement strategy
3. Implement Particle swarm optimization for benchmark function (eg. Square, Rosenbrock function). Initialize the population from the Standard Normal Distribution. Evaluate fitness of all particles.
Use :
 - $c_1=c_2 = 2$
 - Inertia weight is linearly varied between 0.9 to 0.4.
 - Global best variation
4. Implement basic logic gates using Mc-Culloch-Pitts or Hebbnet neural networks
5. 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.
6. 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.
7. 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]



8. **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
9. Apply the Particle swarm optimization for Travelling Salesman Problem
10. **Mini-Project 2** on Fuzzy Logic:
Solve Greg Viot's fuzzy cruise controller using MATLAB Fuzzy logic toolbox or Octave or Python.
11. **Mini-Project 3** on Fuzzy Logic:
Solve Air Conditioner Controller using MATLAB Fuzzy logic toolbox or Octave or Python.

410253: Elective III

Course: 410253 (A) Software Defined Networks

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

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.

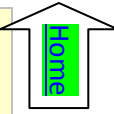
Course: 410253 (C) Cloud Computing

List of Mini-projects: Students have to carry out following **two mini-projects in a group of 2-3 students.**

1.	1. Installation and configuration of own Cloud 2. Implementation of Virtualization in Cloud Computing to Learn Virtualization Basics, Benefits of Virtualization in Cloud using Open Source Operating System. 3. Study and implementation of infrastructure as Service using Open Stack. 4. Write a program for Web feed using PHP and HTML. 5. Write a Program to Create, Manage and groups User accounts in own Cloud by Installing Administrative Features. 6. Case study on Amazon EC2 to learn about Amazon EC2, Amazon Elastic Compute Cloud is a central part of Amazon.com's cloud computing platform, Amazon Web Services. How EC2 allows users torrent virtual computers on which to run their own computer applications. 7. Case study on Microsoft azure to learn about Microsoft Azure is a cloud computing platform and infrastructure, created by Microsoft, for building, deploying and managing applications and services through a global network of Microsoft-managed datacenters. How it work, different services provided by it. 8. Design and develop custom Application (Mini Project) using Salesforce Cloud. 9. Assignment to install and configure Google App Engine. 10. Design an Assignment to retrieve, verify, and store user credentials using Firebase Authentication, the Google App Engine standard environment, and Google Cloud Data store. 11. Creating an Application in SalesForce.com using Apex programming Language. 12. Design an Assignment based on Working with Mangrasoft Aneka Software.
2.	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.
3.	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.

Course: 410253 (D) Open Elective

Suitable set of programming assignments/Mini-projects for open elective Opted.



Savitribai Phule Pune University
Fourth Year of Computer Engineering (2015 Course)

410256: Project Work Stage II

Teaching Scheme: Practical : 06 Hours/Week	Credit 06	Examination Scheme: Term Work: 100 Marks Presentation: 50 Marks
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Companion Course:

Course Objectives:

- 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—

- 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

Guidelines

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 and submit the report of Project work in standard format for satisfactory completion of the work that is the duly certified by the concerned guide and head of the Department/Institute.

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)
410257: Audit Course 6


 Home

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 |
|---|--|

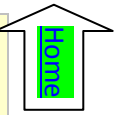
Guidelines for Assessment (Any one or more of following but not limited to)

- | | |
|---|---|
| <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 (Refer Page 48)

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 understand the concept of Business Intelligence
- To know the details of Decision Support System
- To inculcate the concepts of Data Warehousing
- To understand the basics of design and management of BI systems

Course Outcome:

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

- Apply the concepts of Business Intelligence in real world applications
- Explore and use the data warehousing wherever necessary
- Design and manage practical BI systems

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, Determining BI Cycle, BI Environment and Architecture, Identify BI opportunities, Benefits 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 and 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 or business continuity

Books:

1. R. Sharda, D. Delen, and 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: 9788120339279

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 Zechemann, 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–

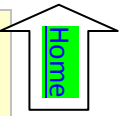
- design efficient quantum algorithms
- apply quantum algorithms for several basic promise problems
- learn the hidden subgroup problems and their role in quantum computing

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 and 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:

- To understand the human centered design process and usability engineering process and their roles in system design and development.
- To know usability design guidelines, their foundations, assumptions, advantages, and weaknesses
- Understand the user interface based on analysis of human needs and prepare a prototype system

Course Outcome:

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

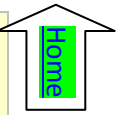
- Describe the human centered design process and usability engineering process and their roles in system design and development.
- Discuss usability design guidelines, their foundations, assumptions, advantages, and weaknesses.
- Design a user interface based on analysis of human needs and prepare a prototype system.
- Assess user interfaces using different usability engineering techniques.
- Present the 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:

- To understand the basics of conversation
- To know the interactive environments for conversational skills
- To acquaint with the speech to text and text to speech techniques

Course Outcome:

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

- Develop an effective interface for conversation
- Explore advanced concepts in user interface

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. Srinijanthan, “Hands-On Chatbots and Conversational UI Development: Build chatbots”

Savitribai Phule Pune University
Bachelor of Computer Engineering (2015 Course)
(Total 190 Credit)

First Year		Second Year		Third Year		Forth Year	
Credit =50		Credit =50		Credit =46		Credit =44	
Semester I							
Course Code	Course	Course Code	Course	Course Code	Course	Course Code	Course
107001	Engineering Mathematics I	210241	Discrete Mathematics	310241	Theory of Computation	410241	High Performance Computing
107002 / 107009	Engineering Physics / Engineering Chemistry	210242	Digital Electronics and Logic Design	310242	Database Management Systems (DBMS)	410242	Artificial Intelligence and Robotics
102006	Engineering Graphics I	210243	Data Structures and Algorithms	310243	Software Engineering & Project Management	410243	Data Analytics
103004 / 104012	Basic Electrical Engineering /Basic Electronics Engineering	210244	Computer Organization and Architecture	310244	Information Systems & Engineering Economics	410244	Elective I • Digital Signal Processing • Software Architecture and Design • Pervasive and Ubiquitous Computing • Data Mining and Warehousing
101005	Basic Civil and Environmental Engineering	210245	Object Oriented Programming	310245	Computer Networks (CN)	410245	Elective II • Distributed Systems • Software Testing and Quality Assurance • Operations Research • Mobile Communication
110003	Fundamentals of Programming Languages I	210246	Digital Electronics Lab	310246	Skills Development Lab	410246	Laboratory Practice I
111007	Workshop Practice	210247	Data Structures Lab	310247	DBMS Lab	410247	Laboratory Practice II
		210248	Object Oriented Programming Lab	310248	CN Lab	410248	Project Work Stage I
		210249	Soft Skills	310249	Audit Course 3	410249	Audit Course 3
		210250	Audit Course 1				

Semester II[Home](#)

Course Code	Course	Course Code	Course	Course Code	Course	Course Code	Course
107008	Engineering Mathematics II	207003	Engineering Mathematics III	310250	Design & Analysis of Algorithms	410250	Machine Learning
107009 / 107002	Engineering Chemistry / Engineering Physics	210251	Computer Graphics	310251	Systems Programming & Operating System (SP & OS)	410251	Information and Cyber Security
102013	Basic Mechanical Engineering	210252	Advanced Data Structures	310252	Embedded Systems & Internet of Things (ES & IoT)	410252	Elective III Advanced Digital Signal Processing Compilers Embedded and Real Time Operating System Soft Computing and Optimization Algorithms
101011	Engineering Mechanics	210253	Microprocessor	310253	Software Modeling and Design	410253	Elective IV Software Defined Networks Human Computer Interface Cloud Computing Open Elective
04012 / 103004	Basic Electronics Engineering / Basic Electrical Engineering	210254	Principles of Programming Languages	310254	Web Technology	410254	Laboratory Practice III
110010	Fundamentals of Programming Languages II	210255	Computer Graphics Lab	310255	Seminar & Technical Communication	410255	Laboratory Practice IV
102014	Engineering Graphics II	210256	Advanced Data Structures Lab	310256	Web Technology Lab	410256	Project Work Stage II
		210257	Microprocessor Lab	310257	SP & OS Lab	410257	Audit Course 3
		210258	Audit Course 2	310258	ES & IoT Lab		
				310259	Audit Course 4		

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Syllabus for ME (Computer Engineering)

Course 2013 (w.e.f 2013)

Subject Code	Subject	Teaching Scheme Hrs/Week		Examination Scheme					Credits
		Lect.	Pract	Paper		Tw	Oral/Presentation	Marks	
				In Semester Assessment	End Semester Assessment				
SEM — I									
510101	Applied Algorithms	04	—	50	50	—	—	100	4
510102	High Performance Databases	04	—	50	50	—	—	100	4
510103	Advanced Computer Architecture	04	—	50	50	—	—	100	4
510104	Research Methodology	04	—	50	50	—	—	100	4
510105	Elective –I	05	—	50	50#	—	—	100	5
510106	Laboratory Practice-I	—	04	—		50	50	100	4
	Total	21	04	250	250	50	50	600	25
Subject Code	Subject	Teaching Scheme Hrs/Week		Examination Scheme					Credits
		Lect.	Pract	Paper		Tw	Oral/Pre-sentation	Marks	
				In Semester Assessment	End Semester Assessment				
SEM— II									
510107	Operating System Design	04	—	50	50	—	—	100	4
510108	Software Design and Architecture	04	—	50	50	—	—	100	4

510109	Advanced Computer Networks	04	—	50	50	—	—	100	4
510110	Elective –II	05	—	50	50#	—	—	100	5
510111	Laboratory Practice-II	—	04	—		50	50	100	4
510112	Seminar-I	—	04	—		50	50	100	4
	Total	17	08	200	200	100	100	600	25
Subject Code	Subject	Teaching Scheme Hrs/Week		Examination Scheme				Credits	
		Lect.	Pract	Paper		Tw	Oral/Pre sentation	Marks	
				In Semes ter Assess ment	End Semes ter Assess ment				
SEM— III									
610101	Advanced Storage Systems and Infrastructure Management	04	—	50	50	—	—	100	4
610102	Advanced Unix Programming	04	—	50	50	—	—	100	4
610103	Elective-III	05	—	50	50#	—	—	100	4
610104	Seminar –II	04	—			50	50	100	5
610105	Dissertation Stage – I	—	08	—		50	50	100	8
	Total	17	08	150	150	100	100	500	25

Subject Code	Subject	Teaching Scheme Hrs/Week		Examination Scheme					Credits
		Lect.	Pract	Paper		Tw	Oral/Pre sentation	Marks	
				In Semes ter Assess ment	End Semes ter Assess ment				
SEM— IV									
610106	Seminar –III	—	05	—	—	50	50	100	5
610107	Dissertation Stage – II	—	20	—	—	150	50	200	20
	Total		25	—	—	200	100	300	25

#: Ref. Rule R-1.3 for Examination Rules of “Rules and Regulations for M.E. Programs under faculty of Engineering effective from June 2013”.

Electives:

Elective I		Elective II	
510105A	Intelligent Systems	510110A	Business Intelligence and Data Mining
510105B	IR and Web Mining	510110B	Usability Engineering
510105C	Machine Learning and Translation	510110C	Advanced Compiler Design
510105D	Open Elective /Real Time Systems	510110D	Open Elective/ Embedded System Design

Elective III	
610103A	Network Security
610103B	Cloud Computing
610103C	Computer Vision and Pattern Recognition
610103D	Open Elective/ Soft Computing

For the purpose of workload/ Contact Hrs calculation, the dissertation workload of two Hrs/week/dissertation and for the seminars one Hrs/week/seminar be considered in the teachers and class time-table.

The dissertation must result into the publication of at least two research papers (at Stage-I and Stage-II respectively) preferably in the Journal having Citation Index 2.0 and ISSN number; or paper can be published in reputed International Journal recommended by the guide of the Dissertation and the BoS supported cPGCON event for paper presentation and participation. The guides certificate covering originality of the work and plagiarism-testing result shall be included in the report along with the Published Journal Papers and. cPGCON paper presentation and participation certificates. The comments received by the journal paper reviewers be attached in the Dissertation report and shall be made available during dissertation presentation/viva to the examiners.

Objectives

- This course covers selected topics in algorithms that have found applications in areas such as geometric modeling, graphics, robotics, vision, computer animation, etc.
- The course objective is to teach problem formulation and problem solving skills.
- The course aims at keeping a sound balance between programming and analytical problem solving.

Unit I. Analysis of Algorithms

Review of algorithmic strategies, Asymptotic analysis: upper and lower complexity bounds. Identifying differences among best, average and worst Case Behaviors. Big O, little O, omega and theta notations, Standard complexity classes. Empirical measurements of performance. Time and space trade-offs in algorithms. Analyzing recursive algorithms using recurrence relations.

Unit II. Fundamental Computing Algorithms

Numerical algorithms, Sequential and binary search algorithms. Quadratic sorting algorithms and $O(n \log n)$ sorting algorithms. Algorithms on graphs and their complexities using Greedy Approach for --- Prim's and Krushkal's Algorithm for minimum spanning tree, Single source shortest path Algorithm, all pair shortest paths in Graph

Unit III. Approximation Algorithms

Introduction, Absolute approximation, Epsilon approximation, Polynomial time Approximation schemes, probabilistically good algorithms.

Unit IV. Geometric Algorithms

Prerequisites – Basic properties of line, intersection of line, line segment, polygon, etc. Line segment properties, detecting segment intersection in time complexity $(n \log n)$, Convex hull problem – formulation, solving by Graham scan algorithm, Jarvis march algorithm; closest pair of points – problem formulation, solving by divide & conquer method.

Unit V. Linear Programming

Standard and Slack forms, formulation of problems as linear programs, simplex algorithm, duality, initial basic feasible solution.

Problem formulation for – single source shortest path, maximum flow problem, Vertex cover problem, Knapsack problem.

Unit VI. Probability Based Analysis

Expectations: Introduction, Moments, Expectations of functions of more than one random variable, transform methods, moments and transforms of distributions, computation of mean time to failure, inequalities and limit theorems

Reference Books:

1. Kishore S. Trivedi, "Probability & Statistics with Reliability, Queing, and Computer Science Applications" PHI
2. Cormen, Leiserson, Rivest, "Algorithms", PHI
3. Bressard, "Fundamentals of Algorithms", PHI
4. Horowitz, Sahni, "Fundamentals of Computer Algorithm", Galgotia

5. S. Baase, S and A. Van Gelder, "Computer Algorithms: Introduction to Design and Analysis", 3rd edition. Addison Wesley, 2000
6. Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms", Addison Wesley
7. Knuth, "Art of Programming", Addison Wesley
8. C Papadimitriou and K Steiglitz, "Combinatorial Optimization", PHI

510102 - High Performance Databases

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory In-semester Assessment: 50 Marks
Theory End-semester Assessment: 50 Marks
Total Credits : 04

UNIT I. Physical database design & Tuning

Database workloads, physical design and tuning decisions, Need for Tuning

Index selection: Guideline for index selection, Clustering & Indexing Tools for index selection

Database Tuning: Tuning indexes, Tuning Conceptual schema Tuning Queries & views, Impact of Concurrency, Benchmarking

UNIT II. Distributed Databases

Introduction, Design Framework, Design of database fragmentation, The Allocation of Fragments, Translation of global queries to fragment queries, Optimization of access queries, Distributed Transaction Management, Concurrency Control, Reliability.

UNIT III. Advance Transaction Processing

Transaction Processing Monitors, Transactional Workflow, Real time transaction System, Long duration Transactions, Transaction Management in Multi-databases, Distributed Transaction Management, Main Memory Databases, and Advanced Transaction Models.

UNIT IV. Semi-Structured Data and XML

Semi-Structured Data, Introduction to XML, XML hierarchical Model, DTD & XML schema, XML Namespace, XML query & Transformation: Xpath, XSLT, XQuery, Storage of XML data, **XML Technologies** : DOM & SAX Interfaces X pointer, Xlink, XHTML, SOAP, WSDL, UDDI, XML database Application.

UNIT V. Emerging Trends in Databases

Introduction, Motivation, Temporal databases, Spatial & geographic databases, Multimedia Databases, Mobility & personal Databases

UNIT VI. Advanced Application Development

Performance Tuning, Performance Benchmarks, Standardization, E-Commerce, Legacy Systems, Large-scale Data Management with HADOOP, Semi structured database COUCHDB: Introduction, Architecture and principles, features

References:

- Database system Concept by Silberschatz And Korth 6th Edition
- Distributed Databases principles & systems by Stefano Ceri, Giuseppe Pelagatti
- Web Data Management, Abiteboul, Loana, Philippe Et. al Cambridge publication
- Database Systems, Thomas Connolly, Carolyn Begg, Pearson 4th Edition
- Database Management Systems by [Raghu Ramakrishnan](#) and [Johannes Gehrke](#)

510103- Advanced Computer Architecture

Teaching Scheme

Lectures: 4 Hrs/week

Examination Scheme

Theory In-semester Assessment: 50 Marks

Theory End-semester Assessment: 50 Marks

Total Credits : 04

Unit – I Introduction to architectures and Computing Models

Evolution in processor development, Generic computer architecture, Data representation, Instruction sets, data path and control, memory management, Buses and peripherals, Networking and communication, Multiprocessor and multicomputer, multivector and SIMD systems, PRAM and VLSI models, network properties, conditions for parallelisms, partitioning and scheduling, program flow mechanisms, system interconnect architectures

Unit –II Performance metrics

Metrics and measures for parallel programs, Speedup performance laws, scalability analysis approaches, Amdahl's law, limitation, Benchmark, SIMD, MIMD Performance.

Unit – III Hardware parallelism

Processor and memory hierarchy- Advanced processor technology, superscalar and vector processors, memory hierarchy, virtual memory, shared memory organizations, bus systems, consistency on shared data, Pipelining- Linear and non linear pipelines, Instruction pipelines, instruction and arithmetic pipeline design

Unit – IV Parallel and Scalable architectures

Multiprocessor and system interconnects, cache coherence and synchronization mechanisms, multicomputer generations, message passing paradigms, Multivector architecture-principles of vector processing, multivector multiprocessors, compound vector processing, SIMD organization, MIMD organization, multithread and dataflow architectures: Multithreading, fine grained multicomputers, dataflow and hybrid architectures, Single Program-Multiple Data(SPMD), Multiple Program, Multiple Data(MPMD), Case study of non-coherent multiprogramming in PRAM

Unit – V Parallel programming and program development environments

Parallel programming models, parallel languages and compilers, dependence analysis and of data arrays, code optimization and scheduling, loop parallelism and pipelining, Parallel programming environments, synchronization and multiprocessing modes, shared variable programs, message passing programs, mapping programs on multi-computers. Operating system support for parallel program execution, processes and threads, parallel programming languages-C-Linda, Fortran-90, Programming with MPI. Introduction to map-reduce.

Unit – VI Advanced Computing Architectures

Quantum Computing, Bio/Molecular Computing, Grid Computing, Neuro Computing, Cloud Computing, Introduction to GPU parallel architecture.

Reference Books:

1. Computer Architecture and Organization, Miles Murdocca, Vincent Heuring- Wiley Publication
2. Advanced Computer Architecture, Kai Hwang and Naresh Jotwani, Mc. Graw. Hill Publication
3. High Performance Computer Architectures by Harrold Stone
4. Computer Architecture: A Quantitative Approach, John L Hennessy, David a Patterns, 4th Edition, Elsevier, ISBN: 976-61-312-0721-0

510104- Research Methodology

Teaching Scheme

Lectures: 4 Hrs/week

Examination Scheme

Theory In-semester Assessment: 50 Marks

Theory End-semester Assessment: 50 Marks

Total Credits : 04

- Objective: to introduce the student to research methodology, and to prepare them for conduct independent research

Unit I. Understand the research process

Evolution of research methodology; Meaning, nature, scope, and significance of research; Research paradigm; Objectives of research, Motivation for research; Postulates underlying scientific investigations; Types of research; Research process and workflow; Principles of ethics, ethical considerations in research; Intellectual Property Rights (IPR)

Unit II. Problem identification and hypothesis formulation

Selecting an area for research; Problem identification; Literature search; “Understanding” reported research; Fitting the pieces; Ascertaining current state of knowledge; Sources of information; Recording literature search findings; Defining the problem; Hypothesis formulation

Unit III. Research design

Type of research designs, pitfalls and advantages; Research approaches; Principles of experimental design; Design of experiments; Characteristics of good research design; Universe, population, and sample; Sampling concepts, principles, and techniques; Sample design (random, pseudo random, cluster, stratified, multi-stage); Sampling considerations (size, design, selection, measurements); Measures, Measurements, Metrics, and Indicators; Measurement scales and direct measurements

Unit IV. Methods, tools, and techniques

Data collection techniques (observation, interviewing, questionnaires, web-based, group techniques, experimentation, surveys); Sources of errors; Reliability and validity; Probability theory and theoretical distributions; Parametric statistics, Simple linear models (ANOVA, correlation and Regression, ANACOVA), Multivariate analysis, Step-wise regression; Non-parametric statistics, Sign test, Paired ranking test, Pearson Correlation, Man-Whitney U Test, Chi-square test,

Unit V. Data processing and Data analysis

Primary and secondary data; coding and summarization of data, quantification of qualitative data (content analysis); Computation of indirect metrics; Role of descriptive statistics; Measures of central tendency, dispersion, skewness, kurtosis; plots and correlations; Inferential statistics, hypothesis testing, Type I and Type II errors, Power of tests; Role of computers in research; Use of statistical packages (e.g. SPSS)

Unit VI. Reporting research

Dissemination of research findings; Reporting and interpretation of results; cautions in interpretations, Type of reports, Typical report outlines, use of diagrams, tables, and charts; Optimization and optimization methods, Introduction to game theory, Queuing theory

References:

1. Kothari C.R., Research Methodology (2nd Ed.), New Age International, (2004); ISBN(13): 978-81-224-1522-3
2. Kumar, Ranjit, Research Methodology (3rd Ed); Sage Publications, 2011; IBSN: 978-1-8492-0301-2
3. Berkman, Elliot T., A Conceptual Guide to Statistics Using SPSS, Sage Publications, 2011; ISBN: 978-1-4129-7406-6

ELECTIVE-I

510105A- Intelligent Systems

Teaching Scheme

Lectures: 5 Hrs/week

Examination Scheme

Theory In-semester Assessment: 50 Marks

Theory End-semester Assessment: 50 Marks

Total Credits : 05

1. Introduction

Intelligent Agents: Introduction. Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Problem Formulation: Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Avoiding Repeated States, Searching with Partial Information.

2. Search Methods

Informed Search and Exploration: Informed (Heuristic) Search Strategies, Heuristic Functions, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces, Online Search Agents and Unknown Environments, Generic Algorithms for TSP.

Constraint Satisfaction Problems: Constraint Satisfaction Problems, Backtracking Search for CSPs, Local Search for Constraint Satisfaction Problems, Structure of Problems.

3. Planning

The Planning Problem, Planning with State-Space Search, Partial-Order Planning, Planning Graphs, Planning with Propositional Logic, Analysis of Planning Approaches.

4. Planning and Acting in the Real World

Time, Schedules and Resources, Hierarchical Task Network Planning, Planning and Acting in Nondeterministic Domains, Conditional Planning, Execution Monitoring and Re-planning, Continuous Planning, Multi-Agent Planning.

5. Uncertain knowledge and reasoning

Acting under Uncertainty, Basic Probability Notation, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions, Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks, Extending Probability to First-Order Representations, Other Approaches to Uncertain Reasoning.

6. Making Simple &Complex Decisions

Combining Beliefs and Desires under Uncertainty, The Basis of Utility Theory, Utility Functions, Multi-attribute Utility Functions, Decision Networks, The Value of Information, Decision-Theoretic Expert Systems, Sequential Decision Problems, Value Iteration, Policy Iteration.

Reference Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach" 2nd Edition Pearson Publication, ISBN No.978-81-775-8367-0.
2. Patrick Henry Winston, "Artificial Intelligence", 3rd Edition.,Pearson Publication, ISBN No. 978-81-317-1505-5.
3. Patrick Henry Winston., "Lisp programming language", Pearson Publication.

510105B- IR and WEB Mining

Teaching Scheme

Lectures: 5 Hrs/week

Examination Scheme

Theory In-semester Assessment: 50 Marks

Theory End-semester Assessment: 50 Marks

Total Credits : 05

Unit I. Information Retrieval Basics

Goals and history of IR. The impact of the web on IR. Components of an IR system, Boolean and vector-space retrieval models; ranked retrieval; text-similarity metrics; TF-IDF (term frequency/inverse document frequency) weighting; cosine similarity. Simple tokenizing, stop-word removal, and stemming; inverted indices, Index Construction and compression.

Unit II. Information Retrieval Models

Probabilistic Information Retrieval, Language Modeling for Information Retrieval, Adhoc Retrieval, Latent Semantic Indexing, Relevance feedback, Pseudo relevance feedback, Query expansion, Query languages, POS tagging,

Unit III. Web Mining

Web Structure, content and usage mining, Web Crawling, Indexes, Search engines; spidering; metacrawlers; directed spidering; link analysis (e.g. hubs and authorities, Google PageRank), Information Extraction, spam filtering, XML retrieval.

Unit IV. Performance metrics

Recall, precision, and F-measure; Evaluations on benchmark text collections, TREC Tracks. Social Networks : Social Web, Blogs, Wikis, Forums, Social Network analysis, Recommender systems, Information Filtering, Collaborative filtering and content-based recommendation of documents and products.

Unit V. Semantic web

Web 3.0, Ontology, OWL, RDF Schema, ontology learning, Knowledge representation, management and extraction, Multimedia Retrieval, Content based Image retrieval, Pattern Matching and classification for IR.

Unit VI. Specific topics in IR and Web Mining

Focused Retrieval, Transfer Learning, Learning to Rank, Personalisation, Behavioral Targeting, Cross Language IR, Digital Libraries, Bibliographic systems, Patent Search, E-learning, Security Issues, Political and ethical issues.

References :

1. Yates & Neto, "Modern Information Retrieval", Pearson Education, ISBN 81-297-0274-6 (2011).
2. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze , "Introduction to Information Retrieval" (available online at <http://nlp.stanford.edu/IR-book/>)
3. Chakrabarti, S., Mining the Web, Morgan Kaufmann (An Imprint of Elsevier) 2005.

Additional References :

1. C.J. Rijsbergen, "Information Retrieval", (<http://www.dcs.gla.ac.uk/Keith/Preface.html>)
2. Grossman, D. A. and Frieder, O., Information Retrieval: Algorithms and Heuristics. Kluwer 1998.
3. Search Engines: Information Retrieval in Practice by Bruce Croft, Donald Metzler, and Trevor Strohman, Addison-Wesley, 2009.
4. Information Retrieval: Implementing and Evaluating Search Engines by S. Buttcher, C. Clarke and G. Cormack, MIT Press, 2010.
5. Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data by B. Liu, Springer, Second Edition, 2011.

510105C- Machine Learning and Translation

Teaching Scheme

Lectures: 5 Hrs/week

Examination Scheme

Theory In-semester Assessment: 50 Marks

Theory End-semester Assessment: 50 Marks

Total Credits : 05

Unit I. Introduction to Machine Learning

Introduction to ML, Introduction to Statistical Learning Methods, History of Machine Learning, Machine-Learning Problem, Learning Paradigms, Machine-Learning Techniques and Paradigms, Need of Learning, Machine Intelligence

Unit II. Learning theory : Supervised learning and Unsupervised learning.

Logistic regression, Simple Neural Network, Perceptron, Generative learning algorithms. Gaussian discriminant analysis. Naive Bayes. Support vector machines. Model selection and feature selection. Ensemble methods: Bagging, boosting. Evaluating and debugging learning algorithms. VC dimension. Worst case (online) learning. Practical advice on how to use learning algorithms. Measuring Learning Performance, Learning and Knowledge building, Clustering. K-means. EM. Mixture of Gaussians. Factor analysis. PCA (Principal components analysis). ICA (Independent components analysis).

Unit III. Fundamentals of Whole-System, Systemic, and Multi-perspective Machine Learning

Systemic Machine Learning, Machine-Learning Framework, Multi-perspective Decision Making and Multiperspective Learning, Dynamic and Interactive Decision Making, The Systemic Learning Framework, System Analysis

Unit IV. Reinforcement Learning

Learning Agents, Returns and Reward Calculations, Reinforcement Learning and Adaptive Control, Dynamic Systems, Reinforcement Learning and Control, Markov Property and Markov Decision Process, Value Functions, Action and Value, Learning an Optimal Policy (Model-Based and Model-Free Methods), Dynamic Programming, Adaptive Dynamic Programming, Example: Reinforcement Learning for Boxing Trainer

Unit V. Machine Learning Models and Inference

A Framework for Learning, Capturing the Systemic View for learning, Mathematical Representation of System Interactions, Impact Function, Decision-Impact Analysis. Inference Mechanisms and Need, Integration of Context and Inference, Statistical Inference and Induction, Pure Likelihood Approach, Applying Bayesian Paradigm and Inference, Time-Based Inference, Inference to Build a System View, Applying Bayesian Learning, Applying SVM, Applying Gaussian maximum likelihood

Unit VI. Adaptive and Incremental Machine Learning

Adaptive Learning and Adaptive Systems, Adaptive Machine Learning, Adaptation and Learning Method Selection Based on Scenario, Applications of Adaptive Learning, Competitive Learning and Adaptive Learning, Incremental Learning, Learning from What Is Already Learned, Supervised Incremental Learning, Incremental Unsupervised Learning and Incremental Clustering, Semi-supervised Incremental Learning, Incremental and Systemic Learning, Incremental Closeness Value and Learning Method, Learning and Decision-Making Model, Incremental Classification Techniques

Unit VII. Knowledge Representation and Augmentation: A Machine Learning Perspective

Knowledge Augmentation and Knowledge Elicitation, Life Cycle of Knowledge, Incremental Knowledge Representation, Case-Based Learning and Learning with Reference to Knowledge Loss, Knowledge Augmentation: Techniques and Methods

Heuristic Learning , Systemic Machine Learning and Knowledge Augmentation, Knowledge Augmentation in Complex Learning Scenarios

Unit VIII. Building a Learning System

Systemic Learning System, Algorithm Selection, Knowledge Representation, Designing a Learning System, Making System to Behave Intelligently, Example-Based Learning. Holistic Knowledge Framework and Use of Reinforcement Learning, Intelligent Agents—Deployment and Knowledge Acquisition and Reuse, Case-Based Learning: Human Emotion-Detection System, Holistic View in Complex Decision Problem, Knowledge Representation and Data Discovery

References :

1. Reinforcement and Systemic Machine Learning for Decision Making, Parag Kulkarni, July 2012, Wiley-IEEE Press, ISBN: 978-0-470-91999-6
2. Introduction to Machine Learning, Ethem ALPAYDIN, The MIT Press, October 2004, ISBN 0-262-01211-1
3. Machine Learning, Tom Mitchell, McGraw Hill, 1997.
4. The Elements of Statistical Learning: Data Mining, Trevor Hastie, Robert Tibshirani, Jerome Friedman, Inference, and Prediction, Second Edition, February 2009

510105D- Real Time Systems

Teaching Scheme

Lectures: 5 Hrs/week

Examination Scheme

Theory In-semester Assessment: 50 Marks

Theory End-semester Assessment: 50 Marks

Total Credits : 05

Unit I. Introduction

Issues in Real-Time Computing, Structures of Real-Time System, Task Classes, Performance Measures for Real-Time Systems, Estimating Program Run Times

Unit II. Task Assignment and Scheduling

Classical Uni-processor Scheduling algorithm, Uni-processor Scheduling of IRIS Tasks, Task Assignment, Mode Changes, Fault Tolerant Scheduling

Unit III. Programming Languages and Tools

Desired Language characteristics, Data Typing , Control Structures , Facilitating Hierarchical Decomposition, Packages, Runtime Error (Exception) Handling, Overloading and Generics, Multitasking ,Low-Level Programming, Task Scheduling, Timing Specifications, Some experimental Languages, Programming Environments, Run-Time Support.

Unit IV. Real-Time Databases

Basic Definitions, Real-Time Vs General-Purpose Databases, Main Memory Databases, Transaction Priorities, Transaction Aborts, Concurrency Control Issues, Disk Scheduling algorithm, A Two Phase Approach To Improve Predictability, Maintain Serialization Consistency, Databases for Hard Real Time Systems.

Unit V. Real-Time Communication

Network Topologies ,Protocols ,Clocks , A Non Fault Tolerant Synchronization Algorithm, Impact of Faults , Fault Tolerant Synchronization in Hardware, Synchronization in Software

Unit VI. Fault Tolerant Techniques

Fault Types , Fault Detection, Fault and error Containment, Redundancy, Data Diversity, Reversal Checks, Malicious or Byzantine Failures, Integrated Failure Handling, Obtaining Parameter Values, Reliability Models for Hardware Redundancy, Software Error models, Taking Time into Account.

References:

1. C.M. Krishna, Kang G. Shin, “Real-Time Systems”, Tata McGraw Hill

510106- Laboratory Practice- I

Teaching Scheme

Practical: 4 Hrs/week

Examination Scheme

OR: 50 Marks

TW: 50 Marks

Total Credits : 04

1. Develop algorithmic solution for solving the problem stated in assignment 2, 3 below using set theory, Probability theory and/or required theories, strategy to design Turing machine, multiplexer logic inducing concurrency and perform NP-Hard analysis for the solution feasibility.
2. Design and implement the distributed architecture for the Hadoop having Name node, Tracker node and data nodes (separated by ADSL routers) or such recent technology. Prepare architecture diagram and installation document to be used for the assignment number 3
3. Implement Digital Library Infrastructure using Hadoop or similar recent technology for distributed database storage. To develop front end GUI and algorithm for searching the multimedia resource files, presentations in the selected domain, author, book title, ISBN. Use different search exploration techniques.

Or Assignments equivalent to above assignments.

4. Elective teacher shall design four suitable assignments based on Elective I maintaining above quality of the assignments.
5. Design and implement class/classes using latest 64-bit C++/JAVA/ Python/QT 5.1 and above, Cuda C++ or such latest 64-bit programming tools for the implementation of Two journal (IEEE Transactions/ACM Elsevier/Springer) papers published in the current year related to the respective elective subjects. Development Tools such as MATLAB/OPENCV/OPENMP/NS3 or equivalent may be used if required to interface the developed classes to the simulators.

Semester - II

510107- Operating System Design

Teaching Scheme

Lectures: 4 Hrs/week

Examination Scheme

Theory In-semester Assessment: 50 Marks

Theory End-semester Assessment: 50 Marks

Total Credits : 04

Unit I. Introduction

System levels, Hardware Resources, Resource management, Virtual Computers, The Hardware Interface, The CPU, Memory and Addressing, Interrupts, I/O Devices, The Operating System Interface, Information and Meta-Information, Naming Operating System Objects, Device as Files, The process Concept, Communication between Processes, UNIX-Style Process Creation, Standard Input and Standard Output, The User Interface to an Operating

Design Techniques: Operating Systems and Design, Design Problems, Design Techniques, Two Level Implementation, Interface Design, Connection in Protocols, Interactive and Programming Interfaces, Decomposition Patterns.

Unit II. Implementing Processes

Implementation of a Simple Operating System, Implementation of Processes, System Initialization, Process Switching, System Call Interrupt Handling, Program Error Interrupts, Disk Driver Subsystem, Implementation of Waiting, Flow of Control Through the Operating System, Signaling in an Operating System, Interrupts in the Operating System, Operating Systems as Event and Table Managers, Process Implementation, Examples of Process Implementation, Mono-programming, Parallel System.

Unit III. Inter process Communication Patterns

Patterns of Inter process communication, New message-passing system calls, IPC Patterns, Failure of Processes, Processes: Everyday Scheduling, Preemptive Scheduling Methods, Policy versus Mechanism in Scheduling, Scheduling in Real Operating Systems, Deadlock, Two Phase Locking, Starvation, Synchronization, Semaphores, Programming Language Based Synchronization Primitives, Message Passing Design Issues

Design Techniques: Indirection, Using State Machines, Win Big Then Give Some Back, Separation of Concepts, Reducing a Problem to a Special Case, Reentrant Programs, Using Models for Inspiration, Adding a New Facility To a System.

Unit IV. Memory Management

Levels of Memory Management, Linking and Loading a Process, Variations in Program Loading, The Memory Management Design Problem, Dynamic Memory Allocation, Keeping Track of the Blocks, Multiprogramming Issues, Memory Protection, Memory Management System Calls, Virtual Memory, Virtual Memory Systems

Design Techniques: Multiplexing, Late binding, Static Versus Dynamic, Space-Time Tradeoffs, Simple Analytic Models

Unit V. I/O Devices & File Systems

I/O Devices, I/O Systems, The File Abstraction, File Naming, File System Objects and Operations, File System Implementation, File Systems Organization

Design Techniques: Caching, Optimization and Hints, Hierarchical Names, Naming of Objects, Unification of Concepts.

Unit VI. Resource Management

Issues, Types of Resources, Integrated Scheduling, Queuing Models of Scheduling, Real-time Operating Systems, Protection of Resources, User Authentication, Mechanisms for Protecting Hardware Resources, Representation of Protection Information, Mechanisms For Software Protection, The Use of Cryptography in Computer Security, The Client Server Model

References:

1. Charles Crowley, “ Operating System: A Design-Oriented Approach”, Tata McGraw-Hill.

510108- Software Design and Architecture

Teaching Scheme
Lectures: 4 Hrs/week

Examination Scheme
Theory In-semester Assessment: 50 Marks
Theory End-semester Assessment: 50 Marks
Total Credits : 04

Unit I. Software Design Process

Role of Software Design: Software design process, nature of design process, design qualities; Transferring Design Knowledge: describe design solution, transferring design knowledge, design notations, design strategies,

Unit II. Object Oriented Design

Creational, Structural, behavioral design patterns, Component based design, Formal Approach to design

Unit III. Introduction to Software Architecture

What Is Software Architecture? Why Is Software Architecture Important? Quality Attributes, Architecture and Requirements, Designing an Architecture, Documenting software Architecture, Architecture and Software Product lines

Unit IV. Software Architecture Design

Designing, Describing, and Using Software Architecture, IS2000: The Advanced Imaging Solution, Global Analysis, Conceptual Architecture View, Module Architecture View, Styles of the Module Viewtype, Execution Architecture View, Code Architecture View. Component-and-Connector Viewtype, Styles of Component-and-Connector Viewtype, Allocation Viewtype and Styles.

Unit V. Archetype Patterns

Archetypes and Archetype Patterns, Model Driven Architecture with Archetype Patterns. Literate Modeling, Archetype Pattern. , Customer Relationship Management (CRM) Archetype Pattern, Product Archetype Pattern, Quantity Archetype Pattern, Rule Archetype pattern.

Unit VI. Software Architectures

Object-Oriented Paradigm, Data Flow Architectures, Data-Centered Software Architecture, Hierarchical Architecture, Interaction-Oriented Software Architectures, Distributed Architecture, Component-Based Software Architecture, Heterogeneous Architecture, Architecture of User Interfaces, Implicit asynchronous communication software architecture.

Reference Books:

1. David Budgen, "Software Design", 2nd edition, Pearson Education (LPE)
2. Software Design: From Programming to Architecture Eric J. Braude ISBN: 978-0-471-20459-6
3. Software Architecture in Practice, 3rd Edition By Len Bass, Paul Clements, Rick Kazman Published Sep 25, 2012 by Addison-Wesley Professional
4. Applied Software Architecture ,Christine Hofmeister, Robert Nord, Deli Soni, Addison-Wesley Professional; 1st edition (November 4, 1999) ,ISBN-10: 0201325713 , ISBN-13: 978-0201325713
5. Enterprise Patterns and MDA: Building Better Software with Archetype Patterns and UMLJim Arlow, Ila Neustadt ,Addison-Wesley Professional, 2004, ISBN-10: 032111230X ISBN-13: 9780321112309
6. Kai Qian, Xiang Fu, Lixin Tao, "Software Architecture and Design Illuminated", Jones & Bartlett Learning, 2009, ISBN 076375420X, 9780763754204

510109- Advanced Computer Networks

Teaching Scheme

Lectures: 4 Hrs/week

Examination Scheme

Theory In-semester Assessment: 50 Marks

Theory End-semester Assessment: 50 Marks

Total Credits : 04

Unit I

Introduction: Types of Networks. Network design issues. Network design tools, advanced network architectures. Reliable data delivery, Routing and forwarding, resource allocation, Mobility, Networked applications, Data in support of network design, General Principles of Network Design, network characteristics.

Unit II

Delay Models in Data Networks: Modeling and Performance evaluation. Multiplexing of Traffic on a Communication Link, Queuing Models- Little's Theorem, Probabilistic Form of Little's Theorem, Application of Little's Theorem, Queuing Systems: M/M/1, M/M/2, M/M/m, M/M/∞, M/M/m/m, M/M/m/q, M/M/1/N, D/D/1, M/G/1 System, M/G/1 Queues with Vacations, Reservations and Polling, Priority Queuing

Unit III

Modeling Networks as Graphs, Problems & algorithms: Multipoint line topology- CMST, Esau-William's Algorithm, Sharma's Algorithm, Bin Packing algorithms. Terminal Assignment- Greedy algorithm and exchange algorithms, Concentrator location- COM, Add, Drop, Relaxation algorithm. Network of queues, Open, closed and semi-open queues, Network node, Kleinrock's Independent approximation.

Unit IV

Quality of Service in Networks: Application and QoS, QoS mechanisms, Queue management Algorithms, Feedback, Resource reservations, traffic engineering, Ubiquitous Computing: Applications and Requirements, Smart Devices and Services, Smart Mobiles, Cards and Device Networks.

Unit V

IP packet format, IP routing method, routing using masks, fragmentation of IP packet, IPv6, advanced features of IP routers: filtering, IP QoS, NAT, routers

Unit VI

Advanced topics in computer networks: Wireless and sensor networks, multimedia networking, content distribution networks, computer network simulation, Domain-specific networks, Next generation networks, Cyber physical systems.

References:

1. Kershenbaum A., "Telecommunication Network Design Algorithms", Tata McGraw Hill
2. Simulation Modeling and analysis, Averill M. Law, W. D. Kelton
3. Computer Networks, Principles, Technologies and Protocols for network design Natalia Olifer, Victor Olifer, Wiley India
4. Ubiquitous Computing, Stefan Poslad, WILEY INDIA EDITION

Elective – II

510110A - Business Intelligence and Data Mining

Teaching Scheme

Lectures: 5 Hrs/week

Examination Scheme

Theory In-semester Assessment: 50 Marks

Theory End-semester Assessment: 50 Marks

Total Credits : 05

Unit I. Introduction to Business Intelligence

Introduction to Data Information and knowledge, Data Decision Challenge, Operational vs Information Data, Introduction to Decision Support System, Introduction to Business Intelligence, Business Intelligent System Components, Business Models, Introduction to Data Warehouse, A Business analysis framework for DW.

Unit II. Data Warehouse

Introduction, Data warehouse modeling, Data warehouse design, Data warehouse technology, Distributed Data warehouse, index techniques, materialized view.

Unit III. Data Preprocessing and Cube Technology

Introduction to Data Preprocessing, Data Cleaning, Data integration, data reduction, transformation and Data Descritization.
Introduction to OLAP, Data Cube : A multidimensional model, data cube computation, data cube computation methods : multidimensional data analysis.

Unit IV. Mining Frequent Patterns and Association Rule

Introduction to association rule, market basket analysis, frequent item set, apriori algorithm, parameter, a pattern growth approach, mining closed and max patterns, pattern evaluation, pattern mining in multilevel, multidimensional data space, pattern exploration and application.

Unit V. Classification

Basic concepts, decision tree, rule based classification, Bayesian belief networks, classification by back propagation, support vector machines, lazy learners – k-NN classifier, case based reasoning , model evaluation and selection , techniques to improve classification accuracy, multiclass classification, semi-supervised classification, ensemble methods.

Unit VI. Clustering Analysis

Cluster analysis, Partitioning methods, hierarchical methods, density based methods, grid based methods, clustering graph and network data, clustering with constrains, evaluation of clustering outliers and analysis, outlier detection methods, scalable clustering algorithms.

References:

1. Data mining concepts and techniques, Jawai Han, Michelline Kamber, Jiran Pie, Morgan Kaufmann Publishers, 3rd Edition.
2. Introduction to Data Mining, Vipin Kumar, Pang-Ning Tan , Pearson
3. Building the Data Warehouse, William H Inmon, Wiley Publication 4th Edition.
4. Introduction to Business Intelligence & Data Warehousing, IBM, PHI.
5. Business modeling and Data Mining Dorian Pyle, Elsevier Publication MK.
6. Database Systems, Thomas Connolly, Carolyn Begg, Pearson 4th Edition.

510110B - Usability Engineering

Teaching Scheme
Lectures: 5 Hrs/week

Examination Scheme
Theory In-semester Assessment: 50 Marks
Theory End-semester Assessment: 50 Marks
Total Credits : 05

Unit I. Introduction to Human-Computer Interaction as an emerging field

Disciplines contributing to HCI, Human Information Processing Psychology of everyday things, Importance of human factors in design – cultural , emotional , technological, business, Need Satisfaction curve of technology, Levels of human computer interaction

Unit II. Foundations of User Interface Design (U.I.D)

Goals of UID, Goal directed Design, User Interface Models, Understanding and Conceptualizing Interface, Psychology of users designing for collaboration and communication, Process of Interaction Design, Standards & Guidelines, Usability Testing, GIU

Unit III. Human Factors

The importance of User Interface – UI and Software Designer – Goals of UI design – Motivations for human factors in Design – Understanding user needs and requirements.

Unit IV.Models

Theories – Different models - Object - Action Interface Model - Principles for Design – Data display and entry guidelines.

Unit V. Design Process

User Interface Design Process – Classes of UI design – Principles of good design – Evaluating design using the principles – Choice of color – Task oriented approach for UI - Case study.

GUI design process - Design of icons – Use of metaphors – GUI style guides and toolkits – Portability – GUI design and object oriented approach – Case study.

Unit VI. Usability

The viewpoint of user, customer and designer –Usability specification – Description of stages in usability specification and evaluation.

Information Related: Information Search and Visualization – Hypermedia and WWW.
HCI Standards: ECMA – ISO – BSI guide.

References:

1. Linda Mcaulay, "HCI for Software Designers", International Thompson Computer Press, USA, 1998.
2. Ben Schneiderman, "Designing the User Interface", Pearson Education, New Delhi, 2005.
3. Alan Cooper, "The Essentials of User Interface Design", IDG Books, New Delhi, 1995.
4. Jacob Nielsen, "Usability Engineering", Academic Press, 1993.
5. Alan Dix et al, "Human - Computer Interaction", Prentice Hall, USA, 1993.
6. Elements of User Interface Design - Theo Mandel, John Wiley & Sons
7. Interaction Design – Preece, Roger, Sharp, John Wiley & Sons
8. Object Modeling & User Interface Design - Mark Hamelen

510110C - Advanced Compiler Design

Teaching Scheme
Lectures: 5 Hrs/week

Examination Scheme
Theory In-semester Assessment: 50 Marks
Theory End-semester Assessment: 50 Marks
Total Credits : 05

Unit I. Introduction

Notation and Concepts for Languages and Grammars, Traditional compilers, structure of compiler, architecture, properties, portability and re-targetability, optimization, grammars, Closure algorithms, abstract syntax tree: lexical structure, syntax.

Unit II. Attribute grammars

Dependency graphs, attribute evaluation, cycle handling, attribute allocation, multi-visit attribute grammars, types of attribute grammars, L-attribute grammar, S-attributed grammars, equivalence of L-attributed and S-attributed grammars, Extended grammar notations and attribute grammars, manual methods.

Unit III. Intermediate code processing

Interpretation, Code generation, Assembler design issues, linker design issues. Memory Management: data allocation with explicit de-allocation, data allocation with implicit de-allocation, Static, Dynamic and Heap Storage allocation.

Unit IV

Context handling, source language data representations, routines and their activation, Code generation for control flow assessment, Code generation for modules. Examples of Parser generators, machine-independent Code generation.

Unit V. Functional & Logic Programs

Offside rules, Lists, List comprehensions, pattern matching, polymorphic typing, referential transparency, High-order functions, lazy evaluation, compiling functional languages, polymorphic type checking, Desugaring, Graph reduction, Code generation for functional, core programs, Optimizing the functional Core, Advanced graph manipulations

The logic programming models, implementation model interpretation, unification, implementation model compilation, compiled code for unification.

Unit VI. Parallel programming

Parallel programming models, processes and threads, shared variables, message passing, parallel object -oriented languages, Tuple space, automatic parallelization. Case study of simple object-oriented compiler/interpreter.

Reference Books

1. Modern Compiler Design, Dick Grune, Henri E Bal, Jacobs, Langendoen Wiley India Pvt Ltd, ISBN: 81-265-0418-8
2. The Theory and Practice of Compiler Writing, Trembley Sorenson, MacGrawHill India ISBN:0-07-Y66616-4

510110D - Embedded Systems Design

Teaching Scheme
Lectures: 5 Hrs/week

Examination Scheme
Theory In-semester Assessment: 50 Marks
Theory End-semester Assessment: 50 Marks
Total Credits : 04

Unit I
Introduction to Embedded systems, building blocks, legacy Embedded processors, Integrated RISC processors, DSP Processors Architecture, Selection of Processor,, LPC2148- Architecture, Register set, Programmers Model,
Unit II
Memory Systems, DRAM Technology, Video RAM, SRAM: Pseudo-Static RAM, Battery Backup SRAM, EPROM and OTP, Parity, Error Detection and Correcting Memory, Access times, Packages, DRAM Interfaces, DRAM Refresh Techniques, Optimizing line length and cache size, Logical versus physical caches, Unified versus Harvard caches, Cache coherency: Write through, write back, no caching of write cycles, write buffer, Bus snooping, MESI Protocol, MEI Protocol, BIG and Little Endian, Dual Port and Shared Memory, Bank Switching, Memory Overlays, Shadowing, Memory Interfacing, HY27UU088G5M-Architecture, Register Set, Programmers Model
Unit III
Basic Peripherals: Parallel ports, Timer Counters, 8253, MC68230 modes, Timer Processors, Real-time clocks, Serial Ports, serial peripheral interface, I ² C bus, M-Bus, RS232C, USB2.0, UART implementations, DMA Controllers, DMA Controller Models, Channels and Control Blocks, Sharing Bus Bandwidth, DMA Implementations, Intel82801 IO Controller HUB Analogue to Digital Conversion, Sample Rate and Size, Codecs, Power Control
Unit IV
Interrupts and Exceptions, Interrupt Structure, Recognizing an Interrupt, Interrupt mechanism, MC68000 Interrupts, RISC Exceptions, Fast Interrupts, Interrupt Controllers, Instruction restart and continuation, Interrupt Latency, Interrupt Handling Do's and Don'ts, Intel i7 interrupts and programmers model
Unit V
Real-Time Operating Systems, Operating systems internals, Multitasking OS, Scheduler Algorithms, Priority Inversion, Tasks, Threads and processes, Exceptions, Memory Models, Memory Models and Address Translation, Commercial Operating Systems, Resource Protection, Linux, Disk Partitioning, Writing software for Embedded Systems: The Compilation Process, Native verses cross compilers, Run-Time Libraries, Writing Library, Using Alternative Libraries, Using Standard Libraries, Porting Kernels, C extensions for Embedded Systems, Downloading, Emulation and Debugging techniques, The role of the development system, Emulation Techniques.
Unit VI
Buffering and other data Structures, buffers, Linear buffers, Directional Buffers, Double Buffering, Buffer Exchange, Linked list, FIFO, Circular buffers, buffer under run and over run, Allocating buffer memory, Memory leakage, effects of memory wait state scenarios, Making the right decisions, Software Benchmark Examples, Creating Software State mechanisms, Design of Burglar alarm system, Digital echo Unit, Choosing the software environment, Deriving realtime systems performance form non-real-time systems, Scheduling the data sampling, sampling the data, Controlling from an external Switch, Problems.

References
1. Embedded Systems Design, Steve Heath, EDN Series for Design Engineers, Elsevier ISBN: 978-81-8147-970-9 2. Philips LPC2148 Datasheet (lpc2141_42_44_46_48_4.pdf) 3. HY27UU0**G5M.pdf 4. Intel82801 IO Controller HUB.pdf 5. (Intel i7 interrupt registers and programming) 322165.pdf

510111- Laboratory Practice- II

Teaching Scheme
Practical: 4 Hrs/week

Examination Scheme
OR: 50 Marks
TW: 50 Marks
Total Credits : 04

Use suitable 64-bit Linux environment and toolset to implement following assignments

1. Demonstrate the Reader-Writer Problem solution by creating multiple processes and share regions or blocks. Use 64-bit Linux derivative and tools for implementation.
2. Write a program to identify the least used icons/files/folders on the desktop and move them to temp folder created in Documents.
3. Create a computing facility grid using networks for Booth's multiplication (64-bit) using sign-extension method. Where bit multiplication, additions and merging of the addition results for final processing. The computing grid is created using Advanced wireless network with few computing resources are separated by the router and identified by the NAT. The network controlling node will be submitted with files having total distributed storage of 1000 numbers as a SAN queued for the execution in sorted manner on the lesser cost due to length of the multiplier and display the results along with the network tracking report for the dynamic allocation of multiplier and addition nodes along with the sleeping/ inactive/ unutilized nodes in the network.
4. Design suitable software architecture for assignment number 1,2 and 3 above.

Or assignments equivalent to the above assignments

5. Design and implement class/classes using latest 64-bit C++/JAVA/ Python/QT 5.1 and above, concurrent Cuda C++ or such latest 64-bit programming tools for the implementation of Two journal (IEEE Transactions/ACM/ Elsevier/Springer) papers published in the current year related to the respective elective subjects. Development Tools such as MATLAB/OPENCV/OPENMP/NS3 or equivalent may be used if required to interface the developed classes to the simulators.

510112- Seminar- I

Teaching Scheme

Practical: 4 Hrs/week

Examination Scheme

TW: 50 Marks

Presentation Oral: 50 Marks

Total Credits: 04

State-of-the-art topic approved by the guide useful for professional growth in the field of expertise. The presentation should cover motivation, mathematical modeling, data-table discussion and conclusion. The reports to be prepared using LATEX derivative.

Semester III

610101- Advanced Storage Systems and Infrastructure Management

Teaching Scheme

Lectures: 4 Hrs/week

Examination Scheme

Theory In-semester Assessment: 50 Marks

Theory End-semester Assessment: 50 Marks

Total Credits : 04

Objectives:

- Understanding components of modern information storage infrastructure.

Upon successful completion of this course, participants should be able to:

- Evaluate storage architecture; understand logical and physical components of a storage infrastructure including storage subsystems;
- Describe storage networking technologies and data archival solution;
- Understand and articulate business continuity solutions including, backup and recovery technologies, and local and remote replication solutions;
- Identify parameters of infrastructure management and describe common infrastructure management activities and solutions;

Prerequisites

To understand the content and successfully complete this course, a participant must have a basic understanding of computer architecture, operating systems, networking, and databases.

Unit I: Introduction to Information Storage Technology / Systems

Review data creation and the amount of data being created and understand the value of data to a business, Challenges in Data Storage and Management, Data Storage Infrastructure. Components of a Storage System Environment: Disk drive components, Disk Drive performance, Logical Components.

Data protection: concept of RAID and different RAID levels (RAID 0, 1, 3, 5, 0+1/1+0, and 6);

Intelligent Storage System (ISS) and its components, Implementation of ISS as high-end and midrange storage arrays.

Unit II: Different Storage Technologies and Virtualization

Introduction to Networked Storage: Evolution of networked storage, Architecture, Overview of FC-SAN, NAS, and IP-SAN. Network-Attached Storage (NAS): Benefits of NAS, Components, Implementations, File Sharing, I/O operations, Performance and Availability. Content Addressed Storage (CAS): features and Benefits of a CAS. CAS Architecture, Storage and Retrieval, Examples.

Storage Virtualization: Forms, Taxonomy, Configuration, Challenges, Types of Storage Virtualizations.

Overview of emerging technologies such as Cloud storage, Virtual provisioning, Unified Storage, FCOE, FAST.

Unit III: Business Continuity

Concept of information availability and its measurement, causes and consequences of downtime, concept of RTO, and RPO, single points of failure in a storage infrastructure and solutions for its mitigation, backup/recovery purposes and considerations, architecture and different backup/recovery topologies;

Local replication technologies and their operation, remote replication technologies and their operation, emerging technologies like de duplication, offsite backup.

Unit IV: Infrastructure Management Overview

Definitions, Infrastructure management activities, Evolutions of Systems since 1960s (Mainframes-to-Midrange-to-PCs-to-Client-server computing-to-New age systems) and their management, growth of internet, current business demands and IT systems issues, complexity of today's computing environment, Total cost of complexity issues, Value of Systems management for business.

Unit V: Preparing for Infrastructure Management

Factors to consider in designing IT organizations and IT infrastructure, Determining customer's Requirements, Identifying System Components to manage, Exist Processes, Data, applications, Tools and their integration, Patterns for IT systems management, Introduction to the design process for information systems, Models, Information Technology Infrastructure Library (ITIL).

Unit VI: Service Management

Service Delivery Processes- Service-level management, financial management and costing, IT services continuity management, Capacity management, Availability management. Service Support Processes- Configuration Management, Service desk. Incident management. Problem management, Change management, Release management.

Reference Books:

1. EMC Educational Services, Information Storage and Management, Wiley India,.
2. Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, Osborne, 2003.
3. Marc Farley, "Building Storage Networks", Tata McGraw Hill ,Osborne, 2001.
4. Jan Van Bon, "Foundations of IT Service Management: based on ITIL", Van Haren Publishing, 2nd edition 2005
5. Harris Kem, Stuart Gaiup, Guy Nemiro, "IT Organization: Building a Worldclass Infrastructure", Prentice Hall, 2000
6. Richard Barker and Paul Massiglia, .Storage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs., Wiley India.
7. Meet Gupta, Storage Area Network Fundamentals., Pearson Education Limited, 2002.

610102- Advanced Unix Programming

Teaching Scheme

Lectures: 4 Hrs/week

Examination Scheme

Theory In-semester Assessment: 50 Marks

Theory End-semester Assessment: 50 Marks

Total Credits : 04

Unit I. Introduction to UNIX File system

Introduction to UNIX file system, file handling utilities, securities and file permissions, process utilities, Disk utilities, networking commands, Introduction to shell scripting, Working with Bourne shell: Shell responsibilities, PIPES and input and output redirection, Shell variables, Shell commands, Control structures, Shell script examples, ext4, IA-64 Architecture: Userlevel Instruction Set Architecture, Runtime and Software Conventions, System Instruction Set Architecture, The Register Stack Engine (RSE). Kernel Entry and Exit: Interrupts, System Calls, Signals, Kernel access to user memory, Stack unwinding: IA-64 ELF unwind sections The Kernel Unwind Interface, Embedding unwind information in Assembly code, Implementation Aspects.

Unit II. Process Management

Process management and working of signals in Unix - process definition, its relation with its environment through environment variables, command-line arguments; process memory layout; process creation-fork(), process control - wait(), waitpid(); program loading-exec() family; process termination-exit(), _exit(); non-local goto-setjmp(), longjmp(); signals-signal disposition, reliable and unreliable ways of signals, creation, pending and delivery stages; signal sets-blocking, unblocking; useful signals-SIGINT, SIGKILL, SIGTERM, SIGALRM, alarm(), pause(), ELF64, Linux Tasks, Virtual Memory Management, Address space for Linux Process, Page Tables, Translation Lookahead Buffers, Page Faults, Memory Coherency, Switching Address spaces.

Unit III. Advanced I/O in Unix

Introduction, Streams and file objects, Standard Input, Standard Output, and Standard Error, Buffering, opening reading & writing in streams, Nonblocking I/O, Record locking, streams, I/O multiplexing, asynchronous I/O, readv & writev functions, readn & writen functions, Memory mapped I/O,

Unit IV. Inter-process Communication

Inter Processes communication within the system and their applications in network programming: types of IPC-pipes, FIFOs, Message Queues, Semaphores, Shared memory; pipes-characteristics, creating a pipe, writing and reading from a pipe, popen(), synchronization, process pipe-lining, co-processes; FIFO-names pipe, characteristics, contrast with pipes, opening, reading and writing, non-blocking option; Message Queues-characteristics, contrast with pipes/fifos, concept of key space, identifier, fork(), msgget(), msgsnd(), msgrcv(),msgctl(); semaphores- characteristics, semget(),semop(),semctl(), semadj variable usage; shared memory-characteristics, fastest IPC, shmget(),shmat(),shmdt(0,shmctl()).

Unit V. Multithreading in UNIX

Different models of concurrent server design: Multiplexing, Forking, Multithreading, Preforking, Prethreading, Preforking and Prethreading; Preforking Models; Prethreading Models. To understand remote procedure calls and practice: RPC model; stubs and skeletons; call semantics. Thread Interface, Thread Synchronization, Symetric Multiprocessing: Multiprocessing on Linux, Linux Locking Principles, Multiprocessor support Interface, CPU-specific Data area.

Unit VI. Introduction to Socket

Understanding of sockets: what is a socket, Study of different types of sockets: Raw sockets, Unix Domain sockets, TCP & UDP sockets, Routing sockets, socket pair, socket descriptor, socket address structure for IPv4 , end point addressing, Study of simple, protocol dependent socket program: Design of a simple client and server: daytime server , echo server with and without threading .

References:

1. Advanced Programming in the UNIX-W. Richard Stevens
2. Unix Network Programming: Vol-II Inter Process Communications
3. IA-64 Linux Kernel: Design and Implementation, David Mosberger, Hewlett-Packard Professional Books, ISBN13: 9780130610140, ISBN10: 0130610143

Additional References:

1. The Design of the Unix Operating System- Maurice J. Bach

Elective III

610103A - Network Security

Teaching Scheme
Lectures: 5 Hrs/week

Examination Scheme
Theory In-semester Assessment: 50 Marks
Theory End-semester Assessment: 50 Marks
Total Credits : 05

Unit I. Introduction

Security Trends, the OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, A model for Network Security The Security problems, Avenues of Attacks

Unit II. Security at each layer :

Security at Application Layer : PGP, and S/MIME, Email Security Security at Transport Layer : SSL & TLS, SSL Architecture, Four Protocols, SSL message formats, Transport layer security Security at Network Layer : IPSec, Two Modes, Two Security Protocols, Security Association, security Policy, Internet Key Exchange (IKE), ISAKMP

Unit III. System Security :

Description of the system, Users, Trust and Trusted systems, Buffer overflow and Malicious software, malicious program, worm, viruses, IDS, Firewall.

Firewalls: Network Partitioning, firewall platforms, partitioning models and methods, Secure SNMP, Secure routing interoperability, virtual network.

Unit IV. Cryptographic Techniques

Secret versus “ Public” key Cryptography, Types of attack, Types of cipher - Substitution, transposition, Other Cipher properties, Secret key cryptography , Public key cryptography and RSA key management, digital certificates, PKI, identity based encryption, Authentication

Unit V. Security Policies and Design Guidelines

Policies: Policy creation, Regularity considerations, Privacy regulations. Security: Infrastructure and components. Design Guidelines. Authentication: Authorization and accounting. Physical and logical access control. User authentication: Biometric devices.

Unit VI. Web Security

Computer Forensics: evidence , collecting Evidence Chain of Custody, free space vs Stack space. TCP/IP Vulnerabilities : Securing TCP/IP Spoofing: The process of an IP spoofing attack, Cost of Spoofing, Types of spoofing, spoofing tools, prevention and Mitigation

References:

1. Cryptography and Network Security – Principles and Practices – William Stallings
2. Cryptography and Network Security – Forozan and Mukhopadhyay – Mc Graw Hill
3. Information Assurance & security Series Principles of Computer Security, Security + and Beyond – Conklin, White, Cothren, Williams, Davis – Dreamtech Press
4. Cheswick W. Bellovin S. “ Firewall and Internet security Repelling the Wily Hacker”, 2nd Addison Wesley
5. Security Architecture, design, deployment and operations – Christoph M King , Curtis, Dalton and T Ertem Osmanoglu
6. Computer Security Concepts, Issues and Implementation – Alfred Basta, Wolf Halton – Cengage Learning

610103B - Cloud Computing

Teaching Scheme
Lectures: 5 Hrs/week

Examination Scheme
Theory In-semester Assessment: 50 Marks
Theory End-semester Assessment: 50 Marks
Total Credits : 05

Unit I. Introduction

Cloud computing fundamentals, the role of networks in Cloud computing, Essential characteristics of Cloud computing, Cloud deployment model, Cloud service models, Multitenancy, Cloud cube model, Cloud economics and benefits, Cloud types and service scalability over the cloud, challenges in cloud NIST guidelines

Unit II. Virtualization, Server, Storage and Networking

Virtualization concepts , types, Server virtualization, Storage virtualization, Storage services, Network virtualization, Service virtualization, Virtualization management, Virtualization technologies and architectures, Internals of virtual machine, Measurement and profiling of virtualized applications. Hypervisors: KVM, Xen, HyperV Different hypervisors and features

Unit III. Data in cloud

Storage system architecture, Big data, Virtualized Data Centre (VDC) architecture, VDC environments, concepts, planning and design, Managing VDC and cloud infrastructures, hybrid storage networking technologies (iSCSI, FCIP,FCoE), host system design consideration

Unit IV. Cloud security

Cloud Security risks, Security, Privacy, Trust, Operating system security, Security of virtualization, Security risks posed by shared images, Security risk posed by a management OS, Xoar, Trusted virtual machine monitor

Unit V. QoS [Quality of Service] of Cloud

Taxonomy and survey of QoS management and service , Selection methodologies for cloud computing, Auto scaling, Load balancing and monitoring in open source cloud, Resource scheduling for Cloud Computing

Unit VI. Cloud patterns and application

Cloud Platforms: Amazon EC2 and S3, Cloudstack, Intercloud, Mobile Cloud Designing an image: Pre-packaged image, singleton instances prototype images Designing an architecture : Adapters, Facades, Proxies and balancers Clustering : The n-Tier Web pattern, Semaphores and Locking Map Reduce Peer-to-Peer framework

References:

1. Dr. Kumar Saurabh,"Cloud Computing", Wiley Publication
2. Borko Furht, "Handbook of Cloud Computing", Springer
3. Venkata Josyula,"Cloud computing – Automated virtualized data center", CISCO Press
4. Greg Schulr,"Cloud and virtual data storage networking",CRC Press
5. Mark Carlson,"Cloud data management and storage", Mc Graw hill
6. Lizhe Wang, " Cloud Computing:Methodology, System and Applications", CRC Press
7. Cloud computing: Data Intensive Computing and Scheduling by Chapman Hall/CRC
8. Christopher M. Moyer, Building Applications in the Cloud: Concepts, Patterns, and Projects

9. Dan C. Marinescu, "Cloud computing: Theory and Practice",

Additional References:

1. Antonopoulos, Nikos, "Cloud computing: Principles, Systems and Applications", 1st edition
2. Ronald Krutz, "Cloud Security: Comprehensive guide to Secure Cloud Computing", Wiley Publishing
3. Barrie Sosinsky, "Cloud Computing Bible", Wiley
4. Rajkumar Buyya, "CLOUD COMPUTING Principles and Paradigms", Wiley and Sons, Inc
5. Anthony T. Velte, "Cloud Computing: Practical Approach", Mc Graw Hill
6. Tim Mather, "Cloud Security and Privacy", O'REILLY
7. Gautham Shroff, "Enterprise Cloud Computing", Cambridge

610103C - Computer Vision and Pattern Recognition

Teaching Scheme
Lectures: 5 Hrs/week

Examination Scheme
Theory In-semester Assessment: 50 Marks
Theory End-semester Assessment: 50 Marks
Total Credits : 05

Unit I. Basics of Digital Imaging

Image Acquisition, Sampling, Quantization, Difference in Monochrome and Multichrome imaging, concept of color spaces, point processing techniques, mask processing methods, image filtering, shape in images, edge detection, gradient operators- Roberts, Sobel, Prewitt, Canny, Slope magnitude method, morphological image processing, erosion, dilation, opening, closing, hit-n-miss transform, thinning, Top Hat transformation, Bottom hat transformation.

Unit II. Image Representation and Region Analysis

Shape Descriptors-contour based, region based, Boundary based; Thresholding based segmentation, Watershed based Segmentation, Gray level Co-occurrence Matrix-energy, entropy, maximum probability, contrast, correlation; wavelets, wavelet Pyramids, Image matching, similarity measures, feature extraction in spatial domain, block truncation coding, feature extraction in transform domain, image transforms, energy based feature extraction.

Unit III. Computer Vision Applications

Image Fusion and Clustering- K-means, Vector Quantization, Hierarchical Clustering, Partitioned Clustering, Image Inpainting, Multisensor image fusion, character recognition, face recognition, Trademark databases, Medical Imaging, Signature Verification, Vehicular license plate Recognition, image and Video retrieval, Surveillance, Robotic vision, Panoramic view Construction

Unit IV. Introduction to Pattern Recognition

Tree Classifiers-Decision Trees, Random Forests; Bayesian Decision Theory; Linear Discriminants, Discriminative Classifiers- Separability, Perceptions, Support Vector Machines.

Unit V. Decision Theory

Parametric Techniques Generative Methods grounded in Bayesian Decision Theory: Maximum Likelihood Estimation, Bayesian Parameter Estimation, Sufficient Statistics; Non-Parametric Techniques- Kernel Density Estimators, Parzen Window, Nearest Neighbor Methods; Unsupervised Methods Exploring the Data for Latent Structure- Component Analysis and Dimension Reduction, principal Component Analysis

Unit VI. Clustering

K-Means, Expectation Maximization, Mean Shift, Vector Quantization- Codebook generation Methods; Classifier Ensembles- Bagging, Boosting / AdaBoost; Graphical Models The Modern Language of Pattern Recognition and Machine Learning- Bayesian Networks, Sequential Models; Neural Networks

Reference Books

1. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison Wesley, 1993.
2. David A. Forsyth, Jean Ponce, "Computer Vision: A Modern Approach" PHI
3. R Jain, R Kasturi, , "Machine Vision", McGraw Hill
4. R. O. Duda, P. E. Hart, D. G. Stork, "Pattern Classification", 2nd Edition, Wiley-Inter-science, John Wiley & Sons, 2001
5. David G. Stork and Elad Yom-Tov, "Computer Manual in MATLAB to accompany Pattern Classification" Wiley Inter-science, 2004

610103D- Soft Computing

Teaching Scheme

Lectures: 5 Hrs/week

Examination Scheme

Theory In-semester Assessment: 50 Marks

Theory End-semester Assessment: 50 Marks

Total Credits : 05

Objectives:

- Design and develop intelligent systems in the framework of soft computing, and to acquire knowledge of scientific application-driven environments.

Outcomes:

Students who successfully complete this course will be able to

- 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.

Unit I: Soft Computing Basics

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, hybrid systems.

Unit II: Neural Networks

Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory, perceptron model, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient; back propagation algorithm, factors affecting back propagation training, applications.

Unit III: Fuzzy Logic

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, interference 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 IV: Genetic Algorithm

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: Evolutionary computing

Role of biologically inspired software, Difficulties in search, optimization and machine learning, Overview of natural evolution and its abilities, Evolutionary Programming/Evolutionary Strategies
Issues in evolutionary search, applying an evolutionary algorithm, Artificial Life, Ant colony optimization, Swarm intelligence

Unit VI: Application areas of soft computing

Optimization, function regression, Scheduling, Fraud detection, Anomaly detection, Design Robot or agent control, Interactive tools such as music composition, art generation, decision making and others.

Text Books:

1. S. Rajsekaran & G.A. Vijayalakshmi Pai, "Neural Networks,Fuzzy Logic and Genetic Algorithm:Synthesis and Applications" Prentice Hall of India.
2. N.P.Padhy,"Artificial Intelligence and Intelligent Systems" Oxford University Press.
3. Neuro-Fuzzy and Soft Computing, J S R Jang, CT Sun and E. Mizutani , PHI PVT LTD.
4. Principles of soft computing –by Sivandudam and Deepa, John Mikey India.

Reference Books:

1. Siman Haykin,"Neural Networks"Prentice Hall of India
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India.
3. Eiben and Smith, "Introduction to Evolutionary Computation", Springer.

610104 - Seminar- II

Teaching Scheme

Practical: 4 Hrs/week

Examination Scheme

TW: 50 Marks

Presentation Oral: 50 Marks

Total Credits: 04

Seminar based on state-of-the art in the selected electives approved by guide. The presentation and the report should cover motivation, mathematical modeling, data-table discussion and conclusion. The reports to be prepared using LATEX derivative.

610105 – Dissertation Stage-I

Teaching Scheme

Practical: 8 Hrs/week/student

Examination Scheme

TW: 50 Marks

OR: 50 Marks

Total Credits: 08

Motivation, Problem statement, survey of journal papers related to the problem statement, problem modeling and design using set theory, NP-Hard analysis, SRS, UML, Classes, Signals, Test scenarios and other necessary, problem specific UML, software engineering documents. Student should publish one International Journal Paper (having ISSN Number and preferably with Citation Index II); or paper can be published in reputed International Journal recommended by the guide of the Dissertation and in addition to above the term work shall include the paper published, reviewers comments and certificate of presenting the paper in the conference organized/sponsored by the Board of Studies in Computer Engineering.

Semester - IV

610106 - Seminar- III

Teaching Scheme

Practical: 5 Hrs/week

Examination Scheme

TW: 50 Marks

Presentation Oral: 50 Marks

Total Credits: 05

Seminar based on selected research methodology preferably algorithmic design advances as an extension to seminar-II approved by guide. The presentation should cover motivation, mathematical modeling, data-table discussion and conclusion. The reports shall be prepared using LATEX derivative.

610106 – Dissertation Stage-II

Teaching Scheme

Practical: 20 Hrs/week/student

Examination Scheme

TW: 150 Marks

OR: 50

Total Credits: 20

Selection of Technology, Installations, UML implementations, testing, Results, performance discussions using data tables per parameter considered for the improvement with existing known algorithms and comparative graphs to support the conclusions drawn. Student should publish one International Journal Paper (having ISSN Number and preferably with Citation Index II); or paper can be published in reputed International Journal recommended by the guide of the Dissertation and in addition to above the term work shall include the paper published, reviewers comments and certificate of presenting the paper in the conference organized/sponsored by the Board of Studies in Computer Engineering.

Important Note Regarding all Open Electives

Open Elective proposal shall be (current state-of the art in Computer Engineering or Inter-disciplinary or intra-disciplinary) focusing algorithms, technologies developed using computing or systems programming (Kernel level/ Embedded) or virtualization or useful for the professional growth, if any, to be forwarded to the BoS, Computer Engineering for necessary approvals on or before the month of December every year. The teaching shall be done through Industry-Institute Interaction/invited talks/webminars etc.

Faculty of Engineering Savitribai Phule Pune University, Pune



Syllabus

Master of Computer Engineering (Course 2017)

(with effect from Year 2017-18)

Prologue

It is with great pleasure and honor that I present the syllabus for Master of Computer Engineering (2017 Course) on behalf of Board of Studies (BoS), Computer Engineering. We, members of BoS are giving our best to streamline the processes and curricula design.

While revising syllabus, honest and sincere efforts are put to tune curriculum for post graduate program in Computer Engineering in tandem with the objectives of Higher Education of India, AICTE, UGC and affiliated University- Savitribai Phule Pune University (SPPU) by keeping an eye on the technological advancements and industrial requirements globally.

The basic motives of designing the contents of various courses is to focus on independent learning convergence to special domains, development of research attitude and comprehensive coverage of technologies. Elective courses with choice for module selection provide flexibility and opportunity to explore the domain specific knowledge.

The open elective is to invite the attention to multidisciplinary, interdisciplinary, exotic, employability or update to technology course. The institute may design the syllabus accordingly. However such designed syllabus needs to be approved by SPPU authority before implementation.

While framing each course contents, Course advisor, Course Coordinators and Team Members have put arduous efforts in meeting the standards of the Courses at PG level. Everybody in the team has meticulously stuck to the guidelines and recommendations to materialize the team efforts. The fruition is only due to sincere efforts, active participation, expert opinions and suggestions from domain professionals.

I am sincerely indebted to all the minds and hands who work dexterously and synchronously to materialize the huge task.

Thanks.

Dr. Varsha H. Patil

Coordinator, Board of Studies (Computer Engineering), SPPU, Pune

Tuesday, March 28, 2017. Mail-id: vh_patil2003@yahoo.com

[This document includes Program Educational Objectives - Program Outcomes, Program Specific Outcomes (page 3-4), Semester-wise Courses (teaching scheme, examination, marks and credit) (page 5-6), Courses syllabi (page 7-63)] and Non Credit Course Contents [64-70].

Program Educational Objectives

- PEO1:** To prepare globally competent post graduates with enhanced domain knowledge and skills attaining professional excellence and updated with modern technology to provide effective solutions for engineering and research problems.
- PEO2:** To prepare the post graduates to work as a committed professionals with strong professional ethics and values, sense of responsibilities, understanding of legal, safety, health, societal, cultural and environmental issues.
- PEO3:** To prepare motivated post graduates with research attitude, lifelong learning, investigative approach, and multidisciplinary thinking to succeed in the career in industry/academia/research
- PEO4:** To prepare post graduates with strong managerial and communication skills to work effectively as an individual as well as in teams.

Program Outcomes

Students are expected to know and be able –

PO1: Scholarship of Knowledge

Acquire in-depth knowledge of Computer Science and Engineering, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

PO2: Critical Thinking

Analyze complex engineering problems critically; apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.

PO3: Problem Solving

Think laterally and originally, conceptualize and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.

PO4: Research Skills

Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.

PO5: Usage of Modern Tools

Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.

PO6: Collaborative and Multidisciplinary work

Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork, decision-making based on open-mindedness,

objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

PO7: Project Management and Finance

Demonstrate knowledge and understanding of Computer Science & Engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

PO8: Communication

Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

PO9: Life-long Learning

Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

PO10: Ethical Practices and Social Responsibility

Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

PO11: Independent and Reflective Learning

Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

Program Specific Outcomes (PSO)

A post graduate of the Computer Engineering Program will demonstrate-

PSO1: Professional Skills

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

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, with zest for research.

PSO4: Research Skills

The ability to study, experiment, interpret, analyze and explore the solutions to the engineering problems which are effective, efficient, optimized and feasible.

Savitribai Phule Pune University, Pune
Master of Computer Engineering (2017 Course)
 (with effect from June 2017)

Semester I

Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks					Credit	
		Theory	Practical	In-Sem	End-Sem	TW	OR/ PRE	Total	TH	PR
510101	Research Methodology	04	--	50	50	--	--	100	04	--
510102	Bio-Inspired Optimization Algorithms	04	--	50	50	--	--	100	04	--
510103	Software Development and Version Control	04	--	50	50	--	--	100	04	--
510104	Embedded and Real Time Operating Systems	04	--	50	50	--	--	100	04	--
510105	Elective I	05	--	50	50	--	--	100	05	-
510106	Laboratory Proficiency I	--	08	--	--	50	50	100	--	04
	Total Credit							21	04	
Total		21	08	250	250	50	50	600	25	
510107	Non-Credit Course I								Grade	
Elective I										
510105A	Advanced Digital Signal Processing			510105B	Data Mining					
510105C	Network Design and Analysis			510105D	Data Algorithms					
510105E	Open Elective									

Semester II

Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks					Credit	
		Theory	Practical	In-Sem	End-Sem	TW	OR/ PRE	Total	TH	PR
510108	Operations Research	04	--	50	50	--	--	100	04	--
510109	System Simulation and Modeling	04	--	50	50	--	--	100	04	--
510110	Machine Learning	04	--	50	50	--	--	100	04	--
510111	Elective II	05	--	50	50	--	--	100	05	--
510112	Seminar I		04	--	--	50	50	100	--	04
510113	Laboratory Proficiency II	--	08	--	--	50	50	100	--	04
	Total Credit								17	08
Total		17	12	200	200	100	100	600	25	
510114	Non-Credit Course II								Grade	
Elective II										
510111A	Image Processing			510111B		Web Mining				
510111C	Pervasive and Ubiquitous Computing			510111D		Network Security				
510111E	Open Elective									

Abbreviations: TW: Term Work , TH: Theory, OR: Oral, PRE: Presentation, Sem: Semester

Savitribai Phule Pune University, Pune										
Master of Computer Engineering (2017 Course)										
<u>Semester III</u>										
Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks					Credit	
		Theory	Practical	In-Sem	End-Sem	TW	OR/PRE	Total	TH	PR
610101	Fault Tolerant Systems	04	--	50	50	--	--	100	04	--
610102	Information Retrieval	04	--	50	50	--	--	100	04	--
610103	Elective III	05	--	50	50	--	--	100	05	--
610104	Seminar II	--	04	--	--	50	50	100	--	04
610105	Dissertation Stage I	--	08	--	--	50	50	100	--	08
Total Credit									13	12
Total		13	12	150	150	100	100	500	25	
610106	Non-Credit Course III								Grade	
Elective III										
610103A	Cloud Security	610103B		Speech Signal Processing						
610103C	Mobile Ad-hoc Network	610103D		Pattern Recognition			610103E		Open Elective	
<u>Semester IV</u>										
Course Code	Course	Teaching Scheme Hours / Week		Examination Scheme and Marks			Credit			
		Practical		TW	OR/PRE	Total	PR			
610107	Seminar III	05		50	50	100	05			
610108	Dissertation Stage II	20		150	50	200	20			
Total		25		200	100	300	25			
<u>Non-Credit Courses</u>										
Typically curriculum is constituted by credit, non-credit and audit courses. These courses are offered as compulsory or elective. Non Credit Courses are compulsory. No grade points are associated with non-credit courses and are not accounted in the calculation of the performance indices SGPA & CGPA. However, the award of the degree is subject to obtain a PP grade for non credit courses. Conduction and assessment of performance in said course is to be done at institute level. The mode of the conduction and assessment can be decided by respective course instructor. Recommended but not limited to- (one or combination of) seminar, workshop, MOOC Course certification, mini project, lab assignments, lab/oral/written examination, field visit, field training. Examinee should submit report/journal of the same. Reports and documents of conduction and assessment in appropriate format are to be maintained at institute. <u>Result of assessment will be PP or NP.</u> Set of non-credit courses offered is provided. The Examinee has to select the relevant course from pool of courses offered. Course Instructor may offer beyond this list by seeking recommendation from SPPU authority. The selection of 3 distinct non-credit courses, one per semester (Semester I, II & III). The Contents of Non Credit Courses are Provided at page 63 onwards.										
<u>Open Elective:</u> The open elective is to invite the attention to multidisciplinary, interdisciplinary, exotic, employability or update to technology course. The institute may design the syllabus accordingly. However such designed syllabus needs to be approved by SPPU authority before implementation.										
<u>Recommended Set of Non-Credit Courses(510107, 510114, 610106):</u>										
NCC1: Game Engineering				NCC2: Advanced Cognitive Computing						
NCC3: Reconfigurable Systems				NCC4: Convergence Technology						
NCC5: Machine Learning				NCC6: Storage Area Networks						
NCC7: Search Engine Optimization				NCC8: Virtual Reality						
NCC9: Machine Translation				NCC10: Infrastructure Management						

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) 510101: Research Methodology		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem : 50 Marks End-Sem : 50 Marks
Course Objectives : - To understand the philosophy of research in general - To understand basic concepts of research and its methodologies - To learn the methodology to conduct the Literature Survey - To acquaint with the tools, techniques, and processes of doing research - To learn the effective report writing skills and allied documentations - To become aware of the ethics in research, academic integrity and plagiarism		
Course Outcomes: After completion of the course, students should be able to - Carry out Literature Survey - Identify appropriate topics for research work in computer engineering - Select and define appropriate research problem and parameters - Design the use of major experimental methods for research - Use appropriate tools, techniques, and processes of doing research in Computer science - Demonstrate own contribution to the body of knowledge - Become aware of the ethics in research, academic integrity and plagiarism - Write a research report and thesis		
Course Contents		
Unit I	Introduction	08 Hours
Evolution of Research Methodology: Meaning, nature, scope, and significance of research; Research paradigm; The purpose and outcomes of Research; Objectives of research, Motivation for research; Postulates underlying scientific investigations; Types of research; Research process and work flow. Engineering Research-Why? Research Questions, Engineering Ethics, conclusive proof-what constitutes, A research project-Why take on? Case Study- Code of Ethics, IEEE Code of Ethics, ACM Software Engineering Code of Ethics and Professional Practice, Code of Ethics especially covering Engineering discipline, various aspects-environment, sustainable outcomes, employer, general public, and Nation, Engineering Disasters.		
Unit II	Literature Search and Review, Developing Research Plan	08 Hours
Archival Literature, Why should engineers be ethical? Types of publications- Journal papers, conference papers, books, standards, patents, theses, trade magazine, newspaper article, infomercials, advertisement, Wikipedia & websites, Measures of research impact, Literature review, publication cost. Case Study- Engineering dictionary, Shodhganga, The Library of Congress, Research gate, Google Scholar, Bibliometrics, Citations, Impact Factor, h-index, I-index, plagiarism, copyright infringement. Developing Research Plan: Research Proposals, Finding a suitable research questions, The		

elements of research proposals-title, details, budget, Design for outcomes-1D data, 2D data, 3D data, N-D data, The research tools- Experimental measurements, numerical modeling, theoretical derivations & Calculations, curve matching.

Case Study- Various Research grants and funding resources

Unit III	Statistical Analysis	08 Hours
Statistical Analysis: Introduction, Sources of error and uncertainty, One-Dimensional Statistics: combining errors and uncertainties, t-test, ANOVA statistics, example, Two-Dimensional Statistics: example, Multi-Dimensional Statistics: partial correlation coefficients, example, Null hypothesis testing. Case Study- GNU PSPP Tool, SOFA, NOST-Dataplot		
Unit IV	Optimization Techniques	08 Hours
Optimization Techniques: Introduction, Two-parameter optimization methods: sequential uniform sampling, Monte Carlo optimization, Simplex Optimization method, Gradient Optimization method, Multi-parameter optimization methods, The cost function. Case Study- Google Optimization Tools, OpenMDAO		
Unit V	Survey Research Methods	08 Hours
Survey Research Methods: Why undertake a survey, Ergonomics and human factors, Ethics approval, General survey guidelines, Survey statements, Survey delivery, Respondent selection, Survey timelines, Statistical analysis, Reporting. Case Study- Qualitative Analysis Tools- AQUAD, CAT		
Unit VI	Research Presentation	08 Hours
Research presentation: Introduction, Standard terms, Standard research methods and experimental techniques, Paper title and keywords, Writing an abstract, Paper presentation and review, Conference presentations, Poster presentations, IPR, Copyright, Patents. Reporting Research: Thesis, Structure and Style for writing thesis, Dissemination of research findings; Reporting and interpretation of results; cautions in interpretations, Type of reports, Typical report outlines. The path forward: Publication trends, Getting started in research, Quality assurance (QA) Occupational health and safety. Case Study: Intellectual Property India- services, InPASS - Indian Patent Advanced Search System, US patent, IEEE / ACM Paper templates. A glimpse into the future of Engineering Research.		
Books:		
Text:		
- David V Thiel, "Research Methods- for Engineers", Cambridge University Press, ISBN:978-1-107-61019-4 - Kothari C.R., "Research Methodology. New Age International, 2004, 2nd Ed; ISBN:13: 978-81-224-1522-3.		
References:		
- Caroline Whitbeck, "Ethics in Engineering Practice and Research", 2nd Ed., Cambridge University Press; ISBN :978-1-107-66847-8 - Gordana DODIG-CRNKOVIC, "Scientific Methods in Computer Science", Department of Computer Science Malardalen University, Vasteas, Sweden; ISBN: 91-26-97860-1		

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) 510102 : Bio-Inspired Optimization Algorithms		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme : In-Sem: 50 Marks End-Sem : 50 Marks
Course Objectives : - To learn how natural and biological systems influence computational field - To understand the strengths and weaknesses of nature-inspired algorithms - To learn the functionalities of various Bio-inspired optimization algorithms		
Course Outcomes: On completion of the course, student will be able to– - Describe the natural phenomena that motivate the algorithms - Apply nature-inspired algorithms to optimization - Select the appropriate strategy or optimal solution based on bio-inspired algorithms		
Course Contents		
Unit I	Natural Computing	08 Hours
From nature to natural computing, sample idea, Philosophy of natural computing, Natural computing approaches, Conceptualization – general concept, Problem solving as a search track, Hill climbing, Simulated annealing		
Unit II	Evolutionary Computing	08 Hours
Evolutionary computing : Evolutionary biology, Evolutionary computing – standard evolutionary algorithm; Genetic algorithm, evolutionary strategies, Evolutionary programming		
Unit III	Swarm Intelligence	08 Hours
Swarm intelligence-biological motivation, from natural to artificial, standard algorithm of Ant colony optimization, Ant clustering algorithm, Particle swarm optimization		
Unit IV	Biological Motivation	08 Hours
Biological motivation, from natural to artificial, standard algorithm of cuckoo search, bat algorithm, flower pollination, firefly algorithm, framework for self tuning algorithms - case study of firefly algorithm		
Unit V	Immune Systems	08 Hours
Immune system, Artificial immune systems - biological motivation, Design principles, main types of algorithms - Bone marrow, Negative selection, Clonal selection, Continuous immune network models, Discrete immune network models, Scope of artificial immune systems		
Unit VI	Artificial Life	08 Hours
The essence of life, Examples of ALife projects- flocks, herds and schools, computer viruses, synthesizing emotional behavior, AIBO robot, Turtles, termites, and traffic jams, framsticks, Scope of artificial life, Current trends and open problems.		
Books:		
Text: L. N. de Castro, “Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications”, 2006, CRC Press, ISBN-13: 978-1584886433		

2. D. Floreano and C. Mattiussi, “ Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies”, 2008, MIT Press, ISBN-13: 978-0262062718

References:

1. Sam Jones (Editor), “Bio Inspired Computing-Recent Innovations and Applications”, Clanrye International; 2 edition (2 January 2015), ISBN-10: 1632400812
2. Yang Xiao (Editor), “Bio-Inspired Computing and Networking”, CRC Press,
3. “Machine Nature: The Coming Age of Bio-Inspired Computing”, New York: McGraw-Hill, 2002)
4. Adries Engelbrecht, “ Computational Intelligence”, Wiley, ISBN:978-0-470-03561-0
5. D.Floreano and C. Mattiussi, “Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies”, 2008, MIT Press, ISBN-13: 978-0262062718
6. Russell C. Eberhart , Yuhui Shi , James Kennedy, “ Swarm Intelligence: The Morgan Kaufmann Series in Evolutionary Computation”, 1st Edition, ISBN-13: 978-1558605954
7. M. Goodrich, Tamassia, “Algorithm Design & Applications”, Wiley, ISBN:978-1-118-33591-8

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
510103 : Software Development and Version Control

Teaching Scheme:
TH: 04 Hours/Week

Credit
04

Examination Scheme:
In-Sem: 50 Marks
End-Sem : 50 Marks

Course Objectives:

- To enable students to understand software design issues
- To understand software architectures and patterns
- To acquaint software solutions to engineering Problems.
- To learn the significance of Version Control.
- To know and utilize version controls.

Course Outcomes:

After completion of the course, students should be able to

- Select and apply the design patterns to software development.
- Design software for real engineering Problems.
- Demonstrate team work for development of software in collaborative environment.
- Use of open source version control tool.

Course Contents

Unit I	Software Development	08 Hours
Design in the software development process, quality attributes of the design product, describing the design solution, design representations, design processes and design strategies. Design practices- incremental, object based and component based. Case study – Software design of a Social Networking site like LinkedIn, Twitter, Facebook.		
Unit II	Software Architecture Design	08 Hours
Models of Software architecture design, Data centered architecture, Hierarchical architecture, Distributed architecture, heterogeneous architecture, product line architecture, product line engineering, and software technology for systematic reuse. Case study – Software architecture of a Mobile Robot System (with specific focus on External sensors and actuators, Real-time responsiveness, Acquire sensor Input, control motion and plan future paths).		
Unit III	Software Architecture Quality	08 Hours
Software Architecture - quality attributes, architecture in agile projects, documenting software architectures, architecture implementation and testing, architecture reconstruction and conformance. Case study – Architecting in cloud environment for multi-tenancy.		
Unit IV	Software Configuration Management	08 Hours
Software Configuration Management - Scope of SCM, source code management core concepts,		

Build Engineering core concepts, Build tools evaluation and selection, Environment configuration control - goals, principles and importance, release management, deployment, configuration management-driven development, compliance, standards and frameworks for configuration management.

Case study – Case Study of Improving Quality of Processes by System Virtualization

Unit V	Software Version Control	08 Hours
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Software Version Control -Introduction, Version control types, centralized & Distributed, Centralized Version Control - Basics, Subversion Distributed Version Control - Basics, Advantages, Weaknesses,

Case Study : Version Control Best Practices on Git (for Management of Files)

Unit VI	Software Version Control Tools	08 Hours
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Software Version Control tools - Basic introduction to open source version control tools like GIT, GitHub, CVS, Apache Subversion, SVN, Mercurial, Bazaar.

Case Study - Setup of a version control tool like Git with understanding Basic configuration, Commits, Branching, Merging, Naming, History.

Case Study - Setup of a version control tool like Git with understanding Basic configuration, Commits, Branching, Merging, Naming, History

Books :

Text:

1. David Budgen, “Software Design” , Pearson - 2nd Edition, ISBN13: 9780201722192
2. Bob Aiello, Leslie Sachs, “Configuration Management Best Practices: Practical Methods that work in the real world “, Addison Wesley Professional (2010)
3. Eric Sink, “Version Control by Example”, Pyrenean Gold Press, ISBN13: 9780983507901

Reference :

1. Ian Gorton, “Essential Software Architecture”, Springer, ISBN 13: 9783642191763.
1. Jorge Luis Ortega-Arjona, “Patterns for Parallel Software Design”, Wiley Series, ISBN:978-0-470-69734-4
2. Kai Qian et al., “ Software Architecture and Design Illuminated”, Jones and Bartlett Publishers International, ISBN 13: 9780763754204.
3. Len Bass, Paul Clements, Rick Kazman, “Software architecture in practice” , 3rd edition, Addison Wesley, ISBN 13: 9780321815736
4. Ben Collins-Sussman, Brian William Fitzpatrick, C. Michael Pilato, “Version Control with Subversion” , O'Reilly Media , ISBN 13: 9781440495878
5. Scott Chacon and Ben Straub, “ Pro Git”, Apress, ISBN 13: 9781484200766
6. Richard E. Silverman, “ Git Pocket Guide: A Working Introduction”, O'Reilly Media, ISBN13: 9781449325862
7. 828-2012 - IEEE Standard for Configuration Management in Systems and Software Engineering
8. Software Engineering Competency Model Version 1.0 SWECOM by IEEE computer society

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) 510104 : Embedded and Real Time Operating Systems		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In- Sem: 50 Marks End- Sem : 50 Marks
Course Objectives: - To understand embedded system, its constituents and 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), types of RTOS, temporal, functional and resource parameters of an RTOS process - To learn various approaches to real-time scheduling and scheduling algorithms and multiprocessor scheduling - To understand resource access control and inter-process communication for RTOS tasks - To understand software development process, tools and debugging for RTOS applications - To learn designing of RTOS based applications		
Course Outcomes: On completion of the course, student will be able to– - 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)	08 Hours
Embedded SOC, ASIC, IP core, ASIP, ASSP, examples of embedded systems. Advanced architectures/processors for embedded systems- ARM, SHARC, DSP, Superscalar Units. Processor organization, Memory organization, Performance metrics for a processor, memory map and addresses, Processor selection and memory selection for real-time applications Networked embedded systems- I2C, CAN, USB, Fire wire. Internet enabled systems- TCP, IP, UDP. Wireless and mobile system Protocols- IrDA, Bluetooth, 802.11, ZigBee		
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.		

Case Study: Wireless and mobile system Protocols- IrDA, Bluetooth, 802.11, ZigBee		
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	08 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	08 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 3. 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 Master of Computer Engineering (2017 Course) Elective I 510105A : Advanced Digital Signal Processing		
Teaching Scheme: TH: 05 Hours/Week	Credits 05	Examination Scheme: In- Sem: 50 Marks End- Sem : 50 Marks
Course Objectives: - 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: After completion of the course, students should be able to- - 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		
Selection of Modules: Kindly note that modules 1, 2 are compulsory and select any three (03) modules from module number-3 to 7.		
Course Contents		
Module No	Module Title	Credit
1	DSP Preliminaries	01
Signals, Systems, and Signal Processing, Classification of Signals, Sampling of Analog Signals, The Sampling Theorem, Response of LTI Systems to Arbitrary Inputs: The Convolution Sum, Causal Linear Time-Invariant Systems, Stability of Linear Time-Invariant Systems, System with Finite-Duration and Infinite-Duration Impulse.		
2	Transforms	01
Efficient Computation of the DFT: FFT Algorithms, The Z-Transform, Properties of Z-Transform, Overview of Real World Applications of DSP, Audio Applications of DSP.		
3	FIR Filter Design	01
Introduction, FIR Filter Design, FIR Filter Specifications, FIR Coefficient Calculation Methods, Window Method, Direct-Form Structure, Cascade-Form Structures, Finite word length effects in FIR Digital Filters.		
4	IIR Filter Design	01
IIR Filter Design by Approximation of Derivatives, IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation, Characteristics of Commonly Used Analog Filters, Design of IIR Filter From Analog Filter, Direct-Form Structures, Cascade-Form Structures, Parallel-Form Structures.		
5	Power Spectrum Estimation	01

Estimation of Spectra From Finite-Duration Observations of Signals, Nonparametric Methods for Power Spectrum Estimation, Relationships Between Autocorrelation and the Model Parameters, The Yule-Walker Method for the AR Model Parameters.		
6	Multi rate Signal Processing	01
Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I / D, Implementation of Sampling Rate Conversion, Multistage Implementation of Sampling Rate Conversion, Sampling Rate Conversion by Arbitrary Factor, Applications of Multi rate Signal Processing, Digital Filter Banks.		
7	Special Purpose Digital Signal Processor	01
Introduction, Computer Architectures for signal processing, General-purpose digital signal processors, Selecting digital signal processors, Implementation of DSP algorithms on general purpose digital signal processors, Special-purpose DSP hardware.		
Books:		
Text:		
1. Alan V. Oppenheim and Ronald W. Schaffer, “ Digital Signal Processing”, Pearson, ISBN-10: 0132146355, 13: 978-0132146357 2. Emmanuel C. Ifeakor, 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 Gold, “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 Master of Computer Engineering (2017 Course) Elective I 510105B : Data Mining		
Teaching Scheme: TH: 05 Hours/Week	Credit 05	Examination Scheme: In-Sem : 50 Marks End-Sem : 50 Marks
Course Objectives: - To understand the fundamentals of Data Mining - To identify the appropriateness and need of mining the data - To learn the preprocessing, mining and post processing of the data - To understand various methods, techniques and algorithms in data mining		
Course Outcomes: On completion of the course the student should be able to- - Apply basic, intermediate and advanced techniques to mine the data - Analyze the output generated by the process of data mining - Explore the hidden patterns in the data - Optimize the mining process by choosing best data mining technique		
Selection of Modules: Kindly note that modules 1, 2, 3 are compulsory and select any one module from module number- 4 to 10.		
Course Contents		
Module No.	Module Title	Credit
1	Introduction	01
Data: Data, Information and Knowledge, Attribute Types: Nominal, Binary, Ordinal and Numeric attributes, Discrete versus Continuous Attributes, Introduction to Data Preprocessing, Data Cleaning, Data integration, data reduction, transformation and Data Descriptization. Concept of class: Characterization and Discrimination, basics /Introduction to: Classification and Regression for Predictive Analysis, Mining Frequent Patterns, Associations, and Correlations, Cluster Analysis.		
2		01
Measuring the Central Tendency: Basics of Mean, Median, and Mode, Measuring the Dispersion of Data, Variance and Standard Deviation. Measuring Data Similarity and Dissimilarity, Data Matrix versus Dissimilarity Matrix, Proximity Measures for Nominal Attributes and Binary Attributes		
3		01
Dissimilarity of Numeric Data: Minkowski Distance, Euclidean distance and Manhattan distance, Proximity Measures for Ordinal Attributes, Dissimilarity for Attributes of Mixed Types, Cosine Similarity.		
Book: 1. <u>Han, Jiawei Kamber, Micheline Pei and Jian</u> , “Data Mining: Concepts and Techniques” Elsevier Publishers Third Edition/Second Edition, ISBN: 9780123814791, 9780123814807		

4	Classification	02
Basic Concepts, General Approach to Classification, Decision Tree Induction, Attribute Selection Measures, Tree Pruning, Scalability and Decision Tree Induction, Visual Mining for Decision Tree Induction, Bayes Classification Methods, Baye's Theorem, Naive Bayesian Classification, Rule-Based Classification, Using IF-THEN Rules for Classification, Rule Extraction from a Decision Tree, Rule Induction Using a Sequential Covering Algorithm, Model Evaluation and Selection: Metrics for Evaluating Classifier Performance, Holdout Method and Random Sub sampling, Cross-Validation, Bootstrap, Model Selection Using Statistical Tests of Significance, Comparing Classifiers Based on Cost-Benefit and ROC Curves, Techniques to Improve Classification Accuracy: Introducing Ensemble Methods, Bagging, Boosting and Ada Boost, Random Forests, Improving Classification Accuracy of Class-Imbalanced Data. Study of open source/Commercial tool (WEKA/MEKA/Mulan/Panthalo), open source is desirable) Book: 1. Han, Jiawei Kamber, Micheline Pei and Jian, "Data Mining: Concepts and Techniques" Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807.		
5	Content Classification	02
Bayesian Belief Networks, Concepts and Mechanisms, Training Bayesian Belief Networks, Classification by Back propagation, A Multilayer Feed-Forward Neural Network, Defining a Network Topology, Back propagation, Inside the Black Box: Back propagation and Interpretability, Support Vector Machines: The Case When the Data Are Linearly Separable, The Case When the Data Are Linearly Inseparable, Classification Using Frequent Patterns, Associative Classification, Discriminative Frequent Pattern-Based Classification, Lazy Learners (or Learning from Your Neighbors), k-Nearest-Neighbor Classifiers, Case-Based Reasoning, Other Classification Methods, Genetic Algorithms, Rough Set Approach, Fuzzy Set Approaches, Additional Topics Regarding Classification: Multiclass Classification, Semi-Supervised Classification Active Learning, Transfer Learning, Reinforcement learning, Systematic Learning, Holistic learning and multi-perspective learning. Study of open source/Commercial tool (WEKA/MEKA/ Mulan/ Panthalo), open source is desirable) Book: 1. Han, Jiawei Kamber, Micheline Pei and Jian, "Data Mining: Concepts and Techniques" Elsevier Publishers Third Edition/Second Edition, ISBN: 9780123814791, 9780123814807 2. Parag Kulkarni, "Reinforcement and Systemic Machine Learning for Decision Making." Wiley-IEEE Press, ISBN: 978-0-470-91999-6.		
6	ANN and Data Mining	02
Deep Feed forward Networks: Gradient-Based Learning, Hidden Units, Architecture Design, Back-Propagation and Other Differentiation Algorithms. Convolution Networks: The Convolution Operation, Pooling, Variants of the Basic Convolution Function. Recurrent Neural Networks: Recurrent Neural Networks, Bidirectional RNNs, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and RNNs. Auto-Encoders: Under complete Auto encoders, Regularized Auto encoders, Stochastic Encoders and Decoders, Denoising Auto encoders Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing. Study of open source/Commercial tool (like Tensor Flow Lib., Caffé Lib., Theano.), open source is desirable)		

References:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, ISBN: 9780262337434
2. Online Course: <http://cs224d.stanford.edu/syllabus.html>

7	Parallel and Distributed Data Mining	02
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Parallel and Distributed Data Mining: Introduction Parallel and Distributed Data Mining, Parallel Design Space: Distributed Memory Machines vs. Shared Memory Systems, Task vs. Data Parallelism, Static vs. Dynamic Load Balancing, Horizontal vs. Vertical Data Layout, Complete vs. Heuristic Candidate Generation.

Algorithms in parallel and distributed data mining: Count Distribution, Data Distribution, Candidate Distribution, Eclat,

Algorithms: Parallel Association Rule Mining: a priori-based Algorithms, Vertical Mining, Pattern-Growth Method,

Parallel Clustering Algorithms: Parallel k-means, Parallel Hierarchical Clustering, Parallel HOP: Clustering Spatial Data, Clustering High-Dimensional Data,

Research Issues and Challenges: High dimensionality, Large size, Data Location, data Types, Data Skew, Dynamic Load Balancing, Incremental Methods, Multi-table Mining, Data Layout, and Indexing Schemes, Parallel DBMS/File systems, Interaction, Pattern Management, and Meta-level Mining.

Distributed Mining Frameworks/Architectures: JAM, PADMA, BODHI, APACHE SPARK.

Introduction to CUDA Parallel programming language: Parallel Programming in CUDA C - CUDA Parallel Programming, Splitting Parallel Blocks, Shared Memory and Synchronization, Constant Memory, Texture Memory, CUDA events, Measuring Performance with Events, Parallel Matrix multiplication, Cuda KNN.

Books:

1. Mohammed J. Zaki, Ching-Tien Ho, "Large-Scale Parallel Data Mining", LCNS, Springer Publishers, ISBN: 978-3-540-46502-7
2. Sanguthevar Rajasekaran and John Reif, "Handbook of Parallel Computing Models Algorithms and Applications", CRC Book Press, **ISBN 9781584886235**
3. Liu, Wei-keng Liao, Alok Choudhary, and Jianwei Li, "Parallel Data Mining Algorithms for Association Rules and Clustering"
4. Kimito Funatsu, "New Fundamental Technologies in Data Mining", 978-953-307-547-1
5. Jason Sanders, Edward Kandrot, "CUDA by Example - An Introduction to General-Purpose GPU Programming", ISBN-10: 0-13-138768-5
6. Addison Wesley, Shane Cook, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs by, Elsevier Publishers, ISBN: 978-0201000238

8	Spatial and Multimedia Data Mining	02
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Data Objects: Generalization of Structured Data, Aggregation and Approximation in Spatial and Multimedia Data Generalization, Generalization of Object Identifiers and Class/Subclass, Hierarchies, Generalization of Class Composition Hierarchies, Construction and Mining of Object Cubes, Generalization-Based Mining of Plan Databases by Divide-and-Conquer.

Spatial Data Mining: Spatial Data Cube Construction and Spatial OLAP, Mining Spatial Association and Co-location Patterns, Spatial Clustering Methods, Spatial Classification and Spatial Trend Analysis, Mining Raster Databases,

Multimedia Data Mining: Similarity Search in Multimedia Data, Multidimensional Analysis of Multimedia Data, Classification and Prediction Analysis of Multimedia Data, Mining Associations in Multimedia Data, Audio and Video Data Mining

Book:		
1. Han, Jiawei Kamber, Micheline Pei and Jian, “Data Mining: Concepts and Techniques” Elsevier Publishers Second Edition, ISBN: 9780123814791, 9780123814807.		
9	Data Mining Applications	02
Mining Complex Data Types, Mining Sequence Data: Time-Series, Symbolic Sequences, and Biological Sequences, Mining Graphs and Networks, Mining Other Kinds of Data, Other Methodologies of Data Mining, Statistical Data Mining, Views on Data Mining Foundations, Visual and Audio Data Mining, Data Mining Applications, Data Mining for Financial Data Analysis, Data Mining for Retail and Telecommunication Industries, Data Mining in Science and Engineering, Data Mining for Intrusion Detection and Prevention, Data Mining and Recommender Systems, Data Mining and Society, Ubiquitous and Invisible Data Mining, Privacy, Security, and Social Impacts of Data Mining, Data Mining Trends.		
Book:		
1. Han, Jiawei Kamber, Micheline Pei and Jian, “Data Mining: Concepts and techniques” Elsevier Publishers Second Edition, ISBN: 9780123814791, 9780123814807.		
10	Pattern Discovery and Social Networks Mining	02
Graph Mining: Methods for Mining Frequent Subgraphs: A priori-based Approach, Pattern-Growth Approach, Mining Variant and Constrained Substructure Patterns: Mining Closed Frequent Substructures Extension of Pattern-Growth Approach: Mining, Alternative Substructure Patterns, Constraint-Based Mining of Substructure Patterns, Mining Approximate Frequent Substructures, Mining Coherent Substructures Mining Dense Substructures, Applications: Graph Indexing with Discriminative Frequent Substructures Substructure Similarity Search in Graph Databases Classification and Cluster Analysis Using Graph Patterns Social Network Analysis: Introduction Social Network, Characteristics of Social Networks, Link Mining: Tasks and Challenges, Mining on Social Networks: Link Prediction, Mining Customer Networks for Viral Marketing, Mining Newsgroups Using Networks, Community Mining from Multi relational Networks Multi relational Data Mining: Introduction Multi relational Data Mining ILP Approach to Multi relational Classification Tuple ID Propagation, Multi relational Classification Using Tuple ID Propagation Multi relational Clustering with User Guidance.		
Books:		
1. Han, Jiawei Kamber, Micheline Pei and Jian, “Data Mining: Concepts and Techniques”, Elsevier Publishers Second Edition, ISBN: 9780123814791, 9780123814807.		
2. Matthew A. Russell, "Mining the Social Web,;Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More" , Shroff Publishers, 2nd Edition		
3. Maksim Tsvetovat,Alexander Kouznetsov, "Social Network Analysis for Startups:Finding connections on the social web", Shroff Publishers , ISBN: 10: 1449306462		

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) Elective I 510105C : Network Design and Analysis		
Teaching Scheme: TH: 05 Hours/Week	Credit 05	Examination Scheme: In- Sem: 50 Marks End- Sem: 50 Marks
Course Objectives : - To develop a comprehensive understanding of computer Networks - To study design issues in networks. - To learn estimation of network requirements. - To learn Enterprise network design. - To understand various issues hindering the performance of the network.		
Course Outcomes: After completion of the course, students should be able to - Apply the knowledge to design computer networks - Analyze the performance of networks based on chosen metrics - Design routing schemes for optimized routing - Choose appropriate and advanced techniques to build the computer network		
Selection of Modules: All modules 1 to 5 are compulsory.		
Course Contents		
1	Introduction	01
Overview of network analysis and design process, Network design issues, requirement analysis (user, application, device, network) concepts, Routing and forwarding, resource allocation, general principles of network design, network characteristics, performance metric in networks		
2	Physical and Logical network design	01
Topologies, Physical addressing, switching, IP packet format, IP routing method, routing using masks, fragmentation of IP packet, IPv6, advanced features of IP routers: filtering, IP QoS, NAT, routers		
3	Queuing Theory	01
Delay Models in Data Networks, Queuing Models- Little's Theorem, Application of Little's Theorem, Queuing Systems: M/M/1, M/M/2, M/M/m, M/M/∞, M/M/m/m, M/M/m/q, M/M/1/N, D/D/1, M/G/1 System, M/G/1 Queues with Vacations, Priority Queuing.		
4	Modelling N/W as Graph	01
Graph terminology, representation of networks, fundamental graph algorithms, shortest path, link prediction algorithms-Dijkstra's, Bellman's, Floyd's, Incremental shortest path algorithm.		
5	Methods of Ensuring Quality of Service	01
Methods of ensuring quality of service – introduction, applications and QoS, QoS mechanisms, Queue management algorithms, feedback, resource reservation, traffic engineering, IP QoS Next generation networks, cyber physical systems, smart mobiles, cards and device networks, smart devices and services, network testing, testing tool – wireshark		
Books: 1. Aaron Kershenbaum, "Telecommunications Network Design Algorithm", McGraw Hill education (India), Edition 2014, ISBN-10: 0070342288 2. James McCabe, "N/W analysis, Architecture and Design", Elsevier, 978-0-12-370480-1 3. Pablo Pavon Marino, "Optimization of Computer Networks : Modeling and algorithms – A hands on approach", Wiley Publication, ISBN: 9781119013358 4. Olifer, Victor Olifer, "Computer Networks, Principles, Technologies and Protocols for network design", Wiley India, ISBN: 13: 9788126509171.		

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) Elective I 510105 D : Data Algorithms		
Teaching Scheme: TH: 05 Hours/Week	Credit 05	Examination Scheme: Internal Assessment : 50 Marks End- Sem: 50 Marks
Course Objectives : - To study concepts of sorting and searching for voluminous data - To learn functionalities of advanced network algorithms - To understand the means for data and market prediction - To study various performance parameters for algorithmic		
Course Outcomes: After completion of the course, students should be able to- - Apply the concept of advanced algorithms for searching, sorting and network algorithms - Estimate the complexity of various algorithms and Measure the Choose appropriate algorithm to solve data centric problems		
Selection of Modules: Modules 1 to 4 are compulsory and select any one from modules 5 and 6.		
Course Contents		
Module No	Module Title	Credit
1	Secondary Sorting Algorithm	01
Secondary Sort: Introduction, Solutions to the Secondary Sort Problem, Map Reduce Solution to Secondary Sort, Spark Solution to Secondary Sort, Secondary Sorting Technique, Complete Example of Secondary Sorting, Top N, Formalized Map Reduce Implementation: Unique Keys & Non unique Keys, Spark Implementation: Unique Keys, Non unique Keys.		
2	Left Outer Join Algorithms	01
Left Outer Join: Implementation of Left Outer Join in Map Reduce with Example, Spark Implementation of Left Outer Join().		
3	Order Inversion	01
Order Inversion : Example of the Order Inversion Pattern, Map Reduce Implementation of the Order Inversion Pattern, Formal Definition of Moving Average.		
4	Market Basket Analysis	01
Market Basket Analysis : MBA Goals, Application Areas for MBA, Market Basket Analysis Using MapReduce, Spark Solution, POJO Common Friends Solution.		
5	Scatter Search Algorithms	01
Introduction of SS algorithms, working principle of SS algorithms / scatter search methodology and basic scatter search design and advance designs, SS Algorithm, Diversification Method, Reference set update method, Improvement Methods, Subset Generation, training method.		
6	Network Algorithms	01
Bellman's equation and acyclic networks, The Network Simplex Algorithm - The minimum cost flow problem, Tree solutions, Constructing an admissible tree structure.		
Books :		
1. Mahmoud Parsian, "Data Algorithms", O'Reilly, ISBN: 10 1491906189 2. Manuel Laguna, Rafael Martí, "Metaheuristic Procedures for Training Neural Networks" Springer (2006) ISBN - 978-0-387-33415-8 3. Dieter Jungnickel, "Graphs, Networks and Algorithms", Springer, 978-3-540-72779-8		

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) 510206 : Laboratory Proficiency I		
Teaching Scheme: Practical: 08 Hours/Week	Credit 04	Examination Scheme: Presentation: 50 Marks TW: 50 Marks
Laboratory Proficiency I (LP I) is companion course of theory courses (core and elective) in Semester I. It is recommended that set of assignments or at least one mini-project/study project per course is to be completed. Set of problem statements are suggested. Course/ Laboratory instructor may frame suitable problem statements. Student has to submit a report/Journal consisting of appropriate documents - prologue, Certificate, table of contents, and other suitable write up like (Introduction, motivation, aim and objectives, outcomes, brief theory, requirements analysis, design aspects, algorithms, mathematical model, complexity analysis, results, analysis and conclusions). Softcopy of report /journal and code is to be maintained by department/ institute in digital repository. Suitable platform/framework/language is to be used for completing mini-project/assignments. Guidelines for Term Work Assessment Continuous assessment of laboratory work is done based on performance of student. Each assignment/ mini project assessment is to be done based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as mini project assessment include- timely completion, performance, innovation, efficient codes, usability, documentation and adhering to SDLC comprehensively. Guidelines for Examination It is recommended that examination should be conducted as presentation by student based on one of the mini projects completed and the content understanding of laboratory work.		
Suggested List of Laboratory Assignments		
A. Research Methodology		
1. Use an academic web search to locate a journal paper which describes a design outcome in your field of interest (i.e. your engineering discipline). You must enter several keywords which relate to your topic. Read the paper and, using your own words, demonstrate your understanding of the paper by: ▪ Brief Contribution ▪ Performance metric, data set, comparative analysis and outcomes ▪ Writing out the major conclusions of the paper; ▪ Outlining the verification method(s) used to support these conclusions ▪ Describing the author's reflective comments on the quality of the design (positive and negative). ▪ The positive and negative environmental impacts; After reading a published research paper, write down the research question you think the author have addressed in undertaking this research. Do you think the paper adequately supports the conclusions reached in addressing the question?		

2.	Consider a journal article in your discipline that was published approximately five years ago. Note the keywords and type them into one of the web-based academic search engines (e.g. googlescholar.com). Does the original article appear in the search results? How many citations does this article have? Have the same authors published further work in this field? Compare the citations of this paper with those from the most highly cited paper in the search results? How many citations does this highly cited article have? If this paper was published before your original article, is it cited in your article? Do you think this high-cited paper should have been listed as a reference in your original article? Give reasons for your decision. Read a journal paper from your discipline. Following the format of patents, write out one or more important outcomes from the paper in terms of one or more Patent Claims 1, 2.... .These claims must not only be new, they must be not-obvious from previous work
3.	a) Literature Review Quality: Using a Journal paper selected in your engineering discipline of interest, write a 400 word evaluation of the quality of Literature Review. In particular, review the quality and relevance of cited papers, the comments made on those papers contribution to the general field, and any omission of papers which are of major importance in the field. b) Develop a new research proposal from a published paper: From selected published Journal paper, read the paper. In particular read the discussion and conclusion section and find Suggestions for further work. Apply one of the question words(How?, Why?, What?, When?) and write one or more research questions arising from this paper. This can be used as guide to help you to develop your own research project proposal
4.	a) Download a set of weather data from the Internet covering the temperature and atmospheric pressure over a four day period. Present the data using 2D and 3D plots, and so deduce if the weather conditions are trending either higher or lower over this four day period. (Possible web sites include http://www.bom.gov.au/climate/data/ and http://www.silkeborg-vejret.dk/english/regn.php). b) Numerical modeling: Find a paper in which nunicricil modeling has been used to verify the experimental results. Comment on the differences between the experimental and modeling results. Have the authors commented on the accuracy of the experimental and modeling procedures? What suggestions do you have to improve the quality of the modeling reported in the paper? c) Statistical review: In your engineering discipline review a published paper which includes a statistical analysis. Write a brief report on the statistical methods used. Can you suggest an improved statistical analysis? Suggest some additional parameters that might have been measured during the data acquisition stage and so explain how you would analyze the total data set to deduce the influence (and statistical significance) of these additional measurements.

B. Bio-Inspired Algorithms	
1. Ant Colony Algorithm:	The Traveling Salesman Problem is a problem of a salesman who, starting from his hometown, wants to find the shortest tour that takes him through a given set of customer cities and then back home, visiting each customer city exactly once." Each city is accessible from all other cities.. Use ant colony algorithm for generating good solutions to both symmetric and asymmetric instances of the Traveling Salesman Problem. Use appropriate representation for graph and an appropriate heuristic that defines the distance between any two nodes of the graph. Use parallel approach to optimize solution
2.	Job Scheduling using PSO, Optimization techniques for N-Queen's problem, Management and allocation of resources in a safety division of any pharmaceutical company, To automate the strategic planning process in an industry., Optimize Staff allocation problem in an organization, Railway Transportation/ Air Transportation : A case study of Transportation problem, Time table generation.
C. Software Development & Version Control	
1.	Study of any open source system/application software like Version Control in Linux Kernel
D. Embedded and Real Time Operating Systems	
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
E. Elective I	
	Course instructor is authorized to frame suitable problem statement for Assignments/ mini project

Semester II

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) 510108 : Operations Research		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem : 50 Marks End-Sem : 50 Marks
Course Objectives: - 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: After completion of the course, students should be able to- - 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	08 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	08 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	08 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 x n and m x 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	08 Hours
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	08 Hours
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" Meerut,2009, ISBN: 978-81-224-2288-7 2. Hrvey 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 Master of Computer Engineering (2017 Course) 510109 : System Simulation and Modeling		
Teaching Scheme: TH: 5 Hours/Week	Credit 05	Examination Scheme: In- Sem: 50 Marks End- Sem : 50 Marks
Course Objectives: - To learn the concepts of Systems behavior - To understand various Modeling schemes - To acquaint with the theory of simulation - To learn applications to simulate the systems		
Course Outcomes: After completion of the course, students should be able to- - To apply modeling to understand system behavior - To design the simulation scheme for particular system - To analyze the modeled and simulated systems - To compare the results of simulations confined to real world application		
Course Contents		
Unit I	Introduction	08 Hours
The Nature of Systems, Event-Driven Model, Characterizing Systems, Simulation Diagrams, The Systems Approach. Dynamical Systems: Initial-Value Problems, Higher-Order Systems, Autonomous Dynamic Systems, Multiple-Time-Based Systems, Handling Empirical Data.		
Unit II	Stochastic Data Representation	08 Hours
Uniformly Distributed Random Numbers, Statistical Properties of U [0,1] Generators, Generation of Non-Uniform Random Variates, Generation of Arbitrary Random Variates, Random Processes, Characterizing Random Processes, Generating Random Processes, Random Walks, White Noise. Stochastic Data Representation: Random Process Models, Moving-Average (MA) processes, Autoregressive (AR) processes, Big-Z notation, Autoregressive Moving-Average (ARMA) models, additive noise.		
Unit III	Sampled Systems	08 Hours
Sampled Systems, Spatial Systems, Finite-Difference Formulae, Partial Differential Equations, Finite Differences for Partial Derivatives, Constraint Propagation. Exogenous Signals and Events: Disturbance Signals, State Machines, Petri Nets, Analysis of Petri Nets, System Encapsulation.		
Unit IV	Stochastic Data Representation	08 Hours
Modeling Input Signals, Nomenclature, Discrete Delays, Distributed Delays, System Integration, Linear Systems, Motion Control Models, Numerical Experimentation. Event-Driven Models: Simulation Diagrams, Queuing Theory, M/M/1 Queues, Simulating Queuing Systems, Finite-Capacity Queues, Multiple Servers, M/M/c Queues.		

Unit V	Behavior of a Stochastic Process	08 Hours
Transient and Steady-State Behavior of a Stochastic Process, Types of Simulations with Regard to Output Analysis, Statistical Analysis for Terminating Simulations, Statistical Analysis for Steady-State Parameters, Statistical Analysis for Steady-State Cycle Parameters, Multiple Measures of Performance, Time Plots of Important Variables		
Unit VI	Simulation of Manufacturing System	08 Hours
Simulation of Manufacturing System: Introduction, Objectives of Simulation in Manufacturing, Simulation Software for Manufacturing, Modeling System Randomness with extended example, A simulation case study of a Metal-Parts Manufacturing Facility.		
Books		
Text:		
1. Frank L. Severance, "System Modeling and Simulation a Introduction", Severance, John Wiley & Sons Ltd, ISBN 9812-53-175-0. 2. Averill M Law, "Simulation Modeling and Analysis", McGraw Hill Education, ISBN-13: 978-0-07- 066733-4.		
Reference:		
1. Daniele Gianni, Andrea D'Ambrogio, and Andreas Tolk (editors), Modeling and Simulation-Based Systems Engineering Handbook, CRC Press, 2014, ISBN:9781138748941 2. Gould, H. and Tobochnik, J., Computer Simulation Methods part I and II (Addison Wesley, 1987)		

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) 510110 : Machine Learning		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In- Sem: 50 Marks End- Sem : 50 Marks
Course Objectives : - To understand Human learning aspects - To learn the primitives in learning process by computer - To Understand nature of problems solved with Machine Learning - To acquaint with the basic concepts and techniques of Machine Learning. - To learn the means for categorization of the information		
Course Outcomes : After completion of the course, students should be able to- - Acquire fundamental knowledge of learning theory - Design and evaluate various machine learning algorithms - Use machine learning methods for multivariate data analysis in various scientific fields - Choose and apply appropriate Machine Learning Techniques for analysis, forecasting, categorization and clustering of the data		
Course Contents		
Unit I	Machine Learning Concepts	09 Hours
Introduction to Machine Learning, Machine Learning applications, Types of learning: Supervised, Unsupervised and semi-supervised, reinforcement learning techniques, Models of Machine learning: Geometric model, Probabilistic Models, Logical Models, Grouping and grading models, Parametric and non-parametric models, Predictive and descriptive learning, Classification concepts, Binary and multi-class classification		
Unit II	Learning Theory	09 Hours
Features: Feature Extraction, Feature Construction and Transformation, Feature Selection, Dimensionality Reduction: Subset selection, the Curse of dimensionality, Principle Components analysis, Independent Component analysis, Factor analysis, Multidimensional scaling, Linear discriminant analysis, Bias/Variance tradeoff, Union and chernoff/Hoeffding bounds, VC dimension, Probably Approximately Correct (PAC) learning, Concept learning, the hypothesis space, Least general generalization, Internal disjunction, Paths through the hypothesis space, model Evaluation and selection		
Unit III	Geometric Models	09 Hours
Regression, Logistic regression , Assessing performance of regression - Error measures, Overfitting, Least square method, Multivariate Linear regression, Regression for Classification, Perceptron, Muli-layer perceptron, Simple neural network, Kernel based methods, Support vector machines(SVM), Soft margin SVM, Support Vector Machines as a linear and non-linear classifier, Limitations of SVM, Concept of Relevance Vector, K-nearest neighbor algorithm		
Unit IV	Logical, Grouping And Grading Models	09 Hours

Decision Tree Representation, Alternative measures for selecting attributes, Decision tree algorithm: ID3, Minimum Description length decision trees, Ranking and probability estimation trees, Regression trees, Clustering trees, Rule learning for subgroup discovery, Association rule mining, Distance based clustering- K-means algorithm, Choosing number of clusters, Clustering around medoids – silhouettes, Hierarchical clustering, Ensemble methods: Bagging and Boosting

Unit V	Probabilistic Models	09 Hours
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Uncertainty, Normal distribution and its geometric interpretations, Baye's theorem, Naïve Bayes Classifier, Bayesian network, Discriminative learning with maximum likelihood, Probabilistic models with hidden variables, Hidden Markov model, Expectation Maximization methods, Gaussian Mixtures and compression based models

Unit VI	Case Studies on Advanced Machine Learning Techniques	09 Hours
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Profiling the online storefronts of counterfeit merchandise, Detecting malicious websites in adversarial classification, Credit card fraud detection, Topic models of the underground Internet economy, Learning to rate vulnerabilities and predict exploits.

Books:

Text:

1. Peter Flach, Machine Learning: The Art and Science of Algorithms that make sense of data, Cambridge University Press, 1st Edition, 2012, ISBN No.: 978-1-316-50611-0
2. Ethem Alpaydin, Introduction to Machine Learning, PHI, 2nd edition, 2013, 978-0-262-01243-0
3. Kevin Murphy, Machine Learning: a Probabilistic Approach, MIT Press, 1st Edition, 2012, ISBN No.: 978-0262-30616-4

Reference:

1. C.M. Bishop, Pattern Recognition and Machine learning, Springer, 1st Edition, 2013, ISBN No.: 978-81-322-0906-5
2. Hastie, Tibshirani, Friedman, Introduction to statistical machine learning with applications in R, Springer, 2nd Edition, 2013, ISBN No.: 978-1-4614-7138-7
3. Tom Mitchell, Machine Learning, McGraw Hill, 1997, 0-07-042807-7
4. Parag Kulkarni, Reinforcement and Systemic Machine learning for Decision Making, Wiley-IEEE Press, 2012, 978-0-470-91999-6
5. M. F. Der, L. K. Saul, S. Savage, and G. M. Voelker (2014). Knock it off: profiling the online storefronts of counterfeit merchandise. In Proceedings of the Twentieth ACM Conference on Knowledge Discovery and Data Mining (KDD-14), pages 1759-1768. New York, NY.
6. J. T. Ma, L. K. Saul, S. Savage, and G. M. Voelker (2011). Learning to detect malicious URLs. ACM Transactions on Intelligent Systems and Technology 2(3), pages 30:1-24.
7. D.-K. Kim, G. M. Voelker, and L. K. Saul (2013). A variational approximation for topic modeling of hierarchical corpora. To appear in Proceedings of the 30th International Conference on Machine Learning (ICML-13). Atlanta, GA.
8. M. Bozorgi, L. K. Saul, S. Savage, and G. M. Voelker (2010). Beyond heuristics: learning to classify vulnerabilities and predict exploits. In Proceedings of the Sixteenth ACM Conference on Knowledge Discovery and Data Mining (KDD-10), pages 105-113. Washington, DC

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
Elective II
510111A : Image Processing

Teaching Scheme: TH: 05 Hours/Week	Credit 05	Examination Scheme: In- Sem: 50 Marks End- Sem : 50 Marks
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Course Objectives :

- To study image processing concepts
- To study mathematics and algorithms for image processing
- To study various methods of image processing in spatial and frequency domain
- To understand various image processing applications

Course Outcomes :

After completion of the course, students should be able to-

- Apply relevant mathematics required for image processing
- Perform and analyze various image processing methods using appropriate tools
- Use various image processing methods in spatial and frequency domain
- Explore current trends and future scope in image processing applications

Selection of Modules:

Kindly note that modules 1, 2 are compulsory and select any three (03) modules from remaining modules 3 to 11.

Course Contents

Module No.	Module Title	Credit
1	Image Processing Fundamentals	01
Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling and Quantization, Image types, Image file formats, Human visual system, Elements of an image processing system, Fundamental steps in image processing, Component labeling algorithm, Morphological image processing		
2	Image Processing Fundamentals	01
Image Enhancement by Spatial domain image enhancement: Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian Image Enhancement by Frequency domain Image enhancement : Low pass filtering in frequency domain (Ideal, Butterworth, Gaussian), High pass filter in frequency domain (ideal, Butterworth, Gaussian).		
Case Study: Open Source image processing software: Octave, OpenCV, Scilab		
3	Image segmentation	01
Classification of image segmentation techniques, thresholding based image segmentation, edge based segmentation, edge detection, edge linking, Hough transform, watershed transform, clustering techniques, region approach		
4	Image restoration	01
Image degradation, Image restoration model, linear and non-linear image restoration, image denoising		
5	Multi resolution analysis	01
Image Pyramids, Multi resolution expansion, Fast Wavelet Transforms, Lifting scheme		
6	Feature extraction	01

Shape Descriptors- Classification of shape descriptor techniques, contour based (Boundary following , chain code, signature, Polygon approximation), region based- (Euler number, shape matrix, statistical moments), feature extraction in transform domain(Fourier descriptor) Relational descriptor, Use of Principal components for description		
7	Image Compression	01
Need and classification of image compression techniques, run-length coding, Shannon Fano coding, Huffman coding, Scalar and vector quantization, Compression Standards-JPEG/MPEG, Video compression		
8	Steganography and Watermarking	01
Information hiding, Steganography: introduction, properties, models, stegnoanalysis, Watermarking : introduction, properties, models, security, content authentication		
9	Satellite Image Processing	01
Concepts and Foundations of Remote Sensing, GPS, GIS, Elements of Photographic Systems, Basic Principles of Photogrammetry, Multispectral, Thermal, and Hyper spectral Sensing, Earth Resource Satellites Operating in the Optical Spectrum		
10	Medical Image Processing	01
Introduction, Medical Image Enhancement, Segmentation, Medical Image Analysis (Images of Brain MRI or Cardiac MRI or Breast Cancer Risk) Validation of registration accuracy		
11	Object Recognition	01
Introduction, Computer Vision, Tensor Methods in Computer Vision, Classifications Methods and Algorithm, Object Detection and Tracking, Object Recognition		
Books :		
Text:		
1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image processing", Pearson Education , Fourth Impression, 2008, ISBN: 978-81-7758-898-9. 2. A. K. Jain, "Fundamentals of Digital Image Processing", PHI, ISBN-978-81- 203-0929-6. 3. S. Annadurai, R. Shanmugalakshmi, "Fundamentals of Digital Image Processing", Pearson Education, First Edition, 2007, ISBN-8177584790. 4. Boguslaw Cyganek, "Object Detection and Recognition in Digital Images: Theory and Practice", Wiley, First Edition, 2013, ISBN: 978-0-470-97637-1. 5. Ingemar Cox, Matthew Miller, Jeffrey Bloom, Jessica Fridrich, Ton Kalker, "Digital Watermarking and Steganography", Morgan Kaufmann (MK), ISBN : 978-0-12-372585-1. 6. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman," Remote Sensing and Image Interpretation", Wiley, Seventh Edition, 2015, ISBN: 978-1-118-91947-7		
Reference:		
1. Isaac Bankman, "Handbook of Medical Imaging", Academic Press, Second Edition, 2008, ISBN: 9780080559148. 2. Jayaraman, Esakkirajan,Veerakumar," Digital image processing", Mc Graw Hill, Second reprint- 2010, ISBN(13): 978-0-07-01447-8, ISBN(10):0-07-014479-6 3. NPTEL Video Lecturers: Title: Digital Image Processing, Prof. P. K. Biswas, IIT Khargapur, A joint venture by IISc and IITs, funded by MHRD, Govt of India, url: http://nptel.ac.in/courses/117105079		

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
Elective II
510111B : Web Mining

Teaching Scheme:
TH: 05 Hours/Week

Credit
05

Examination Scheme:
In- Sem: 50 Marks
End- Sem : 50 Marks

Course Objectives:

- To study concepts of Web Information Retrieval;
- To understand concepts of Social Network Analysis;
- To know various applications of Web Mining;

Course Outcomes:

After completion of the course, students should be able to-

- Transform Web Information into analytical form;
- Use various means to analyze and synthesize Social Networking information
- Use appropriate tools used in analyzing the web information

Selection of Modules:

Kindly note that modules 1, 2 are compulsory and select any three (03) modules from modules 3 to 6.

Course Contents

Module No.	Module Title	Credit
1	Information Retrieval and Social Network Analysis	01
Basic Concepts of Information Retrieval Information Retrieval Models, Relevance Feedback, Evaluation Measures, Text and Web Page Pre-Processing, Inverted Index and Its Compression, Latent Semantic Indexing, Web Search, Meta-Search: Combining Multiple Rankings, Web Spamming.		
2	Social Network Analysis	01
Social Network Analysis, Co-Citation and Bibliographic, Page Rank, HITS, Community Discovery. Web Crawling: A Basic Crawler Algorithm, Implementation Issues, Universal Crawlers, Topical Crawlers, Evaluation, Crawler Ethics and Conflicts.		
3	Structured Data Extraction and Information Integration	01
Wrapper Generation, Preliminaries, Wrapper Induction, Instance-Based Wrapper Learning, Automatic Wrapper Generation: Problems, String Matching and Tree Matching, Multiple Alignment, Building DOM Trees, Extraction Based on a Single List Page: Flat Data Records, Extraction Based on a Single List Page: Nested Data Records, Extraction Based on Multiple Pages.		
4	Schema Matching	01
Introduction to Schema Matching, Pre-Processing for Schema Matching, Schema-Level Matching, Domain and Instance-Level Matching, Combining Similarities, 1:m Match, Integration of Web Query Interfaces, Constructing a Unified Global Query Interface.		
5	Mining and Sentiment Analysis	01

The Problem of Opinion Mining, Document Sentiment Classification, Sentence Subjectivity and Sentiment Classification, Opinion Lexicon Expansion, Aspect-Based Opinion Mining, Mining Comparative Opinions, Opinion Search and Retrieval, Opinion Spam Detection.

6	Web Usage Mining	01
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Data Collection and Pre-Processing, Data Modeling for Web Usage Mining, Discovery and Analysis of Web Usage Patterns, Recommender Systems and Collaborative Filtering, Query Log Mining, Computational Advertising.

Books :

Text:

1. Bing Liu, "Web Data Mining Exploring Hyperlinks, Contents, and Usage Data", Springer, Second Edition, ISBN 978-3-642-19459-7.
2. Zdravko Markov, Daniel T. Larose "Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage", Wiley, 2007, ISBN: 978-0-471-66655-4.

Reference :

1. Jesus Mena, "Data Mining Your Website", Digital Press, 1999, ISBN: 1-55558-222-2.
2. Soumen Chakrabarti, "Mining the Web: Discovering Knowledge from Hypertext Data", Morgan Kaufmann Publishers, 2002, ISBN-13: 978-1-55860-754-5.
3. Mike Thelwall, "Link Analysis: An Information Science Approach", 2004, Academic Press

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) Elective II 510111C : Pervasive and Ubiquitous Computing		
Teaching Scheme: TH: 05 Hours/Week	Credit 05	Examination Scheme: In-Sem : 50 Marks End-Sem : 50 Marks
Course Objectives : - 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– - 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		
Selection of Modules: Kindly note that modules 1, 2 are compulsory and select any three (03) modules from modules 3 to 6.		
Course Contents		
Module No.	Module Title	Credits
1	Pervasive Computing	01
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. Charting Past, Present, and Future Research in Ubiquitous Computing.		
2	Open protocols	01
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		
3	Voice Enabling Pervasive Computing	01
Voice Enabling 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.		
4	Personal Digital Assistant	01
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.		
5	User Interface	01
User Interface Issues in Pervasive Computing, Architecture, Smart Card- based Authentication Mechanisms , Wearable computing Architecture. Touche: Enhancing Touch Interaction on Humans, Screens, Liquids, and Everyday Objects		
6	Applications	01
Smart Tokens, Heating Ventilation and Air Conditioning, Set Top Boxes, Appliances and Home Networking, Residential Gateway, Automotive Computing, On Board Computing Systems, In Vehicle networks, Entertainment Systems, Emerging Sites of HCI Innovation: Hacker spaces, Hardware Startups & Incubators		
Books :		
Text :		
1. Jochen Burkhardt, Horst Henn, Stefan Hepper, Thomas Schaeck & Klaus Rindtorff, “ Pervasive Computing Technology and Architecture of Mobile Internet Applications”, Addison Wesley, Reading, 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. Jochen Burkhardt, , Stefan Hepper, Klaus Rindtorff, Thomas Schaeck “Pervasive Computing-Technology and Architecture of Mobile Internet Application”, Pearson Education, Sixth Edition 2009, ISBN: 5. John Krumm, "Ubiquitous Computing Fundamentals", Shroff Publishers, ISBN: 9781420093605 .		

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) Elective II 510111D : Network Security		
Teaching Scheme: TH: 05 Hours/Week	Credit 05	Examination Scheme: In Sem :: 50 Marks End-Sem: 50 Marks
Course Objectives: - To understand the concept of security and its applications. - To learn various vulnerabilities, threats and attacks - To know various detection and prevention techniques in diversified environments - To study different algorithms for network security		
Course Outcomes: After completion of the course, students should be able to - Design and choose appropriate security model - Apply security means to various applications - Apply security algorithms in various environments for network security - Design network security solutions - Select appropriate tools to thwart network attacks		
Selection of Modules: Kindly note that modules 1, 2 are compulsory and select any three (03) modules from modules 3 to 9.		
Course Contents		
Module No	Module Title	Credit
1	Classification of Network Attacks	01
Basic Security Concepts, History of Network Security, Data Security Vs. Network Security, Computer And Network Attacks, Introduction To Vulnerabilities, Threats And Attacks, Layers Of Attacks, Counter Measure Of Different Attacks Counter Measures For Various Attacks Case Study: How To Detect And Prevent Black Hole Attack In Mobile Ad Hoc Network		
2	WSN attacks	01
Review of WSN Attacks. Challenges on Detection of WSN Attacks, Approaches for Securing WSN		
3	Hacking & Sniffing	01
Hacking tools, The hacking process, Ethical hacking issues, Current technologies, Recent events and statistics of network attacks, Wi-Fi vulnerabilities What is network sniffing? Why network sniffing is important, Scan a single IP, Scan a host, Scan a range of Ips, Scan a subnet		
4	Port Scanning and Spoofing	01
Nmap port selection : Scan a single port, Scan a range of ports, Scan 100 most common ports (fast), Scan all 65535 ports, Scanning a subnet : Spoofing and decoy scans, Evading firewalls Nmap port scan types : Scan using TCP SYN scan (default), Scan using TCP connect		
5	Browser Exploitation, MITM attacks	01

Gathering version info : UDP scan, The reason switch, Using a list, Output to a file Commands, Starting the listener, Countermeasures, Social Engineering Toolkit and Browser Exploitation: Social engineering , What are web injections? How SQL injections work Cross site scripting (XSS) attacks: Preventative measures against XSS attacks How to reduce your chances of being attacked, Browser exploitation with BeEF : Browser hijacking, BeEF with BetterCap, BeEF with man-in-the-middle framework (MITMF), BeEF with SET		
6	Advanced Attacks	01
Advanced Network Attacks :What is an MITM attack?Related types of attacks, Examples o MITM, Tools for MITM attacks, Installing MITMF using Kali Linux, Passing and Cracking the Hash, What is a hash? Authentication protocols, Cryptographic hash functions: How do hackers obtain the hash? What tools are used to get the hash? How are hashes cracked? How do pass the hash attacks impact businesses? What defenses are there against hash password attacks?		
7	Web Content Attacks	01
SQL Injection: Examples of SQL injection attacks, Ways to defend against SQL injection attacks, Attack vectors for web applications, Bypassing authentication, Bypasses blocked and filtered websites, Finding vulnerabilities from a targeted sites, Extracting data with SQLmap, Hunting for web app vulnerabilities with Open Web Application Security Project (OWASP) ZAP		
8	Specialized Attacks	01
Malformed packets: Ping of death, Teardrop attack (aka Nestea), ARP cache poisoning, ARP poisoning commands, ACK scan, TCP port scanning, VLAN hopping, Wireless sniffing, OS fingerprinting ISN Sniffing, Passive OS detection		
9	Intrusions and Remedies	01
Web application exploits, What tools are used for web application penetration testing? Evil Twins and Spoofing : What is an evil twin? What is address spoofing? What is DNS spoofing? What tools are used for setting up an evil twin? The dangers of public Wi-Fi and evil twins, How to detect an evil twin? Detection Systems : IDS, IPS, Host based, Network- based, Physical Threat hunting platforms		
Books:		
Text :		
1. Dileep Kumar G.; Manoj Kumar Singh; M.K. Jayanthi, “Network Security Attacks and Countermeasures”, IGI Global, ISBN-13: 978-1-4666-8761-5 2. Arthur Salmon, Warun Levesque, Michael McLafferty, “Applied Network Security”, Packt Publishing, ISBN-13: 978-1-78646-627-3		
Reference:		
1. William Stallings, ‘Cryptography and Network Security: Principle and Practice’, 5th Edition, Pearson, ISBN: 978-81-317-6166-3. 2. Bernard Menezes, ‘Network Security and Cryptography’, Cengage Learning, ISBN: 978-81-315-1349-1. 3. Matt Bishop, Sathyanarayana, S. Venkatramanayya, “ Introduction to Computer Security”, Pearson Education, ISBN: 978-81-7758-425-7. 4. Bruce Schneier, “Applied Cryptography”, Wiley, ISBN:978-1-1119-09672-6		

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) 510112 : Seminar I		
Teaching Scheme: Practical: 04 Hrs/week	Credit 04	Examination Scheme: TW : 50 Marks Presentation : 50 marks
Course Objectives: - To explore the basic principles of communication (verbal and non-verbal) and active, empathetic listening, speaking and writing techniques. - To Identify, understand and discuss current, real-world issues, new technologies, research, products, algorithms and services.		
Course Outcomes: On completion of the course, student will be able– - To use multiple thinking strategies to examine real-world issues and explore creative avenues of expression,. - To acquire, articulate, create and convey intended meaning using verbal and non-verbal method of communication. - To learn and integrate, through independent learning in sciences and technologies, with disciplinary specialization and the ability to integrate information across The student shall have to deliver the seminar I in semester II on a topic approved by guide and authorities. It is recommended to allot guide to the student since the commencement of semester I. The guide allotment preferably needs to be carried out in synchronization with mutual domains of interest. It is recommended that seminar shall be on the topic relevant to latest trends in the field of concerned branch, preferably on the topic of specialization based on the electives selected or domain of interest. It is appreciated and strongly recommended that the student will select the domain of his/her dissertation and identify the literature confined to the domain. Thorough literature study based on the broad identified topic has to be carried out. This practice will eventually lead to convergence of the efforts for the dissertation in Semester III and IV. The relevant literature then be explored as state-of-the-art, exotic, recent technological advancement, future trend, application and research & innovation. Multidisciplinary topics are encouraged. The student shall submit the duly approved and certified seminar report in standard format, for satisfactory completion of the work by the concerned Guide and head of the department/institute. The student will be assessed based on his/her presentation and preparations by the panel of examiners out of them one has to be an external examiner. The students are expected to validate their study undertaken by publishing it at standard platforms. The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation the frequency of the activities in the sole discretion of the PG coordination. The continuous assessment of the progress need to be documented unambiguously. For standardization and documentation, follow the guidelines circulated / as in seminar logbook approved by Board of Studies.		

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) 510113 : Laboratory Proficiency II		
Teaching Scheme: Practical: 08 Hrs/week	Credit 04	Examination Scheme: Presentation: 50 Marks TW: 50 Marks
Laboratory Proficiency II (LP II) is companion course of theory courses (core and elective) in Semester II. It is recommended that set of assignments or at least one mini-project/study project per course is to be completed. Set of problem statements is suggested. Course/ Laboratory instructor may frame suitable problem statements. Student has to submit a report/Journal consisting of appropriate documents - prologue, Certificate, table of contents, and other suitable write up like (Introduction, motivation, aim and objectives, outcomes, brief theory, requirements analysis, design aspects, algorithms, mathematical model, complexity analysis, results, analysis, and conclusions). Softcopy of report /journal and code is to be maintained at department/institute in digital repository.		
Suitable platform/framework/language is to be used for completing mini-project/assignments.		
Guidelines for Term Work Assessment		
Continuous assessment of laboratory work is done based on performance of student. Each assignment/ mini project assessment to be done based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as mini project assessment include- timely completion, performance, innovation, efficient codes, usability, documentation and adhering to SDLC comprehensively.		
Guidelines for Examination		
It is recommended that examination should be conducted as presentation by student based on one of the mini projects completed and the content understanding of laboratory work.		
Suggested List of Laboratory Assignments		
A. Operations Research		
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 centers			
	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

B. System Simulation & Modeling

1. Using suitable simulation Tool simulate any one of-

A. Automobile Manufacturing Model-

The automobile has changed life of man in a way unimaginable before its invention. "The world travels on wheels" is the buzzword of the 20th century. The manufacturing of these automobiles is both a fascinating and challenging task. The simulation team has simulated the manufacturing process of wagons, sedans and convertibles in a Toyota car plant

	The following is the step by step procedure for the manufacturing of cars in the "Toyota Production System": 1. The manufacturing process begins with the chassis assembly. The chassis is the skeleton of the car. It is the part on which the car is built. 2. Axle and tires are fitted to the chassis assembly. 3. In the next stage, the engine is fitted to the chassis. The engine is the power-producing component of the car. The power produced in the engine is use to propel the car. Engines are mostly of the internal combustion type. 4. The gearbox is then fitted into the chassis. The gearbox is the component that is used to change the speed supplied to the wheels. 5. The next stage involves the fitting of the radiator into the engine. The radiator helps in cooling the engine, transmitting the excess heat to the surrounding by conduction. 6. The seats are then fitted to the car in the next stage. 7. The battery is then fitted and electrical connections are carried out. The electrical connections connect the various components of the car to the battery. 8. The body of the car is then fitted on the chassis. 9. The windshield, doors, and wipers are fitted to the car along with the bonnet. 10. The finishing touches are carried out on the car. 11. The car is then sent for inspection and testing after which it is taken to the parking lot and kept ready for shipping. B. Simulation of Inventory Control System C. Simulation of Single Server queuing system D. Customer Queuing System E. Transportation Model
C. Machine Learning	
	The laboratory course teacher has to design the assignment based on the data analysis of the data confined to any of the following domains or similar, <u>Students need to use R and Python for the assignment</u> The machine learning algorithms need to be applied to these data. For example if it is the Email data, then the student has to perform following operations, • Based on the occurrence of certain key words like lottery, tonic. the designed spam filter will build the information indicating TP,TN,FP and FN. • The system will plot coverage and ROC plots • The system will plot the scoring tree, ranking tree and grading classifier • Depending on the urgency to reply the email will be regressed on the scale of 1 to 10 • Plot the regression graph and use appropriate clustering algorithm and plot the results Other sample statements may be as below-
1	Suspicious activity detection from CCTVs : Use machine learning to make the society a safer place. The idea is to have a machine learning algorithm capturing and analyzing the CCTV video all the time and learn from it the normal activities of people like walking, running. so that if any suspicious activity occurs, say robbery, it alerts the authorities in real time about the incident.

2	Medical diagnostics for detecting diseases : Doctors and hospitals are now increasingly getting assisted in detecting diseases like skin cancer faster and more accurately. A system designed by IBM correctly picked the cancerous lesions(damage) in the images with 95% accuracy where a doctor's accuracy is usually between 75% - 84% using manual methods. So, the computing approach will help the doctors make more informed decisions by increasing the efficiency to recognise melanoma and spot the cases where it is difficult for the doctors to identify.
3	Web Search and Recommendation Engines: • find recognize input, find relevant searches, predict which results are most relevant to us, return a ranked output • recommend similar products (e.g., Netflix, Amazon,)
4	Finance: • predict if an applicant is credit-worthy • detect credit card fraud • find promising trends on the stock market
5	Text and Speech Recognition: • handwritten digit and letter recognition at the post office • voice assistants (Siri) • language translation service
6	Social Networks and Advertisement: • data mining of personal information • selecting relevant ads to show
7	Other: • Web page classification: various spam and junk pages, like soft404, parked domain • Entity extraction from web page and queries, like names, addresses. • Speller correction, running on each queries into Bing. • Search ranking, optimize for NDCG. • Facebook Ads ranking: various events prediction, like CTR, negative feedback, conversion. It serves $\sim 10^{10}$ page views daily. • Facebook news feed ranking, with daily $\sim 10^{11}$ impression. • Facebook PYMK (People You Might Know), aka friend suggestions.
D. Elective II	
Course instructor is authorized to frame suitable problem statement for Assignments/ mini project	

Semester III

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) 610101 :Fault Tolerant Systems		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In-Sem : 50 Marks End-Sem : 50 Marks
Course Objectives : - To identify and understand the need of redundancies in the systems - To understand reliability and accountability in the systems - To know the instances where fault tolerance is inevitable - To understand the concept of fault tolerance in detail		
Course Outcomes : On completion of the course the student should be able to- - Analyze the system for the requirement of fault tolerance - Simulate the fault tolerance algorithms - Implement diagnosis and recovery of the system - Assess the reliability of the system		
Course Contents		
Unit I	Fault Tolerance and Reliability Analysis	08 Hours
Introduction, Redundancy Techniques- Hardware Redundancy, Software Redundancy, Information Redundancy, Time Redundancy, Reliability Modeling and Evaluation - Empirical Models, Analytical Techniques.		
Unit II	Fault Modeling, Simulation and Diagnosis	08 Hours
Fault Modeling, Fault Simulation, Fault Simulation Algorithms- Serial Fault Simulation Algorithm, Parallel Fault Simulation, Deductive Fault Simulation, Concurrent Fault Simulation, Critical Path Tracing, Fault Diagnosis- Combinational Fault Diagnosis, Sequential Fault Diagnosis Methods.		
Unit III	Fault-Tolerant Routing in Multi-Computer Networks	08 Hours
Fault-Tolerant Routing Algorithms in Hypercube- Depth-First Search Approach, Iterative-Based Heuristic Routing Algorithm, Routing in Faulty Mesh Networks- Node Labeling Technique, A FT Routing Scheme for Meshes with Non-convex Faults.		
Unit IV	Fault Tolerance and Reliability in Hierarchical Interconnection Networks	08 Hours
Block-Shift Network (BSN)- BSN Edges Groups, BSN Construction, BSN Degree and Diameter, BSN Connectivity, BSN Fault Diameter, BSN Reliability, Hierarchical Cubic Network (HCN)- HCN Degree and Diameter, HINs versus HCNs, The Hyper-Torus Network (HTN).		
Unit V	Fault Tolerance and Reliability of Computer Networks	08 Hours
Fault Tolerance in Loop Networks - Reliability of Token-Ring Networks, Reliability of Bypass-Switch Networks, Double Loop Architectures, Multi-Drop Architectures, Daisy-Chain		

Architectures, Fault Tolerance in High Speed Switching Networks - Classification of Fault-Tolerant Switching Architectures, Architecture-Dependent Fault Tolerance.		
Unit VI	Fault Tolerance in Distributed System and Mobile Networks	08 Hours
Faults, Errors and Failures, failure models, process resilience, reliable client-server communication, reliable group communication, Check pointing Techniques in Mobile Networks- Minimal Snapshot Collection Algorithm, Mutable Checkpoints, Adaptive Recovery, Message Logging Based Checkpoints, Hybrid Checkpoints.		
Books:		
Text:		
1. Mostafa Abd-El-Barr, “Design and Analysis of Reliable and Fault-Tolerant Computer Systems” , World Scientific Publishing , ISBN 1281867497 2. Andrew Tanenbaum, “Distributed Systems Principles and Paradigms”, Pearson Prentice Hall, ISBN: 978-15-302817-5-6		
Reference:		
2. Dhiraj K. Pradhan, “ Fault Tolerant Computer System Design”, Prentice Hall, ISBN-13: 978-0130578877 3. Martin L. Shooman, “Reliability of Computer Systems and Networks: Fault Tolerance”, ISBN: 471464066 4. Jan Vytöpil, “Formal Techniques in Real-Time and Fault-Tolerant Systems“, ISBN: 1461532205		

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) 610102: Information Retrieval		
Teaching Scheme: TH: 04 Hours/Week	Credit 04	Examination Scheme: In- Sem: 50 Marks End- Sem : 50 Marks
Course Objectives: - To study concepts of Information Retrieval; - To understand the data in the form of XML - To study and Evaluate retrieved information - To understand classification and clustering		
Course Outcomes: On completion of the course the student should be able to- - Implement the concept of Information Retrieval - Evaluate and Analyze retrieved information - Generate quality information out of retrieved information - Apply clustering and classification algorithms to analyze the information		
Course Contents		
Unit I	Dictionaries and tolerant retrieval	08 Hours
Search structures for dictionaries, Wildcard queries :General wildcard queries ,k-gram indexes for wildcard queries, Spelling correction : Implementing spelling correction, Forms of spelling correction, Edit distance, k-gram indexes for spelling correction, Context sensitive spelling correction, Phonetic correction		
Unit II	Index Construction index compression scoring	08 Hours
. Index compression, Searching, Sequential Searching and Pattern Matching, Hardware basics, Types of indexes, Statistical properties of terms in information retrieval : Heaps' law: Estimating the number of terms, Zipf's law : Modeling the distribution of terms, Dictionary compression : Dictionary as a string ,Blocked storage, Postings file compression :Variable byte codes, Gamma codes.		
Unit III	Scoring, term weighting & the vector space model:	08 Hours
Parametric and zone indexes : Weighted zone scoring, Learning weights, The optimal weighting, Term frequency and weighting : Inverse document frequency, Tf- idf weighting, The vector space model for scoring :Dot products, Queries as vectors, Computing vector scores, Variant tf-idf functions : Sub-linear tf scaling Maximum tf normalization, Document and query weighting schemes, Pivoted normalized document length		
Unit IV	XML Retrieval	08 Hours
Basic XML concepts, Challenges in XML retrieval, A vector space model for XML retrieval, Evaluation of XML retrieval, Text-Centric vs. Data-Centric XML retrieval. Language models for information retrieval, Language models, The query likelihood model, Language modeling versus other approaches in IR, Extended language modeling approaches.		

Unit V	Language models for information retrieval	08 Hours
Language models: Finite automata and language models, Types of language models, Multinomial distributions over words, The query likelihood model: Using query likelihood language models in IR ,Estimating the query generation probability ,Ponte and Croft's Experiments , Language modeling versus other approaches in IR ,Extended language modeling approaches.		
Unit VI	Classification & clustering searches	08 Hours
Text Classification and Naïve Bayes ,Vector Space Classification, Support vector machines, and Machine learning on documents. Flat Clustering , Hierarchical Clustering ,Matrix decompositions and latent semantic indexing ,Fusion and Meta learning, Searching the Web Structure of the Web IR and web search		
Books :		
Text 1. C. Manning, P. Raghavan, and H. Schütze, "Introduction to Information Retrieval" , Cambridge University Press, 2008, -13: 9780521865715 2. Ricardo Baeza -Yates and Berthier Ribeiro – Neto, "Modern Information Retrieval: The Concepts and Technology behind Search" 2nd Edition, ACM Press Books 2011. 3. Bruce Croft, Donald Metzler and Trevor Strohman, Search Engines: Information Retrieval in Practice, 1st Edition Addison Wesley, 2009, ISBN: 9780135756324.		
Reference : 1. S. Buttcher, C. Clarke and G. Cormack, "Information Retrieval: Implementing and Evaluating Search Engines", MIT Press, 2010, ISBN: 0-408-70929-4. 2. C.J. Rijsbergen, "Information Retrieval", (http://www.dcs.gla.ac.uk/Keith/Preface.html) 3. W.R. Hersh, "Information Retrieval: A Health and Biomedical Perspective", Springer, 2002. 4. G. Kowalski, M.T. Maybury. "Information storage and Retrieval System" , Springer, 2005 5. W.B. Croft, J. Lafferty, "Language Modeling for Information Retrieval", Springer, 2003.		

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) Elective III 610103A : Cloud Security		
Teaching Scheme: TH: 05 Hours/Week	Credit 05	Examination Scheme: In- Sem: 50 Marks End- Sem : 50 Marks
Course Objectives: • To study concepts of Cloud Computing; • To learn and Explore Cloud Infrastructures • To study cloud Security Fundamentals • To know various issues related to the security of information in cloud environment		
Course Outcomes: • Use various services offered for cloud environment • Apply computing security fundamentals confined to cloud environment • Analyze the cloud system for vulnerabilities, threats and attacks • Propose feasible security solution for cloud security		
Course Contents		
Selection of Modules: Module 1 is compulsory and select any four(04) modules from 2 to 7.		
Module No.	Module Title	Credit
1	Introduction	01
Cloud Computing Fundamentals, Essential Characteristics, Architectural Influences, Technological Influences, Operational Influences, Outsourcing, IT Service Management, Cloud Computing Architecture, Cloud Delivery Models, Cloud Deployment Models, Alternative Deployment Models, Expected Benefits. Understanding Abstraction and Virtualization, Capacity Planning, Exploring Platform as a Service, Using Google Web Services, Using Amazon Web Services, Using Microsoft Cloud Services.		
2	Cloud Security	01
Cloud Information Security Objectives, Confidentiality, Integrity, and Availability, Cloud Security Services, Relevant Cloud Security Design Principles, Secure Cloud Software Requirements, Approaches to Cloud Software Requirements Engineering, Cloud Security Policy Implementation and Decomposition, Secure Cloud Software Testing, Testing for Security Quality Assurance, Cloud Penetration Testing, Regression Testing, Cloud Computing and Business Continuity Planning/Disaster Recovery		
3	Cloud Computing Risk Issues	01
The CIA Triad, Privacy and Compliance Risks, Threats to Infrastructure, Data, and Access Control, Common Threats and Vulnerabilities, Cloud Access Control Issues, Cloud Service Provider Risks, Cloud Computing Security Challenges, Security Policy Implementation, Policy Types, Computer Security Incident Response Team (CSIRT), Virtualization Security Management.		

4	Cloud Computing Security Architecture	01
Architectural Considerations, General Issues, Trusted Cloud Computing, Secure Execution Environments and Communications, Identity Management and Access Control, Identity Management, Access Control, Autonomic Security.		
5	Cloud Computing Life Cycle Issues	01
Standards, The Distributed Management Task Force (DMTF), The International Organization for Standardization (ISO), The European Telecommunications Standards Institute (ETSI), The Organization for the Advancement of Structured Information Standards (OASIS), Storage Networking Industry Association (SNIA), Open Grid Forum (OGF), The Open Web Application Security Project (OWASP), Incident Response, Encryption and Key Management, VM Architecture, Retirement		
6	Cloud storage Security	01
Who wants your data? Legal issues, criminals and authorization. Government and friends, legal responsibility, US Federal Law and regulations affecting cloud storage. Cloud storage provider and compliance. Laws and regulations of other countries.		
7	Privacy Tools and Best Practices	01
Privacy Tools and Best Practices, 2-factor authentication, secure email for cloud storage, Deletion of private data, security as service, distributed cloud storage, what are best practices, cloud data security and check list, Future of cloud data security.		
Books:		
1. Tim Mather, Shahed Latif, Subra Kumaraswamy, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", O'Reilly Media, SBN-13: 978-0596802769, ISBN-10: 0596802765 2. Ronald L Krutz and Russell Dean Vines , "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", ISBN:0470938943		
References:		
1. Vic (J.R.) Winkler , "Securing the Cloud: Cloud Computer Security Techniques and Tactics", ISBN:159749593X 2. Imad M. Abbadi, "Cloud Management and Security", ISBN: 1118817079 3. Sumner Blount, Rob Zanella, "Cloud Security and Governance: Who's on Your Cloud?", ISBN: 1849280908 4. Ryan Ko, Raymond Choo, "The Cloud Security Ecosystem: Technical, Legal, Business", ISBN: 0128017805		

Savitribai Phule Pune University
Master of Computer Network Engineering (2017 Course)
Elective III
610103B : Speech Signal Processing

Teaching Scheme:
TH: 05 Hours/Week

Credit
05

Examination Scheme:
In-Sem: 50 Marks
End-Sem: 50 Marks

Course Objectives:

- To understand basic characteristics of speech signal
- To learn speech signal production and hearing of speech by humans
- To be familiar with the techniques for the analysis of speech signals
- To understand different speech modeling procedures
- To know the applications of speech signal processing

Course Outcomes:

- Inculcate the characteristics of speech signal in relation to production and hearing of speech by humans
- Apply various algorithms of speech analysis common to many applications
- The students will be able to design a simple system for speech processing
- Analyze the performance of speech signal processing system

Selection of Modules:

Kindly note that modules 1, 2, 3 are compulsory and select any two (02) modules from modules 4-8.

Course Contents

Module No.	Module Title	Credit
1	Basic Concepts	01
Introduction, mechanism of speech production. Articulatory Phonetics – Production and Classification of Speech Sounds Acoustic phonetics: vowels, diphthongs, semivowels, nasals, fricatives, stops and affricates.; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.		
2	Speech Analysis	01
Features, Feature Extraction and Pattern Comparison Techniques: Speech distortion measures—mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances and Filtering, Likelihood Distortions, Spectral Distortion using a Warped Frequency Scale, LPC, PLP and MFCC Coefficients, Time Alignment and Normalization – Dynamic Time Warping, Multiple Time – Alignment Paths.		
3	Speech Modeling	01
Hidden Markov Models: Markov Processes, HMMs – Evaluation, Optimal State Sequence – Viterbi Search, Baum-Welch Parameter Re-estimation, Implementation issues.		
4	Applications of Speech Processing	01
Brief applications of speech processing in voice response systems, hearing aid design and recognition system.		
5	Statistical Models for Speech Recognition	01
(i) Vector quantization models and applications in speaker recognition. (ii) Gaussian mixture modeling for speaker and speech recognition. (iii) Discrete and Continuous Hidden Markov modeling for isolated word and continuous speech recognition.		

6	Speech Recognition	01
Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-grams, context dependent sub-word Units; Applications and present status.		
7	Speech Synthesis	01
Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, sub-word Units for TTS, intelligibility and naturalness – role of prosody, Applications and present		
8	Linear Predictive Analysis of Speech	01
Formulation of Linear Prediction problem in Time Domain-Basic Principle, Auto correlation method, Covariance method, Solution of LPC equations, Cholesky method, Durbin's recursive algorithm, lattice formation and solutions, comparison of different VELP, CELP		
Books:		
Text:		
1. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Edu, 2003. 2. Claudio Becchetti and Lucio Prina Ricotti, “Speech Recognition”, John Wiley and Sons, 1999, isbn: 13: 978-0471977308 3. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education, 2002.		
References:		
1. Steven W. Smith, “The Scientist and Engineer’s Guide to Digital Signal Processing”, California Technical Publishing, 1997. ISBN:0-9660176-4-1 2. Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education, 2004, ISBN: 9788129703187. 3. Ben Gold and Nelson Morgan, “Speech and Audio Signal Processing, Processing and Perception of Speech and Music”, Wiley- India Edition, 2006, ISBN: 10: 8126508221 4. UdoZolzer, " Digital Audio Signal Processing", Second Edition, John Wiley & sons Ltd, ISBN: 9780470680018 5. Lawrence R. Rabiner and R. W. Schaffer," Digital Processing of Speech Signals", Prentice Hall – 1978, ISBN: 0-13-213603-1 6. Frederick Jelinek, “Statistical Methods of Speech Recognition”, MIT Press, 1997.		

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) Elective III 610103C :Mobile Ad-hoc Networks		
Teaching Scheme: TH: 05 Hours/Week	Credit 05	Examination Scheme: In-Sem : 50 Marks End-Sem : 50 Marks
Course Objectives : - To study the concepts of Ad hoc Networks - To learn the concepts of Mobility and Mobility Prediction - To understand the functionalities of various Protocols in MANET - To know the technological advancements in wireless networks		
Course Outcomes : - Assess Quality of Service in MANET - Evaluate the performance of various Protocols in MANET - Choose appropriate constituents and parameters to build MANET - Analyze the performance of MANET		
Selection of Modules: Note that modules 1, 2, 3 are compulsory and select any two (02) from modules 4 to 8.		
Course Contents		
Module No.	Module Title	Credit
1	Introduction	01
Fundamentals of Wireless Communication, Characteristics of Wireless channel, IEEE 802 Networking Standard, 802.3, 803.11, 802.15, 802.16, HIPERLAN Standard, HIPERACCESS, Wireless Internet, TCP in Wireless Domain, WAP, ADHOC Wireless Network, Issues in ADHOC Wireless Network. Recent Advances in Wireless Networks: Ultra Wide-Band Radio Communication, Wireless Fidelity, Optical Wireless Networks, Multimode 802.11, Meghadoot Architecture.		
2	MAC Protocols	01
Design issues, goals and classification. Contention based protocols, Contention based protocols with reservation mechanisms, scheduling mechanisms, protocols using directional antennas, other protocols. Routing Protocols: Design Issues, Classification, Table Driven, On-Demand, Hybrid, Efficient Flooding Mechanism, Hierarchical, Power-Aware Routing Protocols.		
3	Multicast Routing	01
Design Issues, Architecture Reference Model, Classification, Tree-Based, Mesh-Based, Energy Efficient, Application Dependent, Multicasting with QOS-Guarantees. Transport layer: Design Issues and Design Goals, Classification, TCP over Ad Hoc Networks, Transport Layer protocols. Network Security Attacks, Key Management, Secure Routing.		
4	Quality of Service	01
Issues and Challenges, Classification, MAC Layer Solutions, Network Layer Solutions, QOS Frame work. Energy Management: Need, Classification, Schemes for: Battery Management, Transmission Power Management, System Power Management.		
5	Wireless Sensor Networks	01

Introduction, Sensor network Architecture, Data Dissemination, Data Gathering, MAC Protocols for WSN, Quality of WSN. Hybrid Wireless Networks: Introduction, Next Generation Hybrid Wireless Architectures, Routing, Pricing in Multi-hop Wireless Network, Power Control Schemes, Load Balancing.		
6	Algorithms for Mobile Ad-hoc Networks	01
Hierarchical routing and clustering, routing with virtual coordinates, relative location determination, overview and classification of NWB algorithms, Robustness control, NWB robustness solutions.		
7	Encoding for Data Distribution& Power Control Protocols	01
Erasure codes, Network coding, Design principles for power control, single layer approach, the systematic approach, energy oriented perspective.		
8	Vehicular Ad-hoc Networks	01
VANET, characteristics, Connectivity, Dynamic transmission range assignment, routing applications, vehicle mobility, VANET vs MANET.		
Books:		
Text:		
1. C. Siva Ram Murthy and B.S. Manoj, "Ad hoc Wireless Networks Architectures and protocols", 2nd edition, Pearson Education. 2007, ISBN: 9788131706886, 8131706885 2. Charles E. Perkins, "Ad hoc Networking", Addison–Wesley, 2000, ISBN: 0201309769		
Reference:		
1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, "Mobile ad hoc networking", Wiley-IEEE press, 2004, ISBN: 978-0-471-65688-3. 2. Mohammad Ilyas, "The handbook of ad hoc wireless networks", CRC press, 2002, ISBN: 0-8493-1332-5 3. T. Camp, J. Boleng, and V. Davies "A Survey of Mobility Models for Ad Hoc Network Research", Wireless Communication. and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502, ISBN: 4. Fekri M. Abduljalil, "A survey of integrating IP mobility protocols and Mobile Ad hoc networks", ISBN: 10 : 0750675993		

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) Elective III 610103 D : Pattern Recognition		
Teaching Scheme: TH: 05 Hours/Week	Credit 05	Examination Scheme: In-Sem : 50 Marks End- Sem: 50 Marks
Course Objectives: - To learn the basic concept of Pattern recognition - To study different approaches of pattern recognition - To learn various pattern classification techniques - To survey on recent advances and applications in pattern recognition		
Course Outcomes: On completion of the course, student will be able to- - Analyze various type of pattern recognition techniques - Identify and apply various pattern recognition and classification approaches to solve the problems - Evaluate statistical and structural pattern recognition - Percept recent advances in pattern recognition confined to various applications		
Selection of Modules: Kindly note that modules 1,2,3 and module 9 are compulsory and select any two (02) modules from remaining modules.		
Course Contents		
Module No.	Module Title	Credit
1	Pattern Recognition	01
Introduction of Pattern Recognition with its application, Pattern Recognition system, Design cycle of pattern recognition, Learning and adaption, Representation of Patterns and classes, Feature Extraction, pattern recognition models/approaches.		
2	Error Estimation	01
Introduction, Error estimation methods, various distance measures (Euclidean, Manhattan, cosine, Mahalanobis) and distance based classifier, Feature selection based on statistical hypothesis testing, ROC curve.		
3	Decision Theory	01
Introduction, Bayesian decision theory-continuous and discrete features, two- category classification, minimum error rate classification, discriminant functions, Parametric Techniques:- Maximum Likelihood Estimation, Bayesian Parameter Estimation, Sufficient Statistics; Problems of dimensionality. Non-Parametric Techniques:-Density estimation, Parzen Window, Metrics and Nearest-Neighbor classification; Fuzzy classification.		
4	Non Metric and structural pattern recognition	01

Tree Classifiers-Decision Trees, Random Forests, **Structural Pattern recognition:** Elements of formal grammars ,String generation as pattern description ,Recognition of syntactic description ,Parsing ,Stochastic grammars and applications ,Graph based structural representation, **Stochastic method:** Boltzmann Learning.

5	Clustering	01
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Introduction, Hierarchical Clustering, agglomerative clustering algorithm, the single linkage, complete, linkage and average, linkage algorithm. Ward's method ,Partition clustering, , K-means algorithm, clustering algorithms based on graph theory(Minimum spanning tree algorithm),Optimization methods used in clustering: clustering using simulating Annealing.

6	Template Matching	01
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Measures based on Optimal Path Searching techniques: Bellman's optimality principle and dynamic programming, The Edit distance, Dynamic time Warping, Measures based on correlations, Deformable template models

7	Unsupervised Learning	01
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Neural network structures for pattern recognition, Unsupervised learning in neural pattern recognition , deep learning ,Self-organizing networks

8	Fuzzy Logic and Pattern Recognition	01
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Fuzzy logic ,Fuzzy pattern classifiers, Pattern classification using Genetic Algorithms

9	Applications	
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Pattern recognition applications: Application of pattern recognition techniques in object recognition, biometric, facial recognition, IRIS scanner, Finger prints, 3D object recognition.

Books:

Text :

1. R. O. Duda, P. E. Hart, D. G. Stork, "Pattern Classification", 2nd Edition, Wiley-Inter- science, John Wiley & Sons, 2001
2. S. Theodoridis and K. Koutroumbas, "Pattern Recognition", 4th Edition, Elsevier, Academic Press, ISBN: 978-1-59749-272-0
3. B.D. Ripley, "Pattern Recognition and Neural Networks", Cambridge University Press. ISBN 0 521 46086 7

Reference :

1. Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
2. David G. Stork and Elad Yom-Tov, "Computer Manual in MATLAB to accompany Pattern Classification", Wiley Inter-science, 2004, ISBN-10: 0471429775
3. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", PHI, ISBN-978- 81-203-4091-6
4. eMedia at NPTEL : <http://nptel.ac.in/courses/106108057/33>

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) 610104 : Seminar II		
Teaching Scheme: Practical: 4 Hrs/week	Credit 04	Examination Scheme: TW: 50 Marks Presentation: 50 Marks
Course Objectives: - To explore the basic principles of communication (verbal and non-verbal) and active, empathetic listening, speaking and writing techniques. - To Identify, understand and discuss current, real-world issues, new technologies, research, products, algorithms, services.		
Course Outcomes: On completion of the course, student will be able – - To use multiple thinking strategies to examine real-world issues and explore creative avenues of expression,. - To acquire, articulate, create and convey intended meaning using verbal and non-verbal method of communication. - To learn and integrate, through independent learning in sciences and technologies, with disciplinary specialization and the ability to integrate information across The student shall have to deliver the seminar II in semester III on a topic approved by guide and authorities. It is appreciated if student has already selected the domain of his/her dissertation work and identified the literature confined to the domain and thorough literature study based on identified topic has been carried out. This practice will eventually lead to convergence of the efforts for the dissertation work. The meticulous analyses of the literature can be part of seminar. The relevant literature then be explored as state-of-the-art, exotic, recent technological advancements, future trends, applications and research & innovations. The student shall submit the duly approved and certified seminar report in standard format, for satisfactory completion of the work by the concerned Guide and head of the department/institute. The student will be assessed based on his/her presentation and preparations by the panel of examiners out of them one has to be an external examiner. The students are expected to validate their study undertaken by publishing it at standard platforms. The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation the frequency of the activities in the sole discretion of the PG coordination. The continuous assessment of the progress need to be documented unambiguously. For standardization and documentation, follow the guidelines circulated / as in seminar logbook approved by Board of Studies.		

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) 610105 : Dissertation Stage I		
Teaching Scheme: Practical: 08 Hrs/week	Credit 08	Examination Scheme: TW: 50 Marks Presentation: 50 Marks
Course Objectives: • To identify the domain of research • To learn to communicate in a scientific language through collaboration with guide. • To understand the various means of technical publications and terminologies associated with publications • To categorize the research material confined to the domain of choice • To formulate research problem with the help of the guide/mentor elaborating the research. • To Acquire information independently and assessing its relevance for answering the research questions.		
Course Outcomes: On completion of the course the student should be able to- • Conduct thorough literature survey confined to the domain of choice • Develop presentation skills to deliver the technical contents • Furnish the report of the technical research domain • Analyze the findings and work of various authors confined to the chosen domain		
Dissertation Stage – I is an integral part of the Dissertation work. In this, the student shall complete the partial work of the Dissertation which will consist of problem statement, literature review, design, scheme of implementation (Mathematical Model/SRS/UML/ERD/block diagram/ PERT chart,) and Layout & Design of the Set-up. The student is expected to complete the dissertation at least up to the design phase. As a part of the progress report of Dissertation work Stage-I, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected dissertation topic. The student shall submit the duly approved and certified progress report of Dissertation Stage-I in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute. The examiner will be assessed by a panel of examiners of which one is necessarily an external examiner. The assessment will be broadly based on literature study, work undergone, content delivery, presentation skills, documentation and report. The students are expected to validate their study undertaken by publishing it at standard platforms. The investigations and findings need to be validated appropriately at standard platforms – conference and/or peer reviewed journal. The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation the frequency of the activities in the sole discretion of the PG coordination. The continuous assessment of the progress need to be documented unambiguously. For standardization and documentation, it is recommended to follow the formats and guidelines circulated / as in dissertation workbook approved by Board of Studies. Follow guidelines and formats as mentioned in Dissertation Workbook.		

Semester IV

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) 610107 : Seminar III		
Teaching Scheme: Practical: 20 Hrs/week	Credit 20	Examination Scheme: TW: 150 Marks Presentation: 50 Marks
Course Objectives: - To explore the basic principles of communication (verbal and non-verbal) and active, empathetic listening, speaking and writing techniques. - To Identify, understand and discuss current, real-world issues, new technologies, research, products, algorithms, services.		
Course Outcomes: On completion of the course, student will be able– - To use multiple thinking strategies to examine real-world issues and explore creative avenues of expression,. - To acquire, articulate, create and convey intended meaning using verbal and non-verbal method of communication. - To learn and integrate, through independent learning in sciences and technologies, with disciplinary specialization and the ability to integrate information across		
The student shall have to deliver the seminar III in semester IV on a topic approved by guide and authorities. Preferably the seminar III may be extension of seminar II. The relevant literature then be explored as state-of-the-art, exotic, recent technological advancement, future trend, application and research & innovation. The student shall submit the duly certified seminar report in standard format, for satisfactory completion by the concerned Guide and head of the department/institute. The student will be assessed based on his/her presentation and preparations by the panel of examiners out of them one has to be an external examiner. The students are expected to validate their study undertaken by publishing it at standard platforms. The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation the frequency of the activities in the sole discretion of the PG coordination. The continuous assessment of the progress need to be documented unambiguously. For standardization and documentation, the department will follow the seminar guidelines circulated / as in logbook approved by Board of Studies.		

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) 610108 : Dissertation Stage II		
Teaching Scheme: Practical: 20 Hrs/week	Credit 20	Examination Scheme: TW: 150 Marks Presentation: 50 Marks
Course Objectives: - 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 the student shall be able to- - Show evidence of independent investigation - Critically analyze the results and their interpretation ; infer findings - 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		
Guidelines: In Dissertation Work Stage–II, the student shall consolidate and complete the remaining part of the dissertation which will consist of Selection of Technology, Installations, UML implementations, testing, Results, measuring performance, discussions using data tables per parameter considered for the improvement with existing/known algorithms/systems, comparative analysis, validation of results and conclusions. The student shall prepare the duly certified final report of Dissertation in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute. The students are expected to validate their study undertaken by publishing it at standard platforms. The investigations and findings need to be validated appropriately at standard platforms – conference and/or peer reviewed journal. The student has to exhibit the continuous progress through regular reporting and presentations and proper documentation the frequency of the activities in the sole discretion of the PG coordination. The continuous assessment of the progress need to be documented unambiguously. <u>It is recommended to continue with guidelines and formats as mentioned in Dissertation Workbook approved by Board of Studies.</u>		

Non Credit Courses

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) NCC1: Game Engineering	
Course Contents	
1. Introduction to Unity 3D Game Engines - Introduction to game industry ,Unity Basic (Interface Intro), Intro to tools & navigation, The Main Windows, Game Objects , Scenes ,Cameras and Types, The assets store, Intro to Asset Work flow 2. Basic Photoshop - File types, size and resolution, Cropping and Editing sprite sheet 3. C# programming in unity 4. 2D Game Development Using Unity 3D - Intro to 2D Game system in unity, Sprite Editor in Unity, Sprite Animation in Unity 2D Physics in Unity 5. 3D Game Development Using Unity 3D - UI system in Unity, Artificial Intelligence for 3D Game - Object Oriented Design & Programming for 3D Games - Multiplayer Game in unity, Creating 3D Game For PC	
Books	
1. Fabian Birzele, <u>“The Java Game Development Tutorial</u> 2. Sean M. Tracey, <u>“Make Games with Python on Raspberry Pi”</u>	

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) NCC2: Advanced Cognitive Computing	
Course Contents	
1. The Foundation of Cognitive Computing Interdisciplinary Nature of Cognitive Science, Cognitive Computing Systems, Representations for Information and Knowledge, Principal Technology Enablers of Cognitive Computing, Cognitive Computing Architectures and Approaches, Cognitive Computing Resources 2. Cognitive Computing and Neural Networks: Reverse Engineering the Brain Brain Scalability, Neocortical Brain Organization, The Concept of a Basic Circuit, Abstractions of Cortical Basic Circuits, Large-Scale Cortical Simulations, Hardware Support for Brain Simulation, Deep Learning Networks 3. The Relationship Between Big Data Analytics and Cognitive Computing Evolution of Analytics and Core Themes, Types of Learning, Machine Learning Algorithms, Cognitive Analytics: A Coveted Goal, Cognitive Analytics Applications 4. Applications of Cognitive Computing Applications in expert systems, Natural language programming, neural networks, robotics, virtual reality, Future applications	
Books	
1. ‘Cognitive Computing and Big Data Analytics’, by Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Wiley publications, ISBN: 978-1-118-89662-4 2. ‘Cognitive Computing: Theory and Applications’, by Vijay Raghvan, Venu Govindaraju, C.R. Rao, Elsevier publications, eBook ISBN: 9780444637512, Hardcover ISBN: 9780444637444 3. https://www.research.ibm.com/software/IBMResearch/multimedia/Computing_Cognition_WhitePaper.pdf	

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) NCC3: Reconfigurable Systems	
Course Contents	
1. Introduction to reconfigurable systems:- Reconfigurable system (RS), Reconfigurable computing (RC), Architectural components of a configurable computer, primary methods in conventional computing: Application Specific Integrated Circuit (ASIC), software-programmed microprocessors, 2. Reconfigurable computing:- Theories:-Tredennick's Classification, Hartenstein's Xputer, High-performance computing, Partial re-configuration, Current systems Computer emulation, COPACOBANA, Mitronics, National Instruments, Xilinx, Intel, 3. Advanced Applications and Technologies:- Reconfigurability mechanisms, Reconfigurable devices and fabrics, Programmable pathways, Reconfigurability enablers, 4. The Future of Reconfigurable Systems:- Introduction, Multi-million gate FPGA Architectures, future Field Programmable System-on-a-Chip (FPSC), FPGA Architectures for Reconfigurable Computing, CAD Support for Reconfigurable Systems, Applications	
Books	
1. Gokhale, Maya, B., Graham, Paul S., “ Reconfigurable Computing Accelerating Computation with Field-Programmable Gate Arrays”, 2005, 238 p., Springer Netherland, Hardcover ISBN: 0-387-26105-2 2. Bobda Ch, “ Introduction to Reconfigurable Computing Architectures, Algorithms, and Applications”, Springer Netherlands, 2007, ISBN 978-1-4020-6088-5, 5 (Print) 978-1-4020-6100-4 359 3. Papers on the web page of the course Reconfigurable Circuits 3. Katherine Compton and Ccott Hauck, “ Reconfigurable Computing: A Survey of Systems and Software”, ACM Computing Surveys, Vol. 34, No. 2, June 2002, pp. 171–210.	

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) NCC4: Convergence Technology	
Course Contents	
1. Introduction-Convergence continues to gain momentum Worldwide, Responding to convergence, Thinking Strategies about ICT Convergences 2. Security Convergence Types of convergence, Security convergence collaboration, Categories of Convergence Convergence Trends: Value of technology, Convergence in design 3. Security Planning Convergence Initiatives, Convergence and Layers of Security, Levels of Security Need of Technology roadmap 4. Convergence in Practice The Nimble Giants: How converged business models drive successful large enterprises The New face of public sector Small Enterprises Benefits from Strategic Investment management	
Books	

1. Rajendra Singh and Siddhartha Raja, "Convergence in Information and Communication Technology", World Bank, ISBN, 0821381695, 9780821381694
2. Faisal Hoque, "The power of Convergence", AMACOM, ISBN-10: 0814416950,
3. Richard Baldwin, "The Great Convergence", Harvard University Press, ISBN-13: 978-0674660489
4. Ray Bernard "Security Technology Convergence Insights", Ray Bernard., ISBN: 9780128030011.

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
NCC5: Machine Intelligence

Course Contents

1. Introduction to Machine Intelligence, What is MI?, Background/history, Spin-offs, High-level overview, State of the art.
2. Representation of Knowledge- Knowledge Representation, Knowledge Representation using predicate logic, introduction to predicate calculus, resolution, Knowledge Representation using other logic-structured Knowledge Representation.
3. Planning and Machine Learning- Basic Plan generation systems-strips, Advanced Plan generation systems-K strips, Strategic explanations, Machine learning, Adaptive Learning
4. Expert Systems- Architecture of Expert Systems, Roles of Expert Systems, Knowledge acquisition-Meta knowledge heuristics.

Books

1. Stefan Edelkamp and Stefan Schroedl. Heuristic Search: Theory and Applications, Morgan Kaufmann, 2011.
2. John Haugeland, Artificial Intelligence: The Very Idea, A Bradford Book, The MIT Press, 1985.
3. Judea Pearl. Heuristics: Intelligent Search Strategies for Computer Problem Solving, Addison-Wesley, 1984.

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
NCC6: Storage Area Networks

Course Contents

1. **Introduction to Information Storage Technology, Storage System Environment and Data protection:** Evolution, Key Challenges in Managing Information, Information Lifecycle Components, Disk Drive Components & Performance,
2. **Different Storage Technologies and Virtualization**
 Introduction to **Networked Storage**, Overview of FC-SAN, NAS, and IP-SAN. Network-Attached Storage (NAS) & its Components, File Sharing, I/O operations, Performance and Availability. Content Addressed Storage, Storage Virtualization
3. **Content-Addressed Storage, Business Continuity, Backup and Recovery, Local Replication, Remote Replication:**
 BC Terminology, Failure Analysis, Business Impact Analysis, Solutions, Backup Granularity, Recovery Considerations, Backup Methods, Process & Topologies, Backup in NAS Environments, Local Replication Technologies,
4. **Securing & Managing the Storage Infrastructure:**
 Storage Security Framework, Risk Triad, Storage Security Domains, Security Implementations in Storage Networking Monitoring the Storage Infrastructure, Storage Management Activities, Storage Infrastructure Management Challenges,

Books

1. Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, Osborne, 2003.
2. Marc Farley, "Building Storage Networks", Tata McGraw Hill, Osborne, 2001.
3. EMC Educational Services, "Information Storage and Management", Wiley India
4. Meet Gupta, "Storage Area Network Fundamentals", Pearson Education Limited

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
NCC7: Search Engine Optimization

Course Contents**1. Basics for SEO, SEO Research & Analysis**

Basic Knowledge of Domain & World Wide Web, Difference between Portal and Search Engines, need of SEO, Types of SEO Techniques: Black hat techniques & White Hat techniques, Search Engine working Process, Keyword Research and Analysis, Keyword opportunity, Competitors Website Analysis, SWOT, On-page Optimization & Off-page Optimization

2. On-page Optimization: Meta Descriptions & Meta Keywords, Headings, Bold Text, Domain Names & Suggestions, Canonical Tag, Meta Tags, Images and Alt Text, Internal Link Building, Server and Hosting Check, Robots Meta Tag, 301 Redirects, 404 Error, Duplicate content**3. Off-page Optimization:** Page Rank, Link Popularity, Link Building in Detail, Directory Submission, Blog Submission, Links Exchange, Reciprocal Linking, Posting to Forums, RSS Feeds Submissions, Competitor Link Analysis**4. Analytics & SEO Tools**

Study of Google Analytics, How Google Analytics can Help SEO, Webmaster Central & Bing/Yahoo; Website Analysis using various SEO Tools available : Keyword Density Analyzer Tools, Google Tools, Yahoo / Bing Tools, Rich Snippet Text Tools, Comparison Tools, Link Popularity Tools, search Engines Tools, Site Tools

5. SEO Reporting

Google analysis, Tracking and Reporting, Reports Submission, Securing Ranks

Books

1. Jason McDonald Ph.D, "SEO Fitness Workbook: The Seven Steps to Search Engine Optimization Success"
2. Caimin Jones, "SEO Step-by-Step: The Complete Beginner's Guide to Getting Traffic"
3. Bruce Clay, " *Search Engine Optimization All-in-One for Dummies*
4. Adam Clarke, " SEO 2017: Learn search engine optimization with smart internet marketing strategies"

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) NCC8: Virtual Reality	
Course Contents	
1. Introduction and Background What VR is and why it is so different from other mediums. Its history and different forms of reality, ranging from the real world to fully immersive VR. Its various hardware and components, which composes those realities.	
2. Perception Understanding the human brain and how we perceive real and virtual worlds, real-world examples that prove reality is not always what we think it is, explanations of perceptual models and processes, the physiology of the different sensory modalities, theories of how we perceive space and time, and a discussion of how perception relates to action.	
3. Designing in VR Fundamentals of VR design including ergonomics, user testing, interface design, scale and scene setting, graphical user interfaces, and motion mechanics for mobile VR, simulator sickness, its causes.	
4. VR Platforms and Applications Understand what is happening in the VR industry, surveying current trends and technology in VR, the hardware: Mobile Performance & 360 Media, High-Immersion Unity, or High-Immersion Unreal.	
Books	
1. Jason Jerald, The VR Book: Human-Centered Design for Virtual Reality, Association for Computing Machinery and Morgan & Claypool New York, NY, USA©2016, ISBN: 978-1-97000-112-9	
2. John Vince, Virtual Reality Systems, Pearson Prentice Hall, ISBN 10: 0201876876 or ISBN 13: 9780201876871	
3. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, 2nd Edition, ISBN: 978-0-471-36089-6	

Savitribai Phule Pune University Master of Computer Engineering (2017 Course) NCC9: Machine Translation	
Course Contents	
1. Introduction: Concept and translation process. Approaches viz rule based, statistical, Example based, hybrid and neural MT.	
2. Learning and inference for translation models: Maximum likelihood, Expectation maximization, Discriminative learning, Stochastic methods, Dynamic programming, Approximate search.	
3. Linguistic phenomena and their associated modeling problems: Morphology, syntax and semantics.	
4. Applications & Evaluation: Scaling, approximation and efficient data structures	
Books	
1. P. Koehn, “Statistical Machine Translation”, Cambridge University Press	
2. Pushpak Bhattacharyya, “Machine Translation”, 2015	
3. John Hutchinses, “Milestone in Machine Translation”	

Savitribai Phule Pune University
Master of Computer Engineering (2017 Course)
NCC10: Infrastructure Management

Course Contents

1. Introduction to Infrastructure Management

What is Infrastructure Management, Basic Framework, Policy Issues, Types of Infrastructure Management: Systems Management, Network Management, Storage Management, Objectives, Benefits of Infrastructure Management system

2. IT Infrastructure Management

Components of IT Infrastructure, Hardware resources, Data storage, Input-output Technologies used in Businesses, Types of Computer Softwares used for Infrastructure Management in Business, Principle Issues, Foundations of Business Intelligence: Databases and Information Management, Telecommunications, Wireless Technology, Security

3. Key System Applications for the Digital Age

Achieving Operational Excellence and Customer Intimacy: Enterprise Applications, E-Commerce: Digital Markets, Digital Goods, Improving Decision Making and Managing Knowledge

4. Building and Managing Systems

Building Information Systems, Ethical and Social Issues in Information Systems

Books

1. Jane P. Laudon, Azimuth, “Essentials of Business Information Systems”, Pearson, ISBN-10: 0132277816, ISBN-13: 9780132277815
2. Barbara Klein, Richard Alan Long, Kenneth Ray Blackman, “Introduction to IMS, An: Your Complete Guide to IBM Information Management System”, IBM Press, ISBN-10: 0132886871, ISBN-13: 9780132886871
3. David Boddy, Albert Boonstra, “Managing Information Systems: Strategy and Organization”, Financial Times Press, ISBN-10: 0273716816, ISBN-13: 9780273716815