Faculty of Science and Technology
Savitribai Phule Pune University
Maharashtra, India

Curriculum
for
Second Year of Computer Engineering
(2019 Course)
(With effect from 2020-21)

Savitribai Phule Pune University Bachelor of Computer Engineering Program Outcomes (PO)		
Learners are expected to know and be able to–		
PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems
PO2	**Problem analysis**	Identify, formulate, review research literature, and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics natural sciences, and Engineering sciences
PO3	**Design / Development of Solutions**	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO4	**Conduct Investigations of Complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage**	Create, select, 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	**The Engineer and Society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO7	**Environment and Sustainability**	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the Engineering practice
PO9	**Individual and Team Work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication Skills**	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO11	**Project Management and Finance**	Demonstrate knowledge and understanding of the Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.
PO12	**Life-long Learning**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) (With effect from Academic Year 2020-21)

Semester-III

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	Mid-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
210241	Discrete Mathematics	03	-	01	30	70	-	-	-	100	03	--	01	04
210242	Fundamentals of Data Structures	03	-	-	30	70	-	-	-	100	03	-	-	03
210243	Object Oriented Programming	03	-	-	30	70	-	-	-	100	03	-	-	03
210244	Computer Graphics	03	-	-	30	70	-	-	-	100	03	-	-	03
210245	Digital Electronics and Logic Design	03	-	-	30	70	-	-	-	100	03	-	-	03
210246	Humanity and Social Science	-	-	01	-	-	-	-	-	-	-	-	-	-
210247	Data Structures Lab	-	04	-	-	-	25	50	-	75	-	02	-	02
210248	OOP and Computer Graphics Lab	-	04	-	-	-	25	50	-	75	-	02	-	02
210249	Digital Electronics Lab	-	02	-	-	-	25	-	-	25	-	01	-	01
210250	Business Communication Skills Lab	-	02	-	-	-	25	-	-	25	-	01	-	01
210251	Audit Course 3	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total Credit										15	06	01	22
	Total	15	12	02	150	350	100	100	-	700	-	-	-	-

Semester-IV

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	Mid-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
210252	Mathematics III	03	-	01	30	70	-	-	-	100	03	--	01	04
210253	Data Structures and Algorithms	03	-	-	30	70	-	-	-	100	03	-	-	03
210254	Software Engineering	03	-	-	30	70	-	-	-	100	03	-	-	03
210255	Microprocessor	03	-	-	30	70	-	-	-	100	03	-	-	03
210256	Principles of Programming Languages	03	-	-	30	70	-	-	-	100	03	-	-	03
210257	Data Structures and Algorithms Lab	-	04	-	-	-	25	50	-	75	-	02	-	02
210258	Microprocessor Lab	-	04	-	-	-	25	50	-	75	-	02	-	02
210259	Code of Conduct	-	-	01	-	-	-	-	-	-	-	-	-	-
210260	Project Based Learning	-	04	-	-	-	50	-	-	50	-	02	-	02
210261	Audit Course 4	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total Credit										15	06	01	22
	Total	15	12	02	150	350	100	100	-	700	-	-	-	-

Abbreviations:

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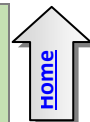PR: Practical   Sem: Semester

Note:
For each course-

- The course objectives, course outcomes and CO-PO mapping table are provided for reference; the course instructor is requested to modify as per his perspective.

- #Exemplar/Case Studies are included at each unit to explore how the learned topics applies to real world situations and are to be designed so as to to assist students to increase their understanding of particular skills, content or knowledge in any given situation and articulate. One or two sample exemplar or case study are included for each unit, instructor may extend the same with more.

- #Exemplar/Case Studies may be assigned as self study by students and to be excluded from theory examinations.

- For each unit, content attainment mapping is indicated with course outcome(s). Instructor may update the same.

- @ CO & PO (Course Objectives and Program Outcomes) Attainment Mapping Table: The CO-PO mapping in the table at end of course contents, indicates the correlation levels of 3, 2, 1 and '-'. The notation of 3, 2 and 1 denotes substantially (high), moderately (medium) and slightly (low). The meaning of '-' is no correlation between CO and PO.

- Set of suggested Laboratory assignments is provided for reference. Laboratory Instructor may design suitable set of assignments for respective institute.

- For each laboratory assignment, it is compulsory for students to draw/write/generate flowchart, algorithm, test cases, mathematical model, Test data set (if applicable), comparative/complexity analysis.

- For each course and laboratory, instructor should motivate students to read article/research paper related to recent development and invention in the field.

- Laboratory conduction and assessment guidelines are to be strictly followed.
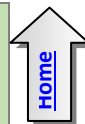
Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210241: Discrete Mathematics		
Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 03 Hours/Week TUT: 01 Hours/Week	04	**Mid_Semester(TH): 30 Marks** **End_Semester(TH): 70 Marks**

Prerequisite Courses, if any: Basic Mathematics

Companion Course, if any: ---

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, learner will be able to–
   CO1: Design and analyze real world engineering problems by applying set theory, propositional logic and mathematical induction
   CO2: Develop skill in expressing mathematical properties of relation and function
   CO3: Identify number of logical possibilities of events to design professional engineering Solutions
   CO4: Model and solve computing problem using tree and graph Analyze the properties of binary operations and evaluate the algebraic structure
   CO5: Apply abstract algebra in combinatorics, coding theory and questions regarding geometric constructions

Course Contents

Unit I	Set Theory and Logic	(06 Hours)

Introduction and significance of Discrete Mathematics, **Sets–** Naïve Set Theory (Cantorian Set Theory), Axiomatic Set Theory, Set Operations, Cardinality of set, Principle of inclusion and exclusion. **Types of Sets** – Bounded and Unbounded Sets, Diagonalization Argument, Countable and Uncountable Sets, Finite and Infinite Sets, Countably Infinite and Uncountably Infinite Sets, Power set, **Propositional Logic-** logic**,** Propositional Equivalences, Application of Propositional Logic-Translating English Sentences, Proof by Mathematical Induction and Strong Mathematical Induction

#Exemplar/Case Studies	Know about the great philosophers- Georg Cantor, Richard Dedekind and Aristotle
Mapping of Course Outcomes for Unit I	CO1, CO3

Unit II	Relations and Functions	(06 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. **Functions-** Surjective, Injective and Bijective functions, Identity function, Partial function, Invertible function, Constant function, Inverse functions and Compositions of functions, The Pigeonhole Principle.

#Exemplar/Case Studies	Know about the great philosophers-Dirichlet
Mapping of Course Outcomes for Unit II	CO2
Unit III	**Counting Principles**	**(06 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.

#Exemplar/Case Studies	Study Sudoku solving algorithms and algorithm for generation of new SUDOKU. Study Hank-shake Puzzle and algorithm to solve it
Mapping of Course Outcomes for Unit III	

Unit IV	Graph Theory	(06 Hours)

Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, the handshaking lemma, Single source shortest path- Dijkstra's Algorithm, Planar Graphs, Graph Colouring.

#Exemplar/Case Studies	Three utility problem, Web Graph, Google map
Mapping of Course Outcomes for Unit IV	CO4

Unit V	Trees	(06 Hours)

Introduction, properties of trees, Binary search tree, tree traversal, 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).

#Exemplar/Case Studies	Algebraic Expression tree, Tic-tac-toe game tree
Mapping of Course Outcomes for Unit V	CO4, CO5

Unit VI	Algebraic Structures and Coding Theory	(06 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, Galois Theory –Field Theory and Group Theory.

#Exemplar/Case Studies	Cryptography used in world war II
Mapping of Course Outcomes for Unit VI	CO6

Learning Resources

Text Books:

1. C. L. Liu, ―Elements of Discrete Mathematics , TMH, ISBN 10:0-07-066913-9.
2. N. Biggs, --"Discrete Mathematics", 3rd Ed, Oxford University Press, ISBN 0 –19-850717–8.

Reference Books:

1. Bernard Kolman, Robert C. Busby and Sharon Ross, ―Discrete Mathematical Structures , Prentice-Hall of India /Pearson, ISBN: 0132078457, 9780132078450.
2. Narsingh Deo, "Graph with application to Engineering and Computer Science", Prentice Hall of India, 1990, 0 – 87692 – 145 – 4.
3. Eric Gossett, "Discrete Mathematical Structures with Proofs", Wiley India Ltd, ISBN:978-81-265-2758-8.
4. Sriram P & Steven S., "Computational Discrete Mathematics", Cambridge University Press, ISBN 13: 978-0-521-73311-3.
5. Kenneth H. Rosen, ―Discrete Mathematics and its Applications , Tata McGraw-Hill, ISBN 978-0-07-288008-3

e-Books

MOOC Courses:

@The CO-PO Mapping Table											
PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	-	-	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	-

CO4	3	3	3	2	-	-	-	-	-	-	-	-
CO5	3	3	3	2	-	-	-	-	-	-	-	-
CO6	3	3	3	2	-	-	-	-	-	-	-	-

Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210242: Fundamentals of Data Structures		
Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 03 Hours/Week	03	**Mid_Semester(TH): 30 Marks** **End_Semester(TH): 70 Marks**

Prerequisite Courses, if any: 110005: Programming and Problem Solving

Companion Course, if any: 210247: Data Structures Laboratory

Course Objectives:
- To understand the basic techniques of algorithm analysis.
- To understand various algorithmic strategies to approach the problem solution.
- To understand the memory requirement for various data structures.
- To understand various data searching and sorting methods with pros and cons.
- To acquaint with the structural constraints and advantages in usage of the data.
- To understand the standard and abstract data representation methods.
- To identify the appropriate data structure and algorithm design method for a specified application.

Course Outcomes:
- CO1: To demonstrate a detailed understanding of behaviour of data structures like array, linked list, stack, and queue by developing programs.
- CO2: To use appropriate algorithmic strategy for better efficiency
- CO3: To summarize data searching and sorting techniques.
- CO4: To discriminate the usage of various structures in approaching the problem solution.
- CO5: To analyze and use effective and efficient data structures in solving various Computer Engineering domain problems.
- CO6: To design the algorithms to solve the programming problems.

<table>
<tr><td colspan="3" align="center">Course Contents</td></tr>
<tr><td align="center">Unit I</td><td align="center">Introduction to Algorithm and Data Structures</td><td align="center">(07 Hours)</td></tr>
</table>

Introduction: From Problem to Data Structure (Problem, Logic, Algorithm, and Data Structure).
Data Structures: Data, Information, Knowledge, and Data structure, Abstract Data Types (ADT), Data Structure Classification (Linear and Non-linear, Static and Dynamic, Persistent and Ephemeral data structures)
Algorithms: Problem Solving, Introduction to algorithm, Characteristics of algorithm, Algorithm design tools: Pseudo-code and flowchart
Complexity of algorithm: Space complexity, Time complexity, Asymptotic notation- Big-O, Theta and Omega, Finding complexity using step count method, Analysis of programming constructs-Linear, Quadratic, Cubic, Logarithmic.
Algorithmic Strategies- Introduction to algorithm design strategies- Divide and Conquer, and Greedy strategy.

#Exemplar/Case Studies	Multiplication technique by the mathematician Carl Friedrich Gauss and Karatsuba algorithm for fast multiplication.
Mapping of Course Outcomes for Unit I	CO3, CO5, CO6

Unit II	**Linear Data Structure Using Sequential Organization**	**(07 Hours)**

Concept of Sequential Organization, Overview of Array, Array as an Abstract Data Type, Operations on Array, Merging of two arrays, Storage Representation and their Address Calculation: Row major and Column Major, 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 using array, Sparse matrix addition, Transpose of sparse matrix- Simple and Fast Transpose, Time and Space tradeoff.

#Exemplar/Case Studies	Study use of sparse matrix in Social Networks and Maps. Study how Economists use polynomials to model economic growth patterns, how medical researchers use them to describe the behaviour of Covid-19 virus.
Mapping of Course Outcomes for Unit II	CO1, CO2, CO3

Unit III	Searching and Sorting	(06 Hours)

Searching: Search Techniques-Sequential Search/Linear Search, Variant of Sequential Search- Sentinel Search, Binary Search, Fibonacci Search, and Indexed Sequential Search.
Sorting: Types of Sorting-Internal and External Sorting, General Sort Concepts-Sort Order, Stability, Efficiency, and Number of Passes, Comparison Based Sorting Methods-Bubble Sort, Insertion Sort, Selection Sort, Quick Sort, Shell Sort, Non-comparison Based Sorting Methods-Radix Sort, Counting Sort, and Bucket Sort, Comparison of All Sorting Methods and their complexities.

#Exemplar/Case Studies	Use of Fibonacci search in non-uniform access memory storage and in Optimization of Unimodal Functions. Timsort as a hybrid stable sorting algorithm
Mapping of Course Outcomes for Unit III	CO1, CO3, CO4

Unit IV	Linked List	(07 Hours)

Introduction to Static and Dynamic Memory Allocation, Linked List: Introduction, of Linked Lists, Realization of linked list using dynamic memory management, operations, Linked List as ADT, Types of Linked List: singly linked, linear and Circular Linked Lists, Doubly Linked List, Doubly Circular Linked List, Primitive Operations on Linked List-Create, Traverse, Search, Insert, Delete, Sort, Concatenate. Polynomial Manipulations-Polynomial addition. Generalized Linked List (GLL) concept, Representation of Polynomial using GLL.

#Exemplar/Case Studies	Garbage Collection
Mapping of Course Outcomes for Unit IV	CO1, CO2, CO5

Unit V	Stack	(07 Hours)

Basic concept, 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.

#Exemplar/Case Studies	Android- multiple tasks/multiple activities and back-stack , Tower of Hanoi, 4 Queens problem.
Mapping of Course Outcomes for Unit V	CO1, CO2, CO5, CO6

Unit VI	Queue	(06 Hours)

Basic concept, Queue as Abstract Data Type, Representation of Queue using Sequential organization, Queue Operations, Circular Queue and its advantages, Multi-queues, Linked Queue and Operations. Deque-Basic concept, types (Input restricted and Output restricted), Priority Queue- Basic concept, types(Ascending and Descending).

#Exemplar/Case Studies	Priority queue in bandwidth management
Mapping of Course Outcomes for Unit VI	CO1, CO2, CO5, CO6

Learning Resources

Text Books:

- Horowitz and Sahani—Fundamentals of Data Structures in C++, University Press, ISBN 10: 0716782928 ISBN 13: 9780716782926.
- Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley Publication, ISBN: 978-1-118-29027-9
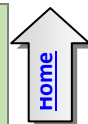
Reference Books:

1. Brassard & Bratley —Fundamentals of Algorithmic Prentice Hall India/Pearson Education, ISBN 13-9788120311312.
2. Allen Downey, Jeffery Elkner, Chris Meyers-How to think like a Computer Scientist: Learning with Python, Dreamtech Press, ISBN:9789351198147.
3. R. Gillberg, B. Forouzn —Data Structures: A Pseudo code approach with C, Cenage Learning, ISBN: 9788131503140.
4. M. Weiss—Data Structures and Algorithm Analysis in C++, 2nd edition, Pearson Education, 2002, ISBN-81-7808-670-0.

e-Books:

MOOC:

Other:

- Know Thy Complexities! (https://www.bigocheatsheet.com/) (https://github.com/RehanSaeed/.NET-Big-O-Algorithm-Complexity-Cheat-Sheet)
- Data Structure Visualizations (https://www.cs.usfca.edu/~galles/visualization/Algorithms.html)
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@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	-	-	-	-
CO2	1	2	2	3	-	-	-	-	-	-	-	-
CO3	3	1	2	2	-	-	-	-	-	-	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-	-
CO5	2	3	3	3	-	-	-	-	-	-	-	-
CO6	1	2	3	3	-	-	-	-	-	-	-	-

Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210243: Object Oriented Programming			
Teaching Scheme:		**Credit**	**Examination Scheme:**
TH: 03 Hours/Week		03	Mid_Semester(TH): 30 Marks End_Semester(TH): 70 Marks

Prerequisite Courses, if any: Good understanding of Programming and Problem Solving concepts

Companion Course, if any:

Course Objectives:
- To explore & understand the principles of Object Oriented Programming (OOP).
- To use the object-oriented paradigm in program design.
- To provide object-oriented programming insight using C++
- To lay a foundation for advanced programming.

Course Outcomes:
On completion of the course, learner will be able to–
- CO1: Analyze the strengths of object oriented programming
- CO2: Design and apply OOP principles for effective programming
- CO3: Develop the application using object oriented programming language(C++)
- CO4: Apply object-oriented concepts for advanced programming.

Course Contents

Unit I	Fundamentals of Object Oriented Programming	(06 Hours)

Introduction to procedural, modular, generic and object-oriented programming techniques, limitations of procedural programming, Need of object-oriented programming, OOP Paradigms, Fundamentals of object-oriented programming: Namespaces, objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism.
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, Access specifiers, separating interface from implementation.
Functions- Function, function prototype, accessing function and utility function, Constructors and destructor, Types of constructor ,Objects and Memory requirements, Static members: variable and functions, inline function, friend function.

#Exemplar/Case Studies	Story of C++ invention by Bjarne Stroustrup
Mapping of Course Outcomes for Unit I	CO1

Unit II	Inheritance and Pointers	(06 Hours)

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, Public and Private Inheritance, Types of Inheritance, Ambiguity in Multiple Inheritance, Virtual Base Class, Abstract class, Friend Class , Nested Class.
Pointers: declaring and initializing pointers, indirection Operators, Memory Management: new and delete, Pointers to Objects, this pointer, Pointers Vs Arrays, accessing Arrays using pointers, Arrays of Pointers, Function pointers, Pointers to Pointers, Pointers to Derived classes, Passing pointers to functions, Return pointers from functions, Null pointer, void pointer.

#Exemplar/Case Studies	Know about Firefox and Thunderbird as popular softwares developed using C++
Mapping of Course Outcomes for Unit II	CO2, CO3, CO4

Unit III	Polymorphism	(06 Hours)

Polymorphism- Introduction to Polymorphism, Early and late binding, Types of Polymorphism:
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.
Function overloading
Run Time Polymorphism- Pointers to Base class, virtual function and its significance in C++, pure virtual function and virtual table, virtual destructor, abstract base class.

#Exemplar/Case Studies	Study about use of C++ SDKs wrappers for Java and .Net.
Mapping of Course Outcomes for Unit III	CO2, CO3, CO4

Unit IV	Files and Streams	(06 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

#Exemplar/Case Studies	Study features used for Microsoft Office, Internet Explorer and Visual Studio that are written in Visual C++
Mapping of Course Outcomes for Unit IV	CO2, CO3, CO4

Unit V	Exception Handling & Templates	(06 Hours)

Exception Handling- Fundamentals, other error handling techniques, simple exception handling-Divide by Zero, Multiple catching, re-throwing an exception, exception specifications, user defined exceptions, processing unexpected exceptions, constructor, destructor and exception handling, exception and inheritance.
Templates- , The Power of Templates, Function template, overloading Function templates, and class template, class template and Nontype parameters, template and friends Generic Functions, The typename and export keywords.

#Exemplar/Case Studies	Study about use of exception handling in Symbian Operating System (discontinued mobile operating system) that was developed using C++.
Mapping of Course Outcomes for Unit V	CO2, CO3, CO4

Unit VI	Standard Template Library (STL)	(06 Hours)

Introduction to STL, STL Components, Containers- Sequence container and associative containers, container adapters, Application of Container classes: vector, list, 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

#Exemplar/Case Studies	Study MySQL open source C++ code available at GitHub.
Mapping of Course Outcomes for Unit VI	CO2, CO3, CO4

Learning Resources

Text Books:

1. E Balagurusamy Object-Oriented Programming with C++.7th edition.McGraw-Hill Publication, ISBN 10: 9352607996 ISBN 13: 9789352607990
2. Robert Lafore, — Object-Oriented Programming in C++ , fourth edition, Sams Publishing, ISBN:0672323087 (ISBN 13: 9780672323089

Reference Books:

1. Herbert Schildt, —C++ The complete reference , Eighth Edition, McGraw Hill Professional, 2011, ISBN:978-00-72226805
2. Matt Weisfeld, —The Object-Oriented Thought Process, Third Edition Pearson ISBN-13:075-2063330166
3. Cox Brad, Andrew J. Novobilski, —Object –Oriented Programming: An EvolutionaryApproach , Second Edition, Addison–Wesley, ISBN:13:978-020-1548341
4. **Deitel,** "C++ How to Program", 4th Edition, Pearson Education, ISBN:81-297-0276-2

e-Books

MOOC Courses:

@The CO-PO mapping table												
PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	-	-	-	-	-	-	-	-
CO2	2	2	3	2	-	-	-	-	-	-	-	-
CO3	2	2	3	2	-	-	-	-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-
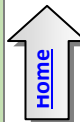
Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210244: Computer Graphics			
Teaching Scheme:	**Credit**	**Examination Scheme:**	
TH: 03 Hours/Week	03	Mid_Semester(TH): 30 Marks End_Semester(TH): 70 Marks	

Prerequisite Courses, if any:

Companion Course, if any: OOP

Course Objectives:
- **Remembering:** To acquaint the learner with the basic concepts of Computer Graphics
- **Understanding:** To learn the various algorithms for generating and rendering graphical figures.
- **Applying:** To get familiar with mathematics behind the graphical transformations
- **Understanding:** To understand and apply various methods and techniques regarding projections, animation, shading, illumination and lighting
- **Creating:** To generate Interactive graphics using OpenGL

Course Outcomes:
On completion of the course, learner will be able to–
- CO1: Define basic terminologies of Computer Graphics, interpret the mathematical foundation of the concepts of computer graphics and apply mathematics to develop Computer programs for elementary graphic operations.
- CO2: Define the concept of windowing and clipping and apply various algorithms to fill and clip polygons.
- CO3: Explain the core concepts of computer graphics, including transformation in two and three dimensions, viewing and projection.
- CO4: Explain the concepts of color models, lighting, shading models and hidden surface elimination.
- CO5: Describe the fundamentals of curves, fractals, animation and gaming.

Course Contents		
Unit I	**Graphics Primitives and Scan Conversion Algorithms**	**(06 Hours)**

Introduction, graphics primitives - pixel, resolution, aspect ratio, frame buffer. Display devices, applications of computergraphics.
Introduction to OpenGL - OpenGL architecture, primitives and attributes, simple modelling and rendering of two- and three-dimensional geometric objects, GLUT, interaction, events and call-backs picking.**(Simple Interaction with the Mouse and Keyboard)**
Scan conversion: Line drawing algorithms: Digital Differential Analyzer (DDA), Bresenham. Circle drawing algorithms: DDA, Bresenham, and Midpoint.

#Exemplar/Case Studies	Study about OpenGL Architecture Review Board (ARB)
Mapping of Course Outcomes for Unit I	CO1

Unit II	**Polygon, Windowing and Clipping**	**(07 Hours)**

Polygons: Introduction to polygon, types: convex, concave and complex. Inside test.
Polygon Filling: flood fill, seed fill, scan line fill.
Windowing and clipping: viewing transformations, 2-D clipping: Cohen – Sutherland algorithm line Clipping algorithm, Sutherland Hodgeman Polygon clipping algorithm,Weiler Atherton Polygon Clipping algorithm.

#Exemplar/Case Studies	
Mapping of Course Outcomes for Unit II	CO2

Unit III	2D, 3D Transformations and Projections	(07 Hours)

2-D transformations: introduction, homogeneous coordinates, 2-D transformations - Translation, scaling, rotation and shear, rotation about an arbitrary point.
3-D transformations: introduction, 3-D transformations - Translation, scaling, rotation and shear, rotation about an arbitrary axis.
Projections : Parallel (Oblique: Cavalier, Cabinet and orthographic: isometric, diametric, trimetric) and Perspective (Vanishing Points – 1 point, 2 point and 3 point)

#Exemplar/Case Studies	Study use of transformations and projections in education and training softwares.
Mapping of Course Outcomes for Unit III	CO3

Unit IV	Light, Colour, Shading and Hidden Surfaces	(06 Hours)

Colour models: Properties of Light, CIE chromaticity Diagram, RGB, HSV, CMY.
Illumination Models: 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)

#Exemplar/Case Studies	Study any popular graphics designing software
Mapping of Course Outcomes for Unit IV	CO4

Unit V	Curves and Fractals	(06 Hours)

Curves: Introduction, Interpolation and Approximation, Blending function, B-Spline curve, Bezier curve,
Fractals: Introduction, Classification, Fractal generation: snowflake, Triadic curve, Hilbert curve, Applications.

#Exemplar/Case Studies	Case study on measuring the length of coastline using fractals
Mapping of Course Outcomes for Unit V	CO5

Unit VI	Introduction to Animation and Gaming	(06 Hours)

Segment: Introduction, Segment table, Segment creation, closing, deleting and renaming, Visibility.
Animation: Introduction, Conventional and computer based animation, Design of animation sequences, Animation languages, Key- frame, Morphing, Motion specification.
Gaming: Introduction, Gaming platform (NVIDIA, i8060), Advances in Gaming.

#Exemplar/Case Studies	Study of any open source tool s. a. Unity/Maya/Blender
Mapping of Course Outcomes for Unit VI	CO5

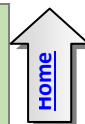| Learning Resources |
|---|

Text Books:
1. S. Harrington-Computer Graphics , 2nd Edition, McGraw-Hill Publications, 1987, ISBN 0 – 07 – 100472 – 6.
2. Donald D. Hearn and Baker- Computer Graphics with OpenGL, 4th Edition, ISBN-13: 9780136053583.
1. D. Rogers-Procedural Elements for Computer Graphics, 2nd Edition, Tata McGraw-Hill Publication, 2001, ISBN 0 – 07 – 047371 – 4.

Reference Books:
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.

e-Books

MOOC Courses:

@The CO-PO mapping table											
PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	-	-	-	-	-	-	-	-
CO2	1	2	-	-	-	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	-	-	-	-	-	-
CO4	1		1	-	-	-	-	-	-	-	-	-
CO5	-	2	2	1	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-

Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210245: Digital Electronics and Logic Design		
Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 03 Hours/Week	03	Mid_Semester(TH): 30 Marks End_Semester(TH): 70 Marks

Prerequisite Courses, if any: 104010 Basic Electronics Engineering

Companion Course, if any: 210249 Digital Electronics Lab

Course Objectives:

- To study number systems and develop skills for design and implementation of combinational logic circuits and sequential circuits
- To understand the functionalities, properties and applicability of Logic Families.
- To introduce programmable logic devices and ASM chart and synchronous state machines.
- To basics of microprocessor.

Course Outcomes:

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

CO1: Simplify Boolean Expressions using K Map.

CO2: Design and implement combinational circuits.

CO3: Design and implement sequential circuits.

CO4: Develop simple real-world application using ASM and PLD.

CO5: Choose appropriate logic families IC packages as per the given design specifications.

CO6: Explain organization and architecture of computer system

Course Contents

Unit I	Minimization Technique	(06 Hours)

Logic Design Minimization Technique -: Minimization of Boolean function using K-map(up to 4 variables) and Quine Mc-Clusky Method, Representation of signed number- sign magnitude representation ,1's complement and 2's complement form (red marked can be removed), Sum of product and Product of sum form, Minimization of SOP and POS using K-map.

#Exemplar/Case Studies	Digital locks using logic gates
Mapping of Course Outcomes for Unit I	CO1

Unit II	Combinational Logic Design	(06 Hours)

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), Cascading multiplexers, Demultiplexers (DEMUX)- Decoder (IC 74138, IC 74154), Implementation of SOP and POS using MUX, DMUX, Comparators (2 bit), Parity generators and Checker.

#Exemplar/Case Studies	Combinational Logic Design of BCD to 7-segment display Controller
Mapping of Course Outcomes for Unit II	CO1, CO2

Unit III	Sequential Logic Design	(06 Hours)

Flip-Flop: SR, JK,D,T; Preset &Clear, Master Slave JK Flip Flops, Truth Tables and Excitation tables, Conversion from one type to another type of Flop Flop. Registers: SISO, SIPO, PISO, PIPO, Shift Registers, Bidirectional Shift Register, Ring Counter , Universal Shift Register Counters: Asynchronous Counter, Synchronous Counter, BCD Counter, Johnson Counter, Modulus of the counter (IC 7490),Synchronous Sequential Circuit Design :Models- Moore and Mealy, State diagram and State Table ,Design Procedure, Sequence Generator and detector.

#Exemplar/Case Studies	Electronic Voting Machine (EVM)
Mapping of Course Outcomes for Unit III	CO2,CO3

Unit IV	Algorithmic State Machines and Programmable Logic Devices	(06 Hours)

Algorithmic State Machines: Finite State Machines (FSM) and ASM, ASM charts, notations, construction of ASM chart and realization for sequential circuits.
PLDS:PLD, ROM as PLD, Programmable Logic Array (PLA), Programmable Array Logic (PAL), Designing combinational circuits using PLDs.

#Exemplar/Case Studies	Wave form generator using MUX controller method
Mapping of Course Outcomes for Unit IV	CO2, CO3, CO4

Unit V	Logic Families	(06 Hours)

Classification of logic families: Unipolar and Bipolar Logic Families, Characteristics of Digital ICs: Fan-in, Fan-out, Current and voltage parameters, Noise immunity, Propagation Delay, Power Dissipation, Figure of Merits, Operating Temperature Range, power supply requirements.
Transistor-Transistor Logic: Operation of TTL NAND Gate (Two input), TTL with active pull up, TTL with open collector output, Wired AND Connection, Tristate TTL Devices, TTL characteristics.
CMOS: CMOS Inverter, CMOS characteristics, CMOS configurations- Wired Logic, Open drain outputs.

#Exemplar/Case Studies	To study the various basic gate design using TTL/CMOS logic family
Mapping of Course Outcomes for Unit V	CO3

Unit VI	Introduction to Computer Architecture	(06 Hours)

Introduction to Ideal Microprocessor – Data Bus, Address Bus, Control Bus. Microprocessor based Systems – Basic Operation, Microprocessor operation, Block Diagram of Microprocessor. Functional Units of Microprocessor – ALU using IC 74181, Basic Arithmetic operations using ALU IC 74181, 4-bit Multiplier circuit using ALU and shift registers. Memory Organization and Operations, digital circuit using decoder and registers for memory operations.

#Exemplar/Case Studies	Microprocessor based system in Communication /Instrumentation Control
Mapping of Course Outcomes for Unit VI	CO2, CO3, CO6

Learning Resources

Text Books:
1. Modern Digital Electronics by R.P.Jain, 4th Edition, ISBN 978-0-07-06691-16 Tata McGraw Hill
2. Digital Logic and Computer Design by Moris Mano, Pearson , ISBN 978-93-325-4252-5

Reference Books:
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-

MOOC Courses:
1. Digital Circuits, by Prof. Santanu Chattopadhyay , https://swayam.gov.in/nd1_noc19_ee51/preview
2. Digital Circuits and Systems , Prof. S. Srinivasan https://nptel.ac.in/courses/117/106/117106086/

@The CO-PO mapping table											
PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	2	-	-	-	-	-	-	-	-	-
CO2	3	1	3	-	-	-	-	-	-	-	-	-
CO3	3	1	3	-	-	-	-	-	-	-	-	-
CO4	3	-	2	1	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	-	-	-	-	-	-	-
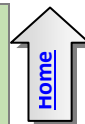
Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210246: Humanity & Social Science		
Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 01 Hours/Week	00	Mid_Semester(TH): NA End_Semester(TH): NA

Prerequisite Courses, if any: No prerequisites required

Companion Course, if any: NA

Course Objectives:
- To facilitate Holistic growth ;
- To Educate about Contemporary ,National and International affairs;
- To bring awareness about the responsibility towards society.
- To give an insight about the emergence of Indian society and the relevance of Economics.

Course Outcomes:
On completion of the course, learner will be able to–
CO1: Aware of the various issues concerning humans and society.
CO2: Aware about their responsibilities towards society.
CO3: Sensitized about broader issues regarding the social, cultural, economic and human aspects, involved in social changes.
CO4: Able to understand the nature of the individual and the relationship between self and the community.
CO5: Able to understand major ideas, values, beliefs, and experiences that have shaped human history and cultures.

Course Contents

Preamble:

As applied sciences, Engineering and Technology are meant to come up with effective solutions to social problems making it imperative that the present generation of engineers and technologists understand the society they live in. Studying the social sciences can provide individuals with crucial answers and observations that could certainly help in understanding of one's life which can alleviate social relations. A broad perspective of nationalistic thinking will provide the students with the ability to be socially conscientious, more resilient and open to building an inclusive society.

Experiencing real-life situations and complex scenarios that arise in each situation will help the budding professions to contribute their skills and knowledge to helping people improve and understand their behaviour or psychological processes. Understanding how the world works begins with an understanding of oneself and gaining hands-on experience and/or thinking about human values and ethics will help trigger a sense of responsibility among the students and lead them to finding effective solutions.

Course Structure:

The tutorial sessions to be divided into 2 groups
1. Interactive Sessions to be conducted in classroom
2. Interactive Activities to be conducted Outside Classroom

Interactive Sessions to be conducted during Tutorial (in classroom)

1. PREPARED SPEECH ON CURRENT AFFAIRS
    a. Purpose – Get students to stay abreast and invested in national current affairs
    b. Method – Each student has to read an editorial from any national paper (English), find out more information on the topic and present it to the class; ending the session with his/her opinion on the matter
    c. Outcome – Awareness of national state of affairs. Improve on oratory skills. Instil the thinking and contemplative skills and form non-judgemental opinions about an issue

2. UNDERSTANDING INDIA'S CULTURAL DIVERSITY
    a. Purpose – Expose students to the intricacies of Indian cultural across various states
    b. Method – Each student (or a small group of students in case the number of students is large) has to pick a state and come to the tutorial session prepared with a PPT that will showcase the demographic, sociographic and cultural information of that state
    c. Outcome – Information about the beauty of Indian cultural diversity. Enhance exploratory skill, communication skills and learn how to present using technological tools

3. WRITING AN ARTICLE ON ANY SOCIAL ISSUE
    a. Purpose – Highlight various social and cultural evil malevolence existing in our country and express one's opinion on how it can be changed
    b. Method – Each student will have to write a 200 word essay on any of existing social malice that is prevalent in society. On evaluation, the top 5 essays can be displayed on the college wall magazine and rewarded if deemed appropriate
    c. Outcome – Learn to raise one's voice against the wrong doings in communities. Build writing skills, improve language and gain knowledge about how to write an impactful essay

4. GROUP DISCUSSION ON COMMUNAL TOPIC
    a. Purpose – Make students aware of the issues that are pertinent in a society and express a learned opinion about it
    b. Method – Students in groups of 20 each will discuss a relevant and grave issue that is dogging the nation. Alternatively, topics from current affairs (National budget, democratic process, economical strengthening of the country).
    c. Outcome – Develop group communication skills. Learn to speak up one's opinion in a forum. Cultivate the habit of presenting solution-driven arguments making them contributors in any team

5. QUIZ ON SOCIAL BEHAVIOUR
    a. Purpose – Augment proper social etiquette among students and make them responsible citizens
    b. Method – Conduct a quiz on traffic rules using audio-visual aids or using dumb charades where one student has to enact the traffic rule and the others have to guess that rule
    c. Outcome – Grasp of various traffic rules and driving etiquette. Build verbal and non-verbal communication skills

6. SCREEN A MOVIE (FOCUS ON POSITIVITY AND POWER OF THE MIND)
    a. Purpose – Expose students to introspective skills and try to develop a positive thinking in life
    b. Method – Screen a movie / a documentary / a video that focuses on the power of the mind and how to create affirmations in one's life. At the end of the movie, students can be asked to express their opinions and write down what changes / improvements they plan to take in their choices thereafter. This can be followed by a guest lecture by expert/s or workshop
    c. Outcome – Comprehend the areas of improvement within themselves. Understand the importance of staying positive and develop affirmations

7. QUIZ ON SOCIAL BEHAVIOUR
    a. Purpose – Augment proper social etiquette among students and make them responsible citizens
    b. Method – Conduct a quiz on traffic rules using audio-visual aids or using dumb charades where one student has to enact the traffic rule and the others have to guess that rule
    c. Outcome – Grasp of various traffic rules and driving etiquette. Build verbal and non-verbal communication skills

8. SCREEN A MOVIE (FOCUS ON POSITIVITY AND POWER OF THE MIND)
    a. Purpose – Expose students to introspective skills and try to develop a positive thinking in life
    b. Method – Screen a movie / a documentary / a video that focuses on the power of the mind and how to create affirmations in one's life. At the end of the movie, students can be asked to express their opinions and write down what changes / improvements they plan to take in their choices thereafter. This can be followed by a guest lecture by expert/s or workshop
    c. Outcome – Comprehend the areas of improvement within themselves. Understand the importance of staying positive and develop affirmations

9. DEBATE ON A TOPIC FROM SOCIAL SCIENCES
    a. Purpose – Educate students about various domains in social sciences and develop an interest towards gaining knowledge about these topics
    b. Method – Various topics from various domains of social sciences can be chosen and students in pairs can pick a topic and present their arguments for or against the topic. Time for each debate will be 10 minutes maximum
    c. Outcome – Recognize the significance of social sciences in our lives. Cultivate the habit to present forceful arguments while respecting the opponents perspective and enhance verbal skills.

Interactive Activities to be conducted during Tutorial (Outside Classroom)
1. WASTE MANAGEMENT & CLEAN CAMPUS
    a. Purpose: Create awareness among students about the significance of a clean environment and social responsibility to deter littering and segregate waste
    b. Method: Students (in groups) will be given charge of areas of campus and will be expected to clean that segment. Also, they will be entrusted with the responsibility to collect, separate waste and hand over to the housekeeping authority
    c. Outcome: Develop the habit to maintain cleanliness at home as well as learn to respect community areas at college or workplace. It will also encourage them become ambassadors among their peers to advocate protection of the environment
2. MAKING A VIDEO ON SOCIAL WASTAGES.
    a. Purpose: Instil among students a sense of responsibility towards judiciously using natural resources like water and electricity
    b. Method: Using their phones / hand-held devices, groups of students will make a 3 – 4 minute short film that will highlight irresponsible behaviour in terms of wastage of water, leaving lights, fans and other electrical appliances on when not in use, defacing public and campus property by scribbling on walls and common areas. They will make awareness for the same among students. The creative videos will be posted on the college website and social media as an encouragement
    c. Outcome: Conscientious behaviour towards saving public utility resources. Explore the use of audio-visual tools to create more meaningful messages that can effect a change in society

3. RELAY MARATHON (3 – 5 kms)
   a. Purpose: Propagate a social message by way of a sport activity
   b. Method: A group of students will begin the race with banner / placard in hand that contains a social message. The group runs for 500 meters and hands over the banner / placard to the next group of students. This chain of exchange will continue for 3 – 5 kms.
   c. Outcome: Become aware of the need for fitness and encouragement towards healthier lifestyle. Students will also be able to express their creativity in terms of meaningful messages and gain attention towards worthy social causes from the community in and around the campus.

4. TREE PLANTATION ON CAMPUS
   a. Purpose: Involve students to actively participate in environment protection and develop greener surroundings
   b. Method: Each student will plant a sapling and take care of that plant until it is able to sustain itself. Alternatively, students can organize a tree plantation drive in a public area and nurture it
   c. Outcome: Besides increase in plants in the locality, students will feel a sense of empowerment and become social contributors towards protecting the environment.

5. VISIT TO AN OLD AGE HOME / ORPHANAGE
   a. Purpose: Build a sense of responsibility towards the less fortunate in our society and feel privileged to be able to effect real change in the world around us
   b. Method: Students have to visit an old age home or orphanage in the vicinity of the college. They can interact with the inmates, probably donate utilities to the charity organization and/or probably stage a few inclusive activities with the residents of the place. After the visit, students can submit a brief report about their experience
   c. Outcome: Learn first-hand about the conditions and social situations that the no-so-privileged members of our society have to endure to survive and go beyond their embarrassment to interact with the destitute which will help students appreciate the importance of Indian family values

6. STREET PLAY ACTIVITY
   a. Purpose: Create awareness in themselves as well as people in the community on various social evils that need to be eradicated
   b. Method: Students will prepare and enact a street play on any pertinent issues in society. The topics suggested can be perils of mobile phones / online fraud / safety for girls / mental and physical health of the youth.
   c. Outcome: Allow students to deliberate and think deeply about the looming issues that is dogging our society and the future of the youth. This will also bring out the creative skills among the students and allow them to showcase their talent.

7. BUDDY / BIG BROTHER SYSTEM
   a. Purpose: Include and involve the less fortunate children making them feel wanted and cared for as well as use the opportunity to share knowledge among school students.
   b. Method: Students have to go to nearby schools after procuring appropriate permissions to teach a particular topic on either technical or non technical domains. Each student can choose to adopt 5 students from the class to be their mentor over a period of 1 year by staying in touch with them and helping them resolve their issues on academic or other matters.
   c. Outcome: Appreciation and respect towards the responsibility of teaching. They will learn to be accountable as social contributors and bring about some change in the lives of the young students they mentor as Buddies or Big Brother.

Learning Resources

Books:

1. A. Alavudeen, M. Jayakumaran, and R Kalil Rahman, Professional Ethics and Human Values
2. Ram Ahuja, Social Problems in India (third edition)
3. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India Pvt. Ltd., 2005.
4. 2. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India
5. Rangarajan, Environmental Issues in India, Pearson Education.
6. University of Delhi, The Individual & Society, Pearson Education.
7. Wikipedia.org / wiki /social studies.
8. M. N. Srinivas, Social change in modern India, 1991, Orient Longman.
9. David Mandelbaum, Society in India, 1990, Popular.
10. Dr. Abha Singh, Behavioural Science : Achieving Behavioural Excellence for Success, Wiley.

e-Books

MOOC Courses:

@The CO-PO Mapping Table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	3	2	2	-	-	-
CO2	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	2	3	-	-	1
CO4	-	-	-	-	-	-	3	2	2	-	-	-
CO5	-	-	-	-	-	-	-	3	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-

Following Fields are applicable for Tutorial of Humanity & Social Science

Tutors Role in HSS
- Teachers will play the role of interventionists and instigating students to apply their thinking abilities on social concepts
- As facilitators and mentors teachers will coax the students to thinking out-of-the-box to come up with creative solutions
- Teachers should focus on instilling a sense of social consciousness through the activities conducted indoors and outdoors.

Change of Mindset
- Since the course deviates from technical subjects, students will have to be counseled into the importance of social sciences
- A background understanding of the importance of this course in their professional and personal life will have to be enumerated to the students
- Teachers will have to rationalize the course outcomes to get the students invested in the activities being conducted

Designing of Course
- Since students lack prior knowledge, it is imperative that the tutorials conducted be engaging in its activities
- Focus of the sessions should be the learning outcome of each activity conducted either in the class or outside the class

- All activities designed should be as close to real-life as possible making them relatable and applicable
- Student-engagement should be a priority so that the knowledge internalized will be higher
- The activities chosen can be modified to cater to the college location and social context
- The learning should be focused on application of ethics and values during each activity
- The chosen sessions should cater to giving the students the opportunity to be involved and engaged in their role as contributors to society and the nation at large

Basic function of the tutor

- To present a holistic view of the curriculum and the role of this course in it and emphasizing the benefit of the sessions towards developing communications kills, critical thinking and problems solving

Grouping

- The class will be divided into groups of 20 students
- The blend of cultural and social diversity will enhance the learning at the end of each activity
- Teachers will have to be mentored to handle sensitive issues diplomatically while encouraging students to stand up for their beliefs
- The groups will have to have inter-personal sessions so that they get to understand their team members better and work cohesively
- Management support and encouragement to engage students in life-enriching experiences is important

Assessment of Learning

- It is important for tutors to make sure that assessment is consistent with learning objectives of each activity
- Assessment of students should be focused on the students' ability to internalize the learning
- Tutors need to understand meaningful ways of assessing students' work to motivate learning
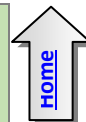
Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210247: Data Structures Laboratory		
Teaching Scheme: PR: 04 Hours/Week	Credit 02	Examination Scheme: TW: 25 Marks PR: 50 Marks

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 Laboratory 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, Test Data Set(if applicable), mathematical model (if applicable), 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 Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory /TW Assessment

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

Group A and B assignments should be implemented in python without using built-in methods for major functionality of assignment. Use List data structure of Python as array. Group C, D and E assignments should be implemented in C++ language.

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

Programming tools recommended: - Open Source python, Programming tool like Jupyter Notebook, Pycharm, Spyder, G++/GCC,

Suggested List of Laboratory Experiments/Assignments

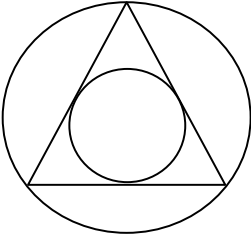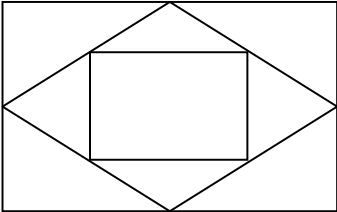| Sr. No.	Group A

1	In second year computer engineering class, group A student's play cricket, group B students play badminton and group C students play football.
	Write a Python program using functions to compute following: -
	    a) List of students who play both cricket and badminton
	    b) List of students who play either cricket or badminton but not both
	    c) Number of students who play neither cricket nor badminton
	    d) Number of students who play cricket and football but not badminton.
	(Note- While realizing the group, duplicate entries should be avoided, Do not use SET built-in functions)

2	Write a Python program to store marks scored in subject "Fundamental of Data Structure" by N students in the class. Write functions to compute following:
	    a) The average score of class
	    b) Highest score and lowest score of class
	    c) Count of students who were absent for the test
	    d) Display mark with highest frequency

3	Write a **Python** program for department library which has N books, write functions for following:
	    a) Delete the duplicate entries
	    b) Display books in ascending order based on cost of books
	    c) Count number of books with cost more than 500.
	    d) Copy books in a new list which has cost less than 500.

4	Write a **Python** program that computes the net amount of a bank account based a transaction log from console input. The transaction log format is shown as following: D 100 W 200 (Withdrawal is not allowed if balance is going negative. Write functions for withdraw and deposit) D means deposit while W means withdrawal.
	Suppose the following input is supplied to the program:
	    D 300
	    D 300
	    W 200
	    D 100
	Then, the output should be: 500

5	Write a Python program to compute following operations on String:
	    a) To display word with the longest length
	    b) To determines the frequency of occurrence of particular character in the string
	    c) To check whether given string is palindrome or not
	    d) To display index of first appearance of the substring
	    e) To count the occurrences of each word in a given string

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 a **python** program to store students PRNs with date and month of birth. Let List_A and List_B be the two list for two SE Computer divisions. Lists are sorted on date and month. Merge these two lists into third list "List_SE_Comp_DOB" resulting in sorted information about Date of Birth of SE Computer students

7	Write a **python** Program for magic square. A magic square is an n * n matrix of the integers 1 to n2 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. | 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	Write a **python** program that determines the location of a saddle point of matrix if one exists. An m x 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.

9	Write a **python** program to compute following computation on matrix:
	  a) Addition of two matrices
	  b) Subtraction of two matrices
	  c) Multiplication of two matrices
	  d) Transpose of a matrix

10	Write a **python** program for sparse matrix realization and operations on it- Transpose, Fast Transpose and addition of two matrices
	Group B
11	a) Write a **python**program to store roll numbers of student in array who attended training program in random order. Write function for searching whether particular student attended training program or not, using Linear search and Sentinel search. b) Write a **python** program to store roll numbers of student array who attended training program in sorted order. Write function for searching whether particular student attended training program or not, using Binary search and Fibonacci search
12	a) Write a **python** program to store names and mobile numbers of your friends in sorted order on names. Search your friend from list using binary search (recursive and non-recursive). Insert friend if not present in phonebook b) Write a **python** program to store names and mobile numbers of your friends in sorted order on names. Search your friend from list using Fibonacci search. Insert friend if not present in phonebook.
13	Write a **python** 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 or not. Ternary search is modified binary search that divides array into 3 halves instead of two.

14	Write a **python**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.

15	Write a **python** 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

16	Write a **python** program to store first year percentage of students in array. Write function for sorting array of floating point numbers in ascending order using quick sort and display top five scores.
17	Write a **python** program to store 12th class percentage of students in array. Write function for sorting array of floating point numbers in ascending order using bucket sort and display top five scores.

18	Write **python** program to store 10th class percentage of students in array. Write function for sorting array of floating point numbers in ascending order using radix sort and display top five scores
	Group C
19	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) Two linked lists exists for two divisions. Concatenate two lists.
20	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.
21	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) d) Sort list based on time e) Sort list based on time using pointer manipulation
22	Second year Computer Engineering class, set A of students like Vanilla Ice-cream and set B of students like butterscotch ice-cream. Write C++ program to store two sets using linked list. compute and display- a) Set of students who like both vanilla and butterscotch b) Set of students who like either vanilla or butterscotch or not both c) Number of students who like neither vanilla nor butterscotch
23	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
24	Write C++ program to realize Set using Generalized Liked List (GLL) e.g. A ={ a, b, {c, d,e, {}, {f,g}, h, I, {j,k}, l, m}. Store and print as set notation.
	Group D
25	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- a) To print original string followed by reversed string using stack b) To check whether given string is palindrome or not

26	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.
27	Implement C++ program for expression conversion as infix to postfix and its evaluation using stack based on given conditions: 1. Operands and operator, both must be single character. 2. Input Postfix expression must be in a desired format. 3. Only '+', '-', '*' and '/ ' operators are expected.
28	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 E
29	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.
30	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.)
31	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.
32	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.
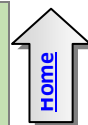
Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210248: OOP and Computer Graphics Laboratory		
Teaching Scheme: PR: 04 Hours/Week	**Credit** 02	**Examination Scheme:** TW: 25 Marks PR: 50 Marks

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a reference and hands-on resource. It should 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 Laboratory Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up of each assignment (Title, Date of Completion, Objectives, Problem Statement, Software & Hardware requirements, Assessment grade/marks and assessor's sign, Theory- Concept in brief, algorithm, flowchart, test cases, Test Data Set(if applicable), mathematical model (if applicable), 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 must be avoided. Use of DVD containing students programs maintained by Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints in the Laboratory.

Guidelines for Laboratory /TW Assessment

Continuous assessment of laboratory work should be based on overall performance of Laboratory assignments by a student. Each Laboratory assignment assessment will assign grade/marks based on parameters, such as timely completion, performance, innovation, efficient codes, punctuality and

Guidelines for Practical Examination

Problem statements must be decided by the internal examiner in consultation with the external examiner. During practical assessment, maximum weightage should be given to satisfactory implementation of the problem statement. Relevant questions may be asked at the time of evaluation to test the student's understanding of the fundamentals, effective and efficient implementation. The questions asked will in no way be the deciding factor for passing the students. This will encourage, transparent evaluation and fair approach, and hence 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 student's academics.

Part I : Computer Graphics Laboratory

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. Use of open source software is encouraged. 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, OPENGL.

| Sr. No.	**Suggested List of Laboratory Experiments/Assignments** **(Implementation of each problem statement is mandatory.)**
	Group A
1	Write C++ program to draw the line styles using DDA and Bresenham's algorithm (solid, dotted, dashed, dash dot and thick). Inherit pixel class and Use Constructors.
2	Write C++ program to draw a Circle using DDA and Bresenham's algorithm. Inherit pixel class and Use function overloading.
3	a) Write C++ program to draw the following pattern. Use DDA and Bresenham's Line drawing algorithm **OR** b) Write C++ program to draw the following pattern. Use DDA and Bresenham's drawing algorithm
4	Write C++ program to draw a 4X4 chessboard. Use DDA and Bresenham's drawing algorithm to draw lines. Use Seed fill algorithm to fill black squares of the board
5	Write C++ program to draw a concave polygon and fill it with desired color using scan fill algorithm.
6	Write C++ program to implement Cohen Southerland line clipping algorithm.
	Group B
7	a) Write C++ program to draw 2-D object and perform following basic transformations, Scaling b) Translation c) Rotation. Use operator overloading. **OR** b) Write C++ program to implement translation, rotation and scaling transformations on equilateral triangle and rhombus.

8	a) Write a program to draw Bezier curve using basic concepts of Object oriented programming. **OR** b) Write Program to draw Sine, Cosine and Tangent Curves using basic concepts of Object oriented programming. **OR** c) Write C++ program to draw any object such as flower, waves using Bezier Curve generation technique.
9	a) Write C++ program to generate snowflake using concept of fractals using basic concepts of Object oriented programming. **OR** b) Write C++ program to generate Hilbert curve using concept of fractals (use constructor). **OR** c) Write C++ program to generate fractal patterns by using Koch curves using basic concepts of Object oriented programming.
	Group C

10	Write C++ program to simulate any one of or similar scene-
	     a) Clock with pendulum **OR**
	     b) National Flag hoisting **OR**
	     c) Vehicle/boat locomotion **OR**
	     d) Water drop falling into the water and generated waves after impact
	 Kaleidoscope views generation (at least 3 colorful patterns)

11	a) Design and simulate any data structure like stack, queue, and trees visualization using graphics. Simulation should include all operations performed on designed data structure. Implement the same using OpenGL. **OR** b) Write C++ program to draw 3-D cube and perform following transformations on it using OpenGL i) Scaling ii) Translation iii) Rotation about one axis. **OR** c) Write OpenGL program to draw Sun Rise and Sunset.
12	a) Write a C++ Program control a ball using arrow keys. **OR** b) Write a C++ Program to implement bouncing ball using sine wave form. **OR** c) Write C++ program to draw Man Walking in the Rain with an Umbrella. **OR** d) Write a C++ Program to make puzzle game. **OR** e) Write a C++ Program to make Tic Tac Toe game
	Mini-Projects/ Case Study
	Design and implement game / animation clip / Graphics Editor using open source graphics library.

Part II : Object Oriented Programming Laboratory
Guidelines for Laboratory Conduction

Suggested List of Laboratory Experiments/Assignments

Sr. No.	Group A
1	Implement a class Complex which represents the Complex Number data type. Implement the following 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.
2	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.
3	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. and other. 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.
4	Imagine a publishing company which does marketing for book and audio cassette 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.
5	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.
6	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
1	Crete User defined exception to check the following conditions and throw the exception if the criterion does not meet. a. User has age between 18 and 55 b. User stays has income between Rs. 50,000 – Rs. 1,00,000 per month c. User stays in Pune/ Mumbai/ Bangalore / Chennai d. 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
2	Write a C++ program that creates an output file, writes information to it, closes the file andopen it again as an input file and read the information from the file.
3	Write a function template selection Sort. Write a program that inputs, sorts and outputs an integer array and a float array.
	Group C
1	Write C++ program using STL for sorting and searching with user defined records such as person record(Name, DOB, Telephone number), Item record (Item code, name, cost,quantity) using vector container
2	Write a program in C++ to use map associative container. The keys will be the names of states, and the values will be the populations of the states. When the program runs, the user is prompted to type the name of a state. The program then looks in the map, using the state name as an index, and returns the population of the state.
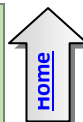
Savitribai Phule Pune University **Second Year of Computer Engineering (2019 Course)** **210249: Digital Electronics Laboratory**		
Teaching Scheme: **PR: 02 Hours/Week**	**Credit** **01**	**Examination Scheme:** **TW: 25 Marks**

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, data sheets of various ICs

Guidelines for Student's Laboratory 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 Laboratory /TW Assessment

Continuous assessment of laboratory work is done based on overall performance and Laboratory performance of student. Each Laboratory assignment assessment should assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory 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 12 experiments with all experiments from group A and any 5 assignments from group Band one from group C assignments.

Suggested List of Laboratory Experiments/Assignments

Sr. No.	Group A
1	To Realize Full Adder/ 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 and Realization of BCD Adder using 4-bit Binary Adder (IC 7483).
4	Realization of Boolean Expression for suitable combination logic using MUX 74151 /74153, DMUX 74154/74138
5	To Verify the truth table of two bit comparators using logic gates.
6	Design & Implement Parity Generator and checker using EX-OR.
	Group B

7	Design and Realization: Flip Flop conversion
8	Design of 2 bit and 3 bit Ripple Counter using MS JK flip-flop.
9	Design of Synchrous 3 bit Up and Down Counter using MSJK Flip Flop / D Flip Flop
10	Realization of Mod -N counter using (Decade Counter IC 7490) .
11	Design and implement Sequence generator (for Prime Number/odd and even) using MS JK flip-flop
12	Design and implement Sequence detector using MS JK flip-flop
	Group C
13	Study of Shift Registers (SISO,SIPO, PISO, PIPO)
14	Design of ASM chart using MUX controller Method.

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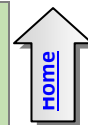
Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210250: Business Communication Skills Laboratory		
Teaching Scheme: PR: 02 Hours/Week	Credit 01	Examination Scheme: TW: 25 Marks

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual needs to include prologue (about University/program/ institute/ department/foreword/preface), University syllabus, conduction & Assessment guidelines, topics under consideration concept objectives, outcomes, guidelines, references.

Guidelines for Student's Laboratory Journal and Guidelines for Laboratory /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 Laboratory assignments performance of student. Each Laboratory assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory 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 Laboratory 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 Experiments/Assignments

Sr. No.	Suggested List of Laboratory Experiments/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. 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 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 asked questions on the article by the readers. Students will get marks 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.
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
14	**Telephonic etiquettes** -To teach students the skills to communicate effectively over the phone.
	Students will be divided into pairs. Each pair will be given different situations, such as phone call to enquire about job vacancy, scheduling a meeting with team members, phone call for requesting of urgent leave from higher authorities. Students will be given 10 min to prepare. Assessment will be done on the basis of performance during the telephone call.
15	**Email etiquettes** -To provide students with an in-depth understanding of email skills.
	Students will be made to send e-mails for different situations such as sending an e-mail to the principal for a leave, inviting a friend for a party, e-mail to enquire about room tariff of a hotel. Students will be assessed on the basis of e-mail such as clarity, purpose and proof reading of e-mail.

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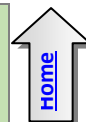
Savitribai Phule Pune University
Second Year of Engineering (2019 Course)
210251: Audit Course 3

In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year. 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 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.

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

Course Guidelines for Assessment (Any one or more of following but not limited to):
- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

Audit Course 3 Options

Audit Course Code	Audit Course Title
AC3-I	Green Construction & Design
AC3-II	Social Awareness and Governance Program
AC3-III	Environmental Studies
AC3-IV	Smart Cities
AC3-V	Foreign Language (one of Japanese/Spanish/French/German). Course contents for **Japanese(Module 1)** are provided. For other languages institute may design suitably

AC3-I: Green Construction & Design

Prerequisites: General awareness of environment and eco system.

Course Objectives:
1. To motivate students for undertaking green construction projects, technical aspects of their design, obstacles to getting them done, and future directions of the field.
2. To increase awareness of green construction issues, so that students will know the range of existing knowledge and issues.
3. Proper use of energy, water and other resources without harming environment.
4. To reduce waste pollution and Environment Degradation.

Course Outcomes:

On completion of the course, student will be able to–
1. To understand the importance of environment friendly society.
2. To apply primary measures to reduce carbon emissions from their surroundings.
3. To learn role of IT solutions in design of green buildings.
4. To understand the use of software systems to complete statutory compliancesinvolved in the design of a new home or office building through green construction.

Course Contents

1. Introduction to Green Construction, need of green construction, Importance, Government Initiatives, your role in the Green Environment.
2. How to do Green Construction, Project Definition, Team Building, Education and Goal Setting, Documents and Specification.
3. Elements of Green Construction, Materials Construction Waste Management, Indoor Air Quality, Energy Efficiency.
4. Indian Green Building Council (IGBC), Introduction to IGBC, IGBC rating system, Green building projects in India, Benefits of green building, effects on natural resources.

Team Projects:

Students will be formed into groups to research green construction and design in a particular construction context and report their results to the class. What are the particular obstacles and opportunities to integrating green construction techniques into the following sectors? Be sure to consider technical, social, political and economic issues:
1. Hotels (economy, luxury, resorts)
2. Hospitals
3. Retail(big box, malls, small scale downtown retail)
4. Office
5. Government
6. Schools
7. Universities
8. Housing
9. Transportation Stations (Airport Terminals, Train Stations)

References :

1. Kibert, C. (2008) Sustainable Construction: Green Building Design and Delivery, 2nd edition(Hoboken, NJ: John Wiley & Sons.
2. Handbook of Green Building Design and Construction 1st Edition, by Sam Kubba, eBook ISBN:9780123851291.
3. IGBC Green New Buildings Rating System, Version 3.0, Abridged Reference Guide September 2014.
Available:https://igbc.in/igbc/html_pdfs/abridged/IGBC%20Green%20New%20Buildings%20Rating%20System%20(Version%203.0).pdf

AC3-II: Social Awareness and Governance Program

Prerequisites:

Awareness about basic terms in Social Science and Governance

Course Objectives:

1. To Increase community awareness about social issues and to promote the practice of good governance in both private and public institutions, through policy advocacy and awareness creation in order to ensure proper utilization of public resources and good service delivery.
2. Increase community awareness on health, education, and human rights.
3. Transferring costs of social activities to other various segments of society.
4. To enhance youth participation in decision-making, democracy and economic development.

Course Outcomes:

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

1. Understand social issues and responsibilities as member of society.
2. Apply social values and ethics in decision making at social or organizational level
3. Promote obstacles in national integration and role of youth for National Integration
4. Demonstrate basic features of Indian Constitution.

Course Contents

1. Indian Society as Pluralistic, Fundamentals of unity in diversity, diversity and disparity in Indian society, women in mass media, disparities due to disability.
2. The Indian constitution as unifying factor, Introduction Making of Indian Constitution, Basic features of Indian Constitution, Strengths of Indian Constitution, and Fundamental Duties.
3. National Integration: Introduction, The Value of Tolerance, Minority Classes And Constitution, Pre-Requisites of National Integration, Obstacles To National Integration, Promotion of National Integration, Role of Youth In Promoting Communal Harmony.
4. Socialization, Ethics, Values and Prejudices, Meaning of Socialization, Functions of Socialization, Agents of Socialization, Importance of Socialization, Role of Ethics In Individual Development, Role of Basic Human Values In Individual Development, Relative Value System.

Activities:

1. Conducting training/workshops/debates on HIV/AIDS prevention and stigma reduction.
2. Public shows on girls' education and empowerment.
3. Conducting campaigns on adult/disabled education.
4. To support the government to develop policy that encourages youth participation in decision-making through government agencies.

References:

1. Social Awareness and Personality Development by Devidas M. Muley , S Chand, ISBN: 812193074X.
2. Introduction to the Constitution of India, BhagabatiProsad Banerjee, Durga Das Basu, Shakeel Ahmad Khan, V. R. Manohar,ISBN : 9788180385599.

AC3-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:
1. Understanding the importance of ecological balance for sustainable development.
2. Understanding the impacts of developmental activities and mitigation measures.
3. Understand and realize the multi-disciplinary nature of the environment, its components, and inter-relationship between man and environment
4. 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–
1. Comprehend the importance of ecosystem and biodiversity
2. 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
3. Identify different types of environmental pollution and control measures
4. 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 #Exemplar/Case Studies, Disaster management

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

AC3-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–
1. 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
2. Exploration of the city as the most complex human-made organism with a metabolism that can be modeled in terms of stocks and flows
3. Knowledge about data-informed approaches for the development of the future city, based on crowd sourcing and sensing
4. Knowledge about the latest research results in for the development and management of future cities
5. 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.

AC3-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 on's age.

Reference:

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)

Savitribai Phule Pune University Second Year of Engineering (2019 Course) 210252: Mathematics III		
Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 03 Hours/Week	03	Mid_Semester(TH): 30 Marks End_Semester(TH): 70 Marks

Prerequisite Courses, if any:

Companion Course, if any:

Course Objectives:
-

Course Outcomes:
CO1:

Course Contents		
Unit I	**U**	**(07 Hours)**
#Exemplar/Case Studies		
Mapping of Course Outcomes for Unit I	C	
Unit II	**U**	**(07 Hours)**
#Exemplar/Case Studies		
Mapping of Course Outcomes for Unit II		
Unit III	**Unit Title**	**(06 Hours)**
#Exemplar/Case Studies		
Mapping of Course Outcomes for Unit III		
Unit IV	**Unit Title**	**(06 Hours)**
#Exemplar/Case Studies		
Mapping of Course Outcomes for Unit IV		
Unit V	**Unit Title**	**(06 Hours)**

#Exemplar/Case Studies	
Mapping of Course Outcomes for Unit V	

Unit VI	Unit Title	(06 Hours)

#Exemplar/Case Studies	
Mapping of Course Outcomes for Unit VI	

Learning Resources

 Text Books:
    1.

Reference Books:
    1.
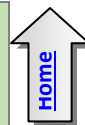
<table>
<tr><td colspan="4">**Savitribai Phule Pune University**
Second Year of Engineering (2019 Course)
210253: Data Structures & Algorithms</td></tr>
<tr><td colspan="2">**Teaching Scheme:**</td><td>**Credit**</td><td>**Examination Scheme:**</td></tr>
<tr><td colspan="2">TH: 03 Hours/Week</td><td>03</td><td>Mid_Semester(TH): 30 Marks
End_Semester(TH): 70 Marks</td></tr>
</table>

Prerequisite Courses, if any:
- Fundamentals of Data Structure
- Basic Mathematics, Geometry, linear algebra, vectors and matrices

Companion Course, if any:

Course Objectives:
- To develop a logic for graphical modeling 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, learner will be able to–

CO1: To identify & articulate the complexity goals and benefits of a good hashing scheme for real-world applications.

CO2: To apply non-linear data structures for solving problems of various domain.

CO3: To design and specify the operations of a nonlinear-based abstract data type and implement them in a high-level programming language.

CO4: To analyze the algorithmic solutions for resource requirements and optimization

CO5: To use efficient indexing methods and multiway search techniques to store and maintain data.

CO6: To use appropriate modern tools to understand and analyze the functionalities confined to the secondary storage.

Course Contents

Unit I	Hashing	(07 Hours)

Hash Table- Concepts-hash table, hash function, basic operations, 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, closed addressing and separate chaining.

Skip List- representation, searching and operations- insertion, removal

#Exemplar/Case Studies	Book Call Number, Dictionary,
Mapping of Course Outcomes for Unit I	CO1

Unit II	Graphs	(08 Hours)

Basic Concepts, Storage representation, Adjacency matrix, adjacency list, adjacency multi list, inverse adjacency list. Traversals-depth first and breadth first, Minimum spanning Tree, Greedy algorithms for computing minimum spanning tree- Prims and Kruskal Algorithms, Dikjtra's Single source shortest path, All pairs shortest paths- Flyod-Warshall Algorithm Topological ordering.

#Exemplar/Case Studies	Data structure used in Webgraph and Google map
Mapping of Course Outcomes for Unit II	CO2, CO3

Unit III	Trees	(07 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(recursive and non-recursive)- inorder, preorder, post order, depth first and breadth first, Operations on binary tree. Huffman Tree (Concept and Use), Binary Search Tree (BST), BST operations, Threaded binary search tree- concepts, threading, insertion and deletion of nodes in in-order threaded binary search tree, in order traversal of in-order threaded binary search tree.

#Exemplar/Case Studies	Use of binary tree in expression tree-evaluation and Huffman's coding
Mapping of Course Outcomes for Unit III	CO2,CO3

Unit IV	Search Trees	(08 Hours)

Symbol Table-Representation of Symbol Tables- Static tree table and Dynamic tree table, Weight balanced tree - Optimal Binary Search Tree (OBST), OBST as an example of Dynamic Programming, Height Balanced Tree- AVL tree. Red-Black Tree, AA tree, K-dimensional tree, Splay Tree

#Exemplar/Case Studies	Keyword search in a document using OBST.
Mapping of Course Outcomes for Unit IV	CO3, CO4

Unit V	Indexing and Multiway Trees	(06 Hours)

Indexing and Multiway Trees- Indexing, indexing techniques-primary, secondary, dense, sparse, Multiway search trees, B-Tree- insertion, deletion , B+Tree - insertion, deletion, use of B+ tree in Indexing, Trie Tree.

#Exemplar/Case Studies	Heap as a priority queue
Mapping of Course Outcomes for Unit V	CO3, CO5

Unit VI	File Organization	(06 Hours)

Files: concept, need, primitive operations. **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.

#Exemplar/Case Studies	**External Sort-** Consequential processing and merging two lists, multiway merging- a k way merge algorithm
Mapping of Course Outcomes for Unit VI	CO6

Learning Resources

Text Books:

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

Reference Books:

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

@The CO-PO mapping table											
PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	3	1	-	-	-	-	1	-	-	1
CO2	3	2	3	1	-	-	-	-	1	-	-	-
CO3	3	2	3	1	-	-	-	-	1	-	-	-
CO4	3	2	3	1	1	-	-	-	1	-	-	-
CO5	3	2	3	1	1	-	-	-	1	-	-	1
CO6	3	2	3	1	1	-	-	-	1	-	-	1
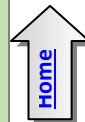
Savitribai Phule Pune University Second Year of Engineering (2019 Course) 210254: Software Engineering		
Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 03 Hours/Week	03	Mid_Semester(TH): 30 Marks End_Semester(TH): 70 Marks

Prerequisite Courses, if any: Fundamentals of Programming Languages

Companion Course, if any:

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.

Course Outcomes:
CO1: Apply software engineering principles to develop software.
CO2: Analyze software requirements and formulate design solution for a software.
CO3: Explain concepts of project estimation, planning and scheduling.
CO4: Explain risk management and software configuration management.
CO5: Explain various types of software testing.

Course Contents

Unit I	Introduction to Software Engineering and Software Process Models	(06 Hours)

Software Engineering Fundamentals: Introduction to software engineering, The Nature of Software, Defining Software, Software Engineering Practice.
Software Process: A Generic Process Model, defining a Framework Activity, Identifying a Task Set, Process Patterns, Process Assessment and Improvement, Prescriptive Process Models, The Waterfall Model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, A Final Word on Evolutionary Processes. Unified Process, Agile software development: Agile methods, plan driven and agile development.

#Exemplar/Case Studies	Agile Tools- JIRA
Mapping of Course Outcomes for Unit I	

Unit II	Software Requirements Engineering and Analysis	(06 Hours)

Modelling: Requirements Engineering, Establishing the Groundwork, Identifying Stakeholders, Recognizing Multiple Viewpoints, working toward Collaboration, Asking the First Questions, Eliciting Requirements, Collaborative Requirements Gathering, Usage Scenarios, Elicitation Work Products, Developing Use Cases, Building the Requirements Model, Elements of the Requirements Model, Negotiating Requirements, Validating Requirements.
Suggested Free Open Source tools: StarUML, Modelio, SmartDraw.

#Exemplar/Case Studies	Write SRS in IEEE format for selected Project Statement/ case study Study SRS of Online Voting system (http://dos.iitm.ac.in/OOSD_Material/CaseStudies/CaseStudy2/eVote-srs.pdf), Library management System, Develop use case model for any software applications.

Mapping of Course Outcomes for Unit II	
Unit III	**Estimation and Scheduling** — **(06 Hours)**

Estimation for Software Projects: The Project Planning Process, Defining Software Scope and Checking Feasibility, Resources management, Reusable Software Resources, Environmental Resources,
Software Project Estimation, Decomposition Techniques, Software Sizing, Problem-Based Estimation, LOC-Based Estimation, FP-Based Estimation, Object Point (OP)-based estimation, Process-Based Estimation, Process-Based Estimation, Estimation with Use Cases, Use-Case–Based Estimation, Reconciling Estimates, Empirical Estimation Models, The Structure of Estimation Models, The COCOMO II Mode, Preparing Requirement Traceability Matrix
Project Scheduling: Project Scheduling, Defining a Task for the Software Project, Scheduling.
Suggested Free Open Source Tool: GanttProject, Agantty, ProjectLibre.

#Exemplar/Case Studies	Write SRS in IEEE format for selected Project Statement/ case study Study SRS of Online Voting system (http://dos.iitm.ac.in/OOSD_Material/CaseStudies/CaseStudy2/eVote-srs.pdf), Library management System,
Mapping of Course Outcomes for Unit III	
Unit IV	**Design Engineering** — **(06 Hours)**

Design Concepts: Design within the Context of Software Engineering, The Design Process, Software Quality Guidelines and Attributes, Design Concepts - Abstraction, Architecture, design Patterns, Separation of Concerns, Modularity, Information Hiding, Functional Independence, Refinement, Aspects, Refactoring, Object-Oriented Design Concept,
Design Classes, The Design Model , Data Design Elements, Architectural Design Elements, Interface Design Elements, Component-Level Design Elements, Component Level Design for WebApps, Content Design at the Component Level, Functional Design at the Component Level, Deployment-Level Design Elements,
Architectural Design: Software Architecture, What is Architecture, Why is Architecture Important, Architectural Styles, A brief Taxonomy of Architectural Styles.
Suggested Free Open Source Tool: SmartDraw.

#Exemplar/Case Studies	Study design of Biometric Authentication software
Mapping of Course Outcomes for Unit IV	
Unit V	**Risks and Configuration Management** — **(06 Hours)**

Risk Management: Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Monitoring, and Management, The RMMM Plan.
Software Configuration Management: Software Configuration Management, The SCM Repository The SCM Process, Configuration Management for any suitable software system
Suggested FreeOpen Source Tools: CFEngine Configuration Tool, Puppet Configuration Tool.

#Exemplar/Case Studies	Risk management in Food delivery software
Mapping of Course Outcomes for Unit V	
Unit VI	**Software Testing** — **(06 Hours)**

A Strategic Approach to Software Testing, Verification and Validation, Organizing for Software Testing, Software Testing Strategy—The Big Picture, Criteria for Completion of Testing, Strategic Issues, Test Strategies for Conventional Software, Unit Testing, Integration Testing, Test Strategies for Object-Oriented Software, Unit Testing in the OO Context, Integration Testing in the OO Context, Test Strategies forWebApps, Validation Testing, Validation-Test Criteria, Configuration Review.
Suggested Free Open Source Tools: Selenium, JUnit.

| **#Exemplar/Case Studies**	Selemium Testing with any online application
Mapping of Course Outcomes for Unit VI	

Learning Resources

Text Books:

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

Reference Books:

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

@The CO-PO mapping table												
PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	2	-	-	-	-	-	-	1
CO3	2	-	-	-	1	-	-	-	1	-	1	-
CO4	2	-	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	1	-	-	-	-	-	-	1
CO6												
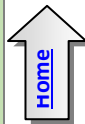
Savitribai Phule Pune University Second Year of Engineering (2019 Course) 210255: Microprocessor		
Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 03 Hours/Week	03	Mid_Semester(TH): 30 Marks End_Semester(TH): 70 Marks

Prerequisite Courses, if any: Digital Electronics and Logic Design

Companion Course, if any:

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–

CO1: To apply the assembly language programming to develop small real life embedded application.

CO2: To understand the architecture of the advanced processor thoroughly to use the resources for programming

CO3: To understand the higher processor architectures descended from 80386 architecture

Course Contents

Unit I	**80386DX- Basic Programming Model and Applications Instruction Set**	**(06 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.

#Exemplar/Case Studies	
Mapping of Course Outcomes for Unit I	CO1,CO2

Unit II	**Systems Architecture and Memory Management**	**(06 Hours)**

Systems Architecture- Systems Registers, Systems Instructions.

Memory Management- Segment Translation, Page Translation, Combining Segment and Page Translation.

#Exemplar/Case Studies	
Mapping of Course Outcomes for Unit II	CO3

| Unit III	**Protection and Multitasking**	**(08 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.

#Exemplar/Case Studies	
Mapping of Course Outcomes for Unit III	CO1,CO2

Unit IV	**Input-Output, Exceptions and Interrupts**	**(08 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.

#Exemplar/Case Studies	
Mapping of Course Outcomes for Unit IV	CO4

Unit V	**Initialization of 80386DX, Debugging and Virtual 8086 Mode**	**(08 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.

#Exemplar/Case Studies	
Mapping of Course Outcomes for Unit V	CO4

Unit VI	**80387 Coprocessor and Introduction to Microcontrollers**	**(06 Hours)**

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.

Introduction to Microcontrollers: Architecture of typical Microcontroller, Difference between Microprocessor and Microcontroller, Characteristics of 8 bit and 16 bit microcontrollers, Application of Microcontrollers

#Exemplar/Case Studies	
Mapping of Course Outcomes for Unit VI	CO4

Learning Resources

Text Books:

1. A.Ray, K.Bhurchandi, "Advanced Microprocessors and peripherals: Arch, Programming & Interfacing", Tata McGraw Hill,2004 ISBN 0-07-463841-6
2. Intel 80386 Programmer's Reference Manual 1986, Intel Corporation, Order no.: 231630-011, December 1995.
3. James Turley, "Advanced 80386 Programming Techniques", McGraw-Hill, ISBN: 10: 0078813425, 13: 978-0078813429.

Reference Books:

1. Chris H. Pappas, William H. Murray, —80386 Microprocessor Handbooks , McGraw-Hill Osborne Media, ISBN-10: 0078812429, 13: 978-0078812422.
2. Douglas Hall, "Microprocessors & Interfacing", McGraw Hill, Revised 2 Edition, 2006 ISBN 0-07-100462-9
3. Intel 387DX Math coprocessor, Order no.: 240448-005, March1992.
4. Walter A. Triebel, —The 80386Dx Microprocessor: Hardware , Software, and Interfacing, Pearson Education, ISBN: 0137877307, 9780137877300.
5. Brey, Barry B, —8086/8088, 80286, 80386 and 80486 Assembly Language Programming , Prentice Hall, ISBN: 13: 9780023142475.
6. Mohammad Rafiquzzaman, —Microprocessors: Theory and Applications: Intel and Motorola", Prentice Hall, ISBN:-10:0966498011, 13:978:0966498011.
7. Introduction to 64 bit Intel Assembly Language Programming for Linux, 2nd Edition, Ray Seyfarth, ISBN10: 1478119209, ISBN-13: 9781478119203, 2012.
8. Assembly Language Step-by-step: Programming with Linux, 3rd Edition, Jeff Duntemann, Wiley ISBN:-10 0470497025, ISBN-13: 978-0470497029, 2009.

@The CO-PO mapping table											
PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	-	-	-	2	2	2	-
CO2	2	2	2	2	-	-	-	-	2	2	-	-
CO3	2	2	1	1	-	-	-	-	2	1	-	-
CO4	2	2	2	2	-	-	-	-	2	2	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-
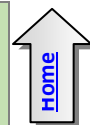
<table>
<tr><td colspan="4" align="center">**Savitribai Phule Pune University**
Second Year of Engineering (2019 Course)
210256: Principles of Programming Languages</td></tr>
<tr><td colspan="2" align="center">**Teaching Scheme:**</td><td align="center">**Credit**</td><td align="center">**Examination Scheme:**</td></tr>
<tr><td colspan="2">**TH: 03 Hours/Week**</td><td align="center">**03**</td><td>**Mid_Semester(TH): 30 Marks**
End_Semester(TH): 70 Marks</td></tr>
</table>

Prerequisite Courses, if any: Fundamentals of Data Structures, Object Oriented Programming, Fundamentals of programming language.

Companion Course, if any: Software Engineering, Data Structures and Algorithms, Project based learning

Course Objectives:
- To learn basic principles of programming languages and programming paradigms
- To learn structuring the data and manipulation of data, computation and program structure
- To learn Object Oriented Programming (OOP) principles using Java Programming Language
- To learn basic concepts of logical and functional programming language

Course Outcomes:
 On completion of the course, student will be able to–
- CO1: Make use of basic principles of programming languages
- CO2: Able to develop a program with Data representation and Computations
- CO3: Able to develop programs using Object Oriented Programming language : Java
- CO4: Develop application using inheritance, encapsulation, and polymorphism
- CO5: Able to demonstrate Applet and Multithreading for robust application development
- CO6: Able to develop a simple program using basic concepts of Functional and Logical programming paradigm

<div align="center">**Course Contents**</div>

Unit I	Fundamentals of Programming	(06 Hours)

Importance of Studying Programming Languages, History of Programming Languages, Impact of Programming Paradigms, Role of Programming Languages, Programming Environments. Impact of Machine Architectures: The operation of a computer, Virtual Computers and Binding Times.
Programming paradigms- Introduction to programming paradigms, Introduction to four main Programming paradigms- procedural, object oriented, functional, and logic & rule based.

#Exemplar/Case Studies	A case study: Retail Sales application
Mapping of Course Outcomes for Unit I	CO1

Unit II	Structuring the Data, Computations and Program	(06 Hours)

Elementary Data Types : Primitive data Types, Character String types, User Defined Ordinal Types, Array types, Associative Arrays, Record Types, Union Types, Pointer and reference Type.
Expression and Assignment Statements: Arithmetic expression, Overloaded Operators, Type conversions, Relational and Boolean Expressions, Short Circuit Evaluation, Assignment Statements, Mixed mode Assignment.
Statement level Control Statements: Selection Statements, Iterative Statements, Unconditional Branching.
Subprograms: Fundamentals of Sub Programs, Design Issues for Subprograms, Local referencing Environments, Parameter passing methods.
Abstract Data Types and Encapsulation Construct: Design issues for Abstraction, Parameterized Abstract Data types, Encapsulation Constructs, Naming Encapsulations

#Exemplar/Case Studies	Data representation and computations in Retail Sales
Mapping of Course Outcomes for Unit II	CO2

Unit III	Java as Object Oriented Programming Language-Overview	(06 Hours)

Fundamentals of JAVA, Arrays: one dimensional array, multi-dimensional array, alternative array declaration statements ,**String Handling:** String class methods, **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.

#Exemplar/Case Studies	Demonstrate classes , objects, data, methods for Online Banking System using Java
Mapping of Course Outcomes for Unit III	CO3

Unit IV	Inheritance, Packages and Exception Handling using Java	(06 Hours)

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. 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.

#Exemplar/Case Studies	Demonstrate inheritance, Packages and interface forOnline Banking System using Java
Mapping of Course Outcomes for Unit IV	CO4

Unit V	Multithreading in Java	(06 Hours)

Concurrency and Synchronization, Java Thread Model: Thread priorities, Synchronization, Messaging, Main Thread, Creating thread: Implementing Thread using thread class and Runnable interface. Creating multiple threads using isAlive() and join()

Web Based Application in Java: Use of JavaScript for creating web based applications in java, Introduction to javascript frameworks- React, Vue, Angular

#Exemplar/Case Studies	Demonstrate Multithreading for Gaming
Mapping of Course Outcomes for Unit V	CO5

Unit VI	Logical and Functional Programming	(06 Hours)

Functional Programming Paradigm: Understanding symbol manipulation, Basic LISP functions, definitions, predicates, conditionals and scoping, Recursion and iteration, Properties List array and access functions, Using lambda definitions, printing, reading and atom manipulation. **Logic Programming Paradigm:** An Overview of Prolog, Syntax and Meaning of Prolog Programs, Lists, Operators, Arithmetic, Using Structures: Example Programs

#Exemplar/Case Studies	Demonstrate Functional and Logic Programming for Software Project Management.
Mapping of Course Outcomes for Unit VI	CO6

Learning Resources

Text Books:

1. T. W. Pratt, M. V. Zelkowitz, "Programming Languages Design and Implementation , 4th Ed, PHI, ISBN 81-203-2035-2.
2. Sebesta R., "Concepts of Programming Languages", 4th Edition, Pearson Education, ISBN-81-7808-161-X.
3. Herbert Schildt, "The Complete Reference Java", 9th Ed, TMH,ISBN: 978-0-07-180856-9.

Reference Books:

1. Dr.R. Nageshwar Rao, "Core Java: An Integrated Approach", Dreamtech Press
2. Deugo, ―Java Gems , Cambridge University Press, ISBN 10: 0521648246 ISBN 13: 9780521648240
3. Carl Townsend ,"Programming in turbo PROLOG", Tata-McGraw Hill
4. Ivan Bratko, " Prolog Programming for Artificial Intelligence", Wesley Publishers Limited
5. Winston P., Klaus B., Horn P., "LISP", 3rd Edition, Pearson Education, 81 - 7808 -155-5
6. Carlo Ghezzi, Mehdi Jazayeri, ―Programming Language Concepts ,3rd Ed, Wiley Publication ISBN : 978-81-265-1861-6.

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CO2	3	3	3	3	2	1	-	1	2	1	3	3
CO3	3	3	3	3	3	2	1	3	2	1	3	3
CO4	3	3	3	3	3	2	1	3	2	1	3	3
CO5	3	3	3	3	3	2	1	3	2	1	3	3
CO6	3	3	3	3	3	2	1	3	2	1	3	3
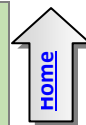
Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210257: Data Structures & Algorithms Laboratory		
Teaching Scheme: PR: 04 Hours/Week	Credit 02	Examination Scheme: TW: 25 Marks PR: 50 Marks

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 Laboratory 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, Test Data Set(if applicable), mathematical model (if applicable), conclusion/analysis. **Program codes with sample output of all performedassignments 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 Laboratory In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Laboratory /TW Assessment

Continuous assessment of laboratory work is done based on overall performance and Laboratory assignments performance of student. Each Laboratory assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each Laboratory assignment assessment include- timely completion, performance, innovation, efficient codes, 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. 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, E, F and G. Each student must perform at least 12 assignments as at least 02 from group A, 03 from group B, 02 from group C, 2 from group D, 01 from group E, 02 from group F.

Operating System recommended :- 64-bit Open source Linux or its derivative
Programming tools recommended: - Open Source Python - Group A assignments,   C++ Programming tool like G++/GCC

Suggested List of Laboratory Experiments/Assignments

| Sr. No.	Group A
1	Consider telephone book database of N clients. Make use of a hash table implementation to quickly look up client's telephone number. Make use of two collision handling techniques and compare them using number of comparisons required to find a set of telephone numbers
2	Implement all the functions of a dictionary (ADT) using hashing and handle collisions using chaining with / without replacement. 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)
3	For given set of elements create skip list. Find the element in the set that is closest to some given value. (note: Decide the level of element in the list Randomly with some upper limit)
4	To create ADT that implement 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
	Group B
5	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.
6	Beginning with an empty binary search tree, Construct binary search tree by inserting the values in the order given. After constructing a binary tree - i. Insert new node ii. Find number of nodes in longest path from root 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
7	Construct an expression tree from the given prefix expression eg. +--a*bc/def and traverse it using postordertraversal(non recursive) and then delete the entire tree.
8	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?
9	Convert given binary tree into threaded binary tree. Analyze time and space complexity of the algorithm.
10	Consider threading a binary tree using preorder threads rather than inorder threads. Design an algorithm for traversal without using stack and analyze its complexity. _
11	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.

12	Implement a file compression algorithm that uses binary tree. Your program should allow the user to compress and decompress messages containing alphabets using the standard Huffman algorithm for encoding and decoding.
	Group C
13	Represent a given graph using adjacency matrix/list to perform DFS and using adjacency list to perform BFS. Use the map of the area around the college as the graph. Identify the prominent land marks as nodes and perform DFS and BFS on that.
14	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 take 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. Check whether the graph is connected or not. Justify the storage representation used.
15	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.
16	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.
17	Consider the scheduling problem. n tasks to be scheduled on single processor. Let t1, ...,tn 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 D
18	Given sequence k = k1 <k2 < … <kn of n sorted keys, with a search probability pi for each key ki . 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	Consider a scenario for Hospital to cater services to different kinds of patients as Serious (top priority), b) non-serious (medium priority), c) General Checkup (Least priority). Implement the priority queue to cater services to the patients.
21	Implement the Heap/Shell sort algorithm implemented in Java demonstrating heap/shell data structure with modularity of programming language
22	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
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.
25	Implementation of a direct access file -Insertion and deletion of a record from a direct access file
26	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.
	Mini-Projects/ Case Study
27	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.
28	Design a mini project to implement Snake and Ladders Game using python.
29	Design a mini project to implement a Smart text editor.
30	Design a mini project for automated Term work assessment of student based on parameters like daily attendance, Unit Test / Prelim performance, Students achievements if any, Mock Practical.
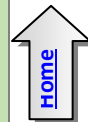
Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210258: Microprocessor Laboratory		
Teaching Scheme: PR: 04 Hours/Week	**Credit** **02**	**Examination Scheme:** TW: 25 Marks PR: 50 Marks

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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 Experiments/Assignments

Sr. No.	Assignments
1	Write X86/64 ALP to count number of positive and negative numbers from the array.

2	Write an ALP to accept five 64 bit Hexadecimal numbers from user and store them in an array and display the accepted numbers.
3	Write X86/64 ALP to perform non-overlapped block transfer (with and without string specific instructions). Block containing data can be defined in the data segment.
4	Write X86/64 ALP to perform overlapped block transfer (with and without string specific instructions). Block containing data can be defined in the data segment.
5	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).
6	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).
7	Write X86 Assembly Language Program (ALP) to implement following OS commands i. TYPE ii. COPY and iii. DELETE Using file operations. User is supposed to provide command line arguments in all cases.
8	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.
9	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.
10	Write X86/64 ALP to switch from real mode to protected mode and display the values of GDTR, LDTR, IDTR, TR and MSW Registers also identify CPU type using CPUID instruction.
11	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.
12	Write 80387 ALP to obtain: i) Mean ii) Variance iii) Standard Deviation. Define the input values in data segment.
13	Write 80387 ALP to find the roots of the quadratic equation. All the possible cases must be considered in calculating the roots.
14	Write an ALP password program that operates as follows: a. Do not display what is actually typed instead display asterisk ("*"). If the password is correct display, "access is granted" else display "Access not Granted"
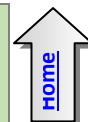
Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210259: Code of Conduct		
Teaching Scheme:	**Credit**	**Examination Scheme:**
TUT: 01 Hours/Week	**00**	**---**

Preamble:

Engineering is one of the important and cultured professions. With respect to any engineering profession, engineers are expected to exhibit the reasonable standards of integrity and honesty. Engineering is directly or indirectly responsible to create a vital impact on the quality of life for the society. Acceptably, the services provided by engineers require impartiality, honesty, equity and fairness and must give paramount importance to the protection of the public health, safety, and welfare. Engineers must perform under a standard of professional behavior that requires adherence to the principles of ethical conduct.

Prime aim is to recognize and evaluate ethical challenges that they will face in their professional careers through knowledge and exercises that deeply challenge their decision making processes and ethics.

Course Objectives:

- To promote ethics, honesty and professionalism.
- To set standards that are expected to follow and to be aware that If one acts unethically what are the consequences.
- To provide basic knowledge about engineering Ethics, Variety of moral issues and Moral dilemmas, Professional Ideals and Virtues
- To provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards, Exposure to Safety and Risk, Risk Benefit Analysis
- To have an idea about the Collegiality and Loyalty, Collective Bargaining, Confidentiality, Occupational Crime, Professional, Employee, Intellectual Property Rights.

Course Outcomes:

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

CO1: Understand the basic perception of profession, professional ethics, various moral & social issues, industrial standards, code of ethics and role of professional ethics in engineering field.

CO2: Aware of professional rights and responsibilities of an engineer, responsibilities of an engineer for safety and risk benefit analysis.

CO3: Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

CO4: Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives.

Course Contents

The following are the certain guidelines as far as ethics and code of conduct are concerned to be clearly and elaborately explained to the students,

Fundamental norms Engineers, in the fulfillment of their professional duties, should include paying utmost attention to the safety, health, and welfare of the society. Along with that engineers should execute the services only in their areas of competence. Whenever there is a need to issue public statements then such statements should be expressed in objective and truthful manner. Engineer should extend high sense of integrity by acting for each employer or client as faithful agents or trustees. Whatever may be the working scope engineer should conduct

themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

As far as ethical practices are concerned engineers should not reveal facts, data, or information without the prior consent of the client or employer except as authorized or required by law or Code. Engineers should not permit the use of their name or associate in business ventures with any person or firm that they believe is engaged in fraudulent or dishonest enterprise moreover he/she should not aid or abet the unlawful practice of engineering by a person or firm.

Engineers having knowledge of any alleged violation of the Code should report thereon to appropriate professional bodies and, when relevant, also to public authorities, and cooperate with the proper authorities in furnishing such information or assistance as may be required. Engineers should disclose all known or potential conflicts of interest that could influence or appear to influence their judgment or the quality of their services. Engineers should not accept compensation, financial or otherwise, from more than one party for services on the same project, or for services pertaining to the same project, unless the circumstances are fully disclosed and agreed to by all interested parties. Engineers should not solicit or accept financial or other valuable consideration, directly or indirectly, from outside agents in connection with the work for which they are responsible.

Engineers should never falsify their qualifications or permit misrepresentation of their or their associates' qualifications. They shall not misrepresent or exaggerate their responsibility in or for the subject matter of prior assignments. Brochures or other presentations incident to the solicitation of employment shall not misrepresent pertinent facts concerning employers, employees, associates, joint ventures, or past accomplishments.

Engineers should not offer, give, solicit, or receive, either directly or indirectly, any contribution to influence the award of a contract by public authority, or which may be reasonably construed by the public as having the effect or intent of influencing the awarding of a contract. They should not offer any gift or other valuable consideration in order to secure work. They should not pay a commission, percentage, or brokerage fee in order to secure work, except to a bona fide employee or bona fide established commercial or marketing agencies retained by them.

There are certain obligations accompanied with engineering profession. Engineers should acknowledge their errors and should not distort or alter the facts. Candid advises in special cases are always welcome. Engineers should not accept outside employment to the detriment of their regular work or interest. Before accepting any outside engineering employment, they will notify their employers.

Engineers should not promote their own interest at the expense of the dignity and integrity of the profession furthermore they should treat all persons with dignity, respect, fairness, and without discrimination. Engineers should at all times strive to serve the public interest. Engineers are encouraged to participate in civic affairs; career guidance for youths; and work for the advancement of the safety, health, and well-being of their community. Engineers are encouraged to adhere to the principles of sustainable development in order to protect the environment for future generations. Engineers shall continue their professional development throughout their careers and should keep current in their specialty fields by engaging in professional practice, participating in continuing education courses, reading in the technical literature, and attending professional meetings and seminar.

Engineers should not, without consent, use equipment, supplies, laboratory, or office facilities of an employer to carry on outside private practice. They should not attempt to injure, maliciously or falsely, directly or indirectly, the professional reputation, prospects, practice, or employment of other engineers. Engineers who believe others are guilty of unethical or illegal practice shall present such information to the proper authority for action. "Sustainable development" is the challenge for the engineers meeting human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base essential for future development.

Following are contents to be covered in tutorial session-

1. Engineering Ethics : Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas –Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy –Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.
2. Global Issues -Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct
3. Engineer's Responsibility for Safety - Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk
4. Responsibilities and Rights - Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

Global Issues- Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

#Exemplar/Case Studies :

General Motors ignition switch recalls (2014), Space Shuttle Columbia disaster (2003), Space Shuttle Challenger disaster (1986), Therac-25 accidents (1985 to 1987), Chernobyl disaster (1986), Bhopal disaster (1984), Kansas City Hyatt Regency walkway collapse (1981)

Guidelines for Conduction:

   The course will exemplify the budding engineers the Code of Conduct and ethics pertaining to their area and scope of their work. The Instructor/Teacher shall explain the students the importance ant impact of the ethics and code of conduct.

   Confined to various courses and project/mini-project development the possible vulnerabilities and threats need to be elaborated and the students' participation need to be encouraged in designing such document explicitly mentioning Code of Conduct and Disclaimers.

Learning Resources

Books:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics –Concepts and Cases", Thompson Learning, (2000).
3. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (1999).
4. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, (2003)
5. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, (2001)
6. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004)

David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)
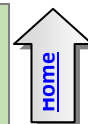
Web Links:

- https://www.ieee.org/about/compliance.html
- https://www.cs.cmu.edu/~bmclaren/ethics/caseframes/91-7.html
- https://www.nspe.org/
- http://www.ewh.ieee.org/soc/pes/switchgear/presentations/tp_files/2017-1_Thurs_Shiffbauer_Singer_Engineering_Ethics.pdf

MOOC:

@The CO-PO mapping table												
PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	2	2	-	-	-	-
CO2	-	-	-	-	-	-	2	2	-	-	-	-
CO3	-	-	-	-	-	-	3	2	-	-	-	-
CO4	-	-	-	-	-	-	2	3	-	-	-	-

Savitribai Phule Pune University Second Year of Computer Engineering (2019 Course) 210260: Project Based Learning		
Teaching Scheme: PR: 04 Hours/Week	Credit 02	Examination Scheme: TW: 50 Marks

Prerequisite Courses, if any: Problem Based Learning.

Companion Course, if any: Software Engineering.

Course Objectives:
- To develop critical thinking and problem solving ability by exploring and proposing solutions to realistic/social problem.
- To Evaluate alternative approaches, and justify the use of selected tools and methods,
- To emphasizes learning activities that are long-term, inter-disciplinary and student-centric.
- To engages students in rich and authentic learning experiences.
- To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.
- To develop an ecosystem this may promote entrepreneurship and research culture among the students.

Course Outcomes:

CO1: Ability to solve real life problems by applying knowledge.

CO2: Ability to analyze alternative approaches, apply and use most appropriate one for feasible solution.

CO3: Ability to understand basics of IT Project management

CO4: Students should be able to accept and meet challenges in the real world, mirroring what professionals do every day.

CO5: Able to Classify software applications and identify unique features of various domains

CO6: Learning by doing approach in PBL will promote long-term retention of material and replicable skill, as well as improve teachers' and students' attitudes towards learning.

Course Contents

Preamble:

Project-based learning is an instructional approach designed to give students the opportunity to develop knowledge and skills through engaging projects set around challenges and problems they may face in the real world. PBL, is more than just projects. With PBL students "investigate and respond to an authentic, engaging, and complex problem, or challenge" with deep and sustained attention. PBL is "learning by doing." The truth is, many in education are recognizing we live in a modern world sustained and advanced through the successful completion of projects. In short, If students are prepared for success in life, we need to prepare them for a project-based world. It is a style of active learning and inquiry-based learning. (Reference: Wikipedia). Project based learning will also redefine the role of teacher as mentor in learning process. Along with communicating knowledge to students, often in a lecture setting, the teacher will also to act as an initiator and facilitator in the collaborative process of knowledge transfer and development. The PBL model focuses the student on a big open-ended question, challenge, or problem to research and respond to and/or solve. It Brings what students should academically know, understand, and be able to do and requires students to present their problems, research process, methods, and results.

Project based learning (PBL) requires regular mentoring by faculty throughout the semester for successful completion of the idea/project tasks selected by the students per

batch. For the faculty involved in PBL , teaching workload of 4 Hrs/week/batch needs to be considered. The Batch should be divided into sub-groups of 4 to 5 students. Idea implementation /Real life problem/Complex assignments / activities / projects. under project based learning is to be carried throughout semester and Credit for PBL has to be awarded on the basis of internal continuous assessment and evaluation at the end of semester

Group Structure:
Working in supervisor/mentor monitored groups; the students plan, manage, and complete a task/project/activity which addresses the stated problem.
1.   There should be team/group of 4-5 students
2.   A supervisor/mentor teacher assigned to individual groups

Selection of Project/Problem:

The problem-based project oriented model for learning is recommended. The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. Students design and analyze the problem/project within an articulated interdisciplinary or subject frame.
A problem can be theoretical, practical, social, technical, symbolic, cultural, and/or scientific and grows out of students' wondering within different disciplines and professional environments. A chosen problem has to be exemplary. The problem may involve an interdisciplinary approach in both the analysis and solving phases.
By exemplarity, a problem needs to refer back to a particular practical, scientific, social and/or technical domain. The problem should stand as one specific example or manifestation of more general learning outcomes related to knowledge and/or modes of inquiry.
There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content, and structure of the activity.
- • A few hands-on activities that may or may not be multidisciplinary.
- • Use of technology in meaningful ways to help them investigate, collaborate, analyse, synthesize, and present their learning.
- • Activities may include- Solving real life problem, investigation, /study and Writing reports of in depth study, field work.

Assessment:

The institution/head/mentor is committed to assessing and evaluating both student performance and program effectiveness.
Progress of PBL is monitored regularly on weekly basis. Weekly review of the work is necessary. During process of monitoring and continuous assessment and evaluation of the individual and the team performance is to be measured. PBL is monitored and continuous assessment is done by supervisor /mentor and authorities.
Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes.
Group may demonstrate their knowledge and skills by developing a public product and/or report and/or presentation.
 1. Individual assessment for each student (Understanding individual capacity, role and involvement in the project)

2. Group assessment (roles defined, distribution of work, intra-team communication and togetherness)

3. Documentation and presentation

Evaluation and Continuous Assessment:

It is recommended that all activities should to be recorded regularly, regular assessment of work need to be done and proper documents need to be maintained at college end by both students as well as mentor (PBL work book).

Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department and institutes.

Recommended parameters for assessment/evaluation and weightage:

1. Idea Inception and Awareness /Consideration of -Environment/ Social /Ethics/ Safety measures/Legal aspects (10%)

2. Outcomes of PBL/ Problem Solving Skills/ Solution provided/ Final product (Individual assessment and team assessment) (40%)

3. Documentation (Gathering requirements, design &modelling, implementation/ execution, use of technology and final report, other documents) (15%)

4. Demonstration (Presentation, User Interface, Usability) (20%)

5. Contest Participation/ publication (15%)

PBL workbook will serve the purpose and facilitate the job of students, mentor and project coordinator. It will reflect accountability, punctuality, technical writing ability and work flow of the work undertaken.

Note :

- While planning for the assessment, choose a valid method based on your context. It should be able to understand by both the students as well as the faculty.
- The student group must follow the principles of Software Engineering (Scoping out the problem, the solution implementation and related documentation).
- Researching the problem and outlining various approaches is key here and should be emphasized by the tutor and the mentor.
- Aspects of design thinking (from the point of view of the person facing the problem) are very important. Students should not jump into the technology aspects first.
- The team can follow the principles of Agile Software Development. The weekly meetings could be used as a Scrum meeting.
- The tutor & mentor should actively help the students to scope the work and the approach. They must validate the technology choices.
- If the implementation code is well documented, the project can be continued by subsequent batch – which will help solve a bigger problem.

Note: @The CO-PO mapping table will be according to project assignment

Text Books:

1. A new model of problem based learning. By Terry Barrett. All Ireland Society for higher education (AISHE). ISBN:978-0-9935254-6-9; 2017
2. Problem Based Learning. byMahnazmoallem, woei hung and Nada Dabbagh, Wiley Publishers. 2019.
3. Stem Project based learning and integrated science, Technology, Engineering and mathematics approach. By Robert RobartCapraro, Mary MargaretCapraro

Reference Books:

1. De Graaff E, Kolmos A., red.: Management of change: Implementation of problem-based and project-based learning in engineering. Rotterdam: Sense Publishers. 2007.
2. Project management core text book, 2 Indian Edition , by Gopalan.
3. The Art of Agile Development. By James Shore & Shane Warden.

Following Fields are applicable for Tutorial of Project Based Learning

Tutors Role in Project Based Learning
- The fundamentals of problem based learning, lies with the Tutors role.
- Tutorsare not the source of solutions rather they act as the facilitator and mentor.
- The facilitator skills of the Tutors / Teacher are central to the success of PBL.

Change of Mindset
- Students are not used to the constructivist approach to learning, it is important that they are carefully told what to expect in PBL.
- Tutors need to explain the differences between PBL and traditional learning.
- Tutors need to explain the principals involved and role of the studenst in PBL learning.

Designing Problem
- Considering the prior knowledge of the students, their ability and creativity, problem statement should be designed.
- For 2nd year PBL students the tutor should place more emphasis on getting the students to perform higher-level tasks.
- It is important for tutors to design problems that are anchored in authentic contexts only
- Students should take ownership of the problem.
- Problems should not be over simplified or well defiled
- Learning should not be the sequencing of instructional events, but the application of principles for responding to the needs of the situation.
- The problems given to students in PBL should be realistic, complex, and should reflect, as much as possible, the actual problems that students would encounter in real life.

Basic function of the tutor
- A good understanding of the overall curriculum the students have to study, the principles of problems solving, critical thinking and metacognitive skills.

Grouping
- Study the background and profile of each student.
- Make sure that students of different backgrounds and experience are assigned in a group
- It is useful to group students of different abilities, gender, and nationalities together.
- Tutors must have the commitment to devote the time to the tutorial process.
- A good tutor is always interested in helping students to learn better.
- Sufficient resources should be made available for students to takepart the PBL tutorial.
- Time management is important.

Assessment of Learning
- It is important for tutors to make sure that assessment is consistent with learning objectives of the groups in PBL
- Assessment of students should not be focused only on the final leaning product.
- PBL tutors need to understand meaningful ways of assessing students' work to motivate learning.
- For assessment to be implemented properly there should be well designed and clearly defined goals and objectives and well thoughtout strategies, techniques, criteria, and marking schemes.

Student's Role in PBL

- Prepare students for PBL before starting the sessions.
- Students must have ability to initiate the task/idea .they should not be mere imitators.
- They must learn to think.
- Students working in PBL must be responsible for their own learning.
- Throughout the PBL process, students have to define and analyze the problem,generate learning issues and apply what they have learned to solve the problemand act for them-selves and be free.
- Students must quickly learn how to manage their own learning,Instead of passively

Receiving instruction.

- Students in PBL are actively constructing their knowledge and understanding of the situation in groups.
- Students in PBL are expected to work in groups.
- They have to develop interpersonal and group process skills, such aseffective listening or coping creatively with conflicts.

Inquiry Skills

- Students in PBL are expected to develop critical thinking abilities by constantly relating:
- What they read to do?
- What they want to do with that information?
- They need to analyze information presented within the context of finding answers.
- Modeling is required so that the students can observe and build a conceptual model of the required processes.
- Formative and summative questions for evaluation:
- How effective is …….?
- How strong is the evidence for ………?
- How clear is ……?
- What are the justifications for thinking?
- Why is the method chosen?
- What is the evidence given to justify the solution?

Information Literacy

- Information literacy is an integral part of self- directed learning
- Information literacy involves the ability to:
- Know when there is a need for information
- Identify the information needed to solve a given problem or issue
- Be able to locate the needed information
- Use the information to solve the given problem effectively.
- Skills required by students in information literacy include:
- How to prepare the search
- How to carry out the research
- Sorting and assessing of information in general

Collaborative learning

- It is an educational approach to teaching and learning that involves
- groups of students working together to solve a problem or complete aproject
- In collaborative learning, learners have the opportunity to talk withpeers, exchange diverse beliefs present and defend ideas, as well asquestioning other ideas.

Interpersonal Skills

- Interpersonal skills relating to group process are essential for effective problem solving and learning.
- It is important that students are made aware of these interpersonalskills.
- Consensual decision making skills
- Dialogue and discussion skills

- Team maintenance skills
- Conflict management skills
- Team leadership skills.
  Students who have these skills have a better opportunity to learn than students who do not have these skills.
- Time Management

Resources

- Students need to have the ability to evaluate the resources used
- Students have to be able to evaluate the source of the resources used byasking the following questions:
- How current is it?
- Is there any reason to suspect bias in the source?
- How credible and accurate is it?

Metacognitive Skills

- Students need to reflect on the processes they are using during thelearning process,
- To compare one strategy with another, and
- To evaluate the effectiveness of the strategy used

Reflection Skills

- Reflection helps students refine and strengthen their high-level thinkingskills and abilities through self-assessment.
- Reflection gives students opportunities to think about how theyanswered a question, made a decision, or solved a problem.
- What strategies were successful or unsuccessful?
- What issues need to be remembered for next time?
- What could or should be done differently in the future?
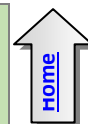
Savitribai Phule Pune University Second Year of Engineering (2019 Course) 210261:Audit Course 4

In addition to credits, it is recommended that there should be audit course in preferably in each semester from second year. 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.

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

Course Guidelines for Assessment (Any one or more of following but not limited to):
- Written Test
- Demonstrations/ Practical Test
- Presentations
- IPR/Publication
- Report

Audit Course 4 Options

Audit Course Code	Audit Course Title
AC4-I	Water Management
AC4-II	Intellectual Property Rights and Patents
AC4-III	The Science of Happiness
AC4-IV	Stress Relief: Yoga and Meditation
AC4-V	Foreign Language (one of Japanese/Spanish/French/German) Course contents for **Japanese(Module 2)** are provided. For other languages institute may design suitably.

AC4-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 recourses.
- 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 recourses.

Course Outcomes

On completion of the course, learner will be able to–
1. Understanding of the global water cycle and its various processes
2. Understanding of climate change and their effects on water systems
3. Understanding of Drinking treatment and quality of groundwater and surface water
4. 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, 978-1-84564-961-6.

AC4-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–
1. Understand the fundamental legal principles related to confidential information, copyright, patents, designs, trademarks and unfair competition
2. Identify, apply and assess principles of law relating to each of these areas of intellectual property
3. Apply the appropriate ownership rules to intellectual property you have been involved in creating

Course Contents

1. **Introduction to Intellectual Property Law –** The Evolutionary Past - The IPR Tool Kit- Para-Legal Tasks in Intellectual Property Law
2. **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
3. **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
4. **Introduction to Trade Secret –** Maintaining Trade Secret – Physical Security – Employee Limitation - Employee confidentiality agreement

Reference:

1. Debirag E. Bouchoux: "Intellectual Property" Cengage learning , New Delhi, ISBN-10:1111648573
2. Ferrera, Reder, Bird, Darrow, "Cyber Law. Texts & Cases", South-Western's Special Topics Collections, ISBN:0-324-39972-3
3. Prabhuddha Ganguli: "Intellectual Property Rights" Tata Mc-Graw –Hill, New Delhi, ISBN-10:0070077177

AC4-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–
1. Ability to understand what happiness is and why it matters to you
2. Ability to learn how to increase your own happiness
3. Understanding of the power of social connections and the science of empathy
4. 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.

AC4-IV: 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–

1. Students understanding of philosophy and religion as well as daily life issues will be challenged and enhanced.
2. Enhances the immune system.
3. Intellectual and philosophical understanding of the theory of yoga and basic related Hindu scriptures will be developed.
4. 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

AC4-V: Foreign Language (Japanese) Module 2

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!!

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

Course Contents

1. Katakana basic Script, Denoting things (nominal & prenominal demonstratives), Purchasing at the Market / in a shop / mall (asking & stating price)
2. 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)
3. 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)